Technical and Bibliographic Notes / Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming, are checked below.

L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

- [ ] Coloured covers/ Couverture de couleur
- [ ] Covers damaged/ Couverture endommagée
- [ ] Covers restored and/or laminated/ Couverture restaurée et/ou pelliculée
- [ ] Cover title missing/ Le titre de couverture manque
- [ ] Coloured maps/ Cartes géographiques en couleur
- [ ] Coloured ink (i.e. other than blue or black)/ Encre de couleur (i.e. autre que bleue ou noire)
- [ ] Coloured plates and/or illustrations/ Planches et/ou illustrations en couleur
- [ ] Bound with other material/ Relié avec d'autres documents
- [ ] Tight binding may cause shadows or distortion along interior margin/ La reliure serrée peut causer de l'ombre ou de la distorsion le long de la marge intérieure
- [ ] Blank leaves added during restoration may appear within the text. Whenever possible, these have been omitted from filming/ Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.
- [ ] Additional comments:/ Commentaires supplémentaires:

- [ ] Coloured pages/ Pages de couleur
- [ ] Pages damaged/ Pages endommagées
- [ ] Pages restored and/or laminated/ Pages restaurées et/ou pelliculées
- [x] Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- [ ] Pages detached/ Pages détachées
- [x] Showthrough/ Transparence
- [ ] Quality of print varies/ Qualité inégale de l'impression
- [ ] Continuous pagination/ Pagination continue
- [x] Includes index(es)/ Comprend un (des) index

Title on header taken from:/ Le titre de l'en-tête provient:

- [ ] Title page of issue/ Page de titre de la livraison
- [ ] Caption of issue/ Titre de départ de la livraison
- [ ] Masthead/ Générique (périodiques) de la livraison

This item is filmed at the reduction ratio checked below/
Ce document est filmé au taux de réduction indiqué ci-dessous.

10X		14X		18X		22X		26X		30X	
							✓				
12X		16X		20X		24X		28X		32X	

DAIRYING

DAIRYING

A BOOK FOR ALL WHO ARE ENGAGED IN THE PRODUCTION & MANAGEMENT OF MILK

BY

JOHN PRINCE SHELDON

Formerly Professor of Agriculture at the Royal Agricultural College, Cirencester, and of Dairying at the College of Agriculture, Downton

WITH COLOURED FRONTISPIECE AND THIRTY-TWO PLATES

CASSELL AND COMPANY, LTD
London, New York, Toronto and Melbourne
1912

INTRODUCTION

DAIRYING as an art and an industry—at once the largest and most important of our agricultural interests—has been for a third of a century providing us with what may, not inaptly, be termed a transformation scene in respect alike to its industrial and scientific features. To those of us who were familiar with it as a business half a century ago, the striking changes which have occurred since are plain to all as if delineated on a coloured map hanging on a wall. These modifications and adaptations—at once fundamental as to principle and structural as to practice—lie before us in memory as if in a book that might have been written at leisure during the last forty years, more or less.

Coming change was in the air of the dairy almost everywhere in the 'sixties of the nineteenth century, but less so, perhaps, in this country than in some European continental countries—from Switzerland to Sweden—and in the United States of America, and also in the Dominion of Canada. So far as England was especially concerned, the keen and sharpening competition of American cheese was causing something more than mere alarm—something, indeed, approaching consternation—amongst British dairy farmers, inside whose cheese-kettles the rents were chiefly made. In those days there was no outlet for milk but the conversion of it into cheese and butter. And although a considerable proportion of the cheese produced in this country was known to be ill-made and evil-flavoured, there were customers for all kinds—good, bad, and indifferent—until the advent of great consignments of a really good second-class American cheese caused our own inferior qualities to become almost unsaleable. This, in fact, was the crux of the situation that had so suddenly and unexpectedly been created.

All this was a mind-searching affair, and our people at last, and for the first time, knew what it was to feel a touch of panic on the subject of foreign competition in dairy products. This alarm, however, painful as it was at first, was really a blessing disguised, for it roused our dairyers as nothing aforetime had been able to do. This spur, indeed, was highly desirable: we can see it now, but it was alarming then. There were, however, undreamt-of potentialities in British dairying that had hitherto been lying fallow, and would have remained so—no one can say how long—but for this advent of American cheese. Many advances have been made since 1870, and they may well be said to be attributable to the great development of American cheese-making at that period. And that development was possible only by means of cheese factories, so-called, the practical idea of which America borrowed from Switzerland, and enlarged upon it immensely.

Developments in the art of dairying, and also in the practice and routine of it, have been potent and striking to an extent to which no other branch of farming is susceptible or ever can be, and this expansion of scientific research within the domain of the dairy and in the manipulation of milk received its needed impetus in the importation of American cheese. This cheese was made in co-operative cheese factories, as they were called; it could not have been made elsewhere. It was consequently assumed, and fairly so, that the inferior grades of farm-house cheese in

England might disappear if the milk were manipulated in factories instead. Such cheese-making was like the brewing of ale: it could be better done in factories than in farm-houses, which, no doubt, for the most part is true enough as a general thing. So, indeed, many men thought at the time, forty years ago, and many think so still.

Be that as it may, the progress that has been made in the twin arts of cheese-making and butter-making in these last twenty-five years has been far-reaching, to an extent which constitutes a phenomenon that has no parallel in the wide and varied domain of agriculture outside dairying. Scientific research has illuminated many points in dairying that were erstwhile wholly unknown and occult—points of fundamental importance. There may have been in some instances a tendency to become ultra-scientific, as we have heard it said; but if so, the tendency was perfectly natural, and pointed to the deep and painstaking earnestness with which the subject was being studied and probed by men and women with exceptional credentials for such work. And, as a matter of fact, thoroughness of aim and experiment are well entitled to a good deal of liberty with the problems before them.

There is now precision where formerly uncertainty prevailed in many points of dairying, and it would appear as if there were not much left to discover. Finality, however, in such a pursuit as that of problems appertaining to milk and its manipulation, is a consummation not to be expected—perhaps not even to be desired—at present. Meanwhile it is correct to say that the art of the dairy has been, not simplified, perhaps, but very considerably illuminated by many expert investigators in various countries. Whilst there is anything left to investigate—and there probably will always be something—we shall have work for experts to do, work which will expedite the toil of the rank and file of dairyers who are not, and do not wish to be, experts themselves.

Building upon foundations of knowledge laid by early and recent investigators, the many Dairy Schools we have are now training considerable numbers of young men and maidens who are devoting themselves to dairying either as a profession or as a business—or possibly as an interesting or even a fascinating pursuit for amateurs—as the case may be, and these in turn become both in theory and in practice disseminators of the best that is so far known on the subject. In this way is the whole country being leavened, as it were, by the educational bacteria which emanate as "pure cultures" from all the institutions in which both theoretical and practical tuition is imparted to those who have the good luck to become students therein.

CONTENTS

CONTENTS

LIST OF ILLUSTRATIONS

DAIRYING

CHAPTER I

FOUNDATION OF DAIRYING

THE basis of dairying, as of all ancient arts and industries, is what we fondly speak of as "Mother Earth!" This stupendous groundwork is indeed fundamental to all affairs of the human family as we see and know them to-day. Familiar though we have been with this basis from our youth up, the singular fact that many of us, more or fewer, fail to realise and appreciate the extreme importance of the source of all so-named natural products is, after all, not very surprising, mankind being what it is. These products are nowadays controlled, guided, and manipulated to a degree which blends the natural with the artificial to a remarkable and extraordinary extent, and in no department of human art is this partnership seen at work in a more complex and interesting way than in dairying.

Keeping, however, for the present in touch with fundamentals, we may point to the curious and pleasing phenomenon that our ancient and differing types and breeds of dairy cattle—far more numerous than on any other equal portion of the earth's surface—are believed to be, for the most part and primarily, a result of various climatic and geological influences. A suggestive parallel may be noticed between the delightful variety in the breeds of our island cattle and sheep on the one hand, and, on the other, the variegated and intermittent geological strata of which our insular crust of earth is built up. Each stratum of the series has yielded its own characteristic soil and herbage, and herein lies embedded a natural law in the domain of animal nutrition by vegetation—as yet not wholly revealed—by means of which these types of the *Bos taurus* became differentiated, during a long period of time, until at length they were distinct breeds. It is to be understood that the foregoing remarks do not refer to breeds of cattle or of sheep whose evolution is due to direct manipulation by man rather than by nature.

Influence of Soil and Climate.—It is now recognised as one of the great principles in the law of natural adaptation, that soil, climate, atmosphere—environments generally—have had a great deal to do with the formation of types in the animal world. This finds a corollary, indeed, in the fact that certain British breeds of cattle are found to lose some of their characteristic fidelity to type, and of their constitutional vigour, in the course of a few generations of breeding in a foreign climate. So obvious a fact has this phenomenon become in America, that fresh blood from the British Islands has had to be repeatedly imported to maintain the vigour of the race.

Dairying, indeed, so far as England is concerned, is under a fortunate obligation alike to soil and climate, both of which are more or less erratic as to variety. The soil originally differentiated the cattle, subsequently to the time when England and Scotland were separated from the Continent by an encroaching sea from the north, now known as the German Ocean. Had that separation never been consummated, it may be assumed that our old types of cattle would, in all probability, have been very different from what they are to-day, inasmuch as Continental—and even our own Channel Island—types are now very different from our other cattle that we see to-day at the great shows of the Royal Agricultural and other societies of a kindred nature in the British Islands.

But it is not on account of types of cattle only that the obligation rests upon us. In the alluvial soil, derived from many rocks, eroded by rain and frost from distant hills, and carried down by brooklets into rivers, to be later on deposited in some estuary to form new land, we get an earthy composition which becomes the best of grazing and meadow land. This is especially the case where lowlands have received their earth from limestone uplands.

The equipment of English dairyers, in these respects, is more versatile than will be found in any other country. To a beginner there is a wider range of choice in land as well as in cattle. All tastes can be met and suited in this tight little island to a degree that will be sought for in vain elsewhere. The weather, too, as a general affair, is not behind either soil or cattle in charming variety. Once in a while we have too much variety in this respect, but we seldom suffer much from its scarcity. The frequent rains try our tempers both in seed-time and harvest, but most of all in harvest. Yet, for all that, we need them much when the seed is in and before the harvest begins; at all times, indeed, when grass should be growing on the pastures and meadows, be it spring, summer, or autumn, save and except when fine weather is wanted for hay and corn. Be these points as they may, frequent rain-showers are indispensable for complete success in dairying.

But we have recently had a calamitous object-lesson to the effect that we can have too much of a good thing in glorious summer weather carried on too far and too long.

CHAPTER II

SOME ROOTS OF SUCCESS

PROSPEROUS dairy farming depends on a variety of factors, each of which is important in its own sphere, though to an outsider some of them may not appear to be. Several of them, in point of fact, are not important only, but indispensable. We may summarise the more salient of them in this way :—

(i.) In the foretront we place the farmer himself—his training for the business, his experiences on dairy farms, his innate faculty of management, his judgment of live stock, his common sense, his knack of doing things just when they ought to be done, his vigour of body and of mind, his live stock, his equipment of the farm, his capital in cash, and his capital wife!

(ii.) The farm and its situation, the character and quality of its soil, its wholesomeness for live stock, its aspect as to the sun, its water supply, its natural and provided shelter against bad weather in any time of the year, its roads, gates, and fences.

(iii.) Its railway advantages for long or short distance freighting of export produce—chiefly of milk—and of import supplies of corn and manures, etc. Its accommodation in buildings of all necessary kinds, farm-house, dairy, etc., shippons, stables, sheds for carts, wagons, implements, hay barns, loose boxes, and whatever else that may be useful, practical, and necessary.

(iv.) Its rent, rates and taxes, its cost of reasonably efficient maintenance, its servants and their wages, its wear and tear of vehicles, harness, implements, machinery, tools, etc. etc.

The capital a man has at command in mind and muscle, in body and brain, in energy and enterprise, in ability and application—if all these are there, at call of duty and of desire, as they are in many men and women of the dairy world—ought to be invested in a farm that is well "worth his while" to take in hand. To take a rented farm out of condition, with the intention of thoroughly improving it, is seldom a promising investment; and this is so simply for the reason that no Agricultural Holdings Act has yet made it perfectly safe for a farmer to employ his time and money to improve permanently land which is not his own. It is less risky now to do so than it formerly was, for in days gone by great numbers of outgoing farmers have been cruelly fleeced over "improvements" left behind in the soil, for which even approximately adequate compensation has commonly not been given.

The State and Tenant Farmer.—The position of tenant farmers is now, it must be admitted, much less unsatisfactory from a "tenant-right" view than was the case time back. All the same, it is hardly likely that farming as a pursuit will remain much longer in its present condition. Already, indeed, great changes are taking place, prominent landlords not a few having decided to sell certain estates in farm lots to the sitting tenants; whilst others have disposed of farms to county councils, by whom they are being cut up into small holdings. It may possibly occur that the State, extending its Irish system, will advance money on easy terms to enable English tenant farmers to purchase their farms, the farms remaining as security for the cash so advanced. In this way the State may soon possess, if and when it is seen to be desirable, the greatest interest in the farming land of this country. Gradually these State mortgages will be diminished, until, under the system of terminable annual payments which has been so extensively bestowed in the Emerald Isle, the vanishing point will be touched. It is not, however, reasonable to expect that farms bought from landlords to-day will all be free from indebtedness when the last payment of interest, and repayment of principal, have been made to the State forty or fifty years hence, for in many cases a new indebtedness will be growing up as the old one is being wiped off.

Meanwhile, there are many desirable farms on sale now that were not in the market in the century recently ended. Many large estate owners are now willing, and not a few are anxious, to sell their land, and this at prices extremely reasonable as compared with thirty years ago. The market value of land, especially of large farms, and of estates as such, has declined to a degree which is most encouraging to would-be purchasers whose object is to farm the land they buy. At prices now current for farms on the one hand, and for produce of farms on the other, there can hardly fail to be profit in farming if he who buys land and farms it has sufficient capital at command—capital either his own out-and-out, or someone else's, or the State's, at favourable terms of interest. The profit of mere ownership of land has receded much more than the profit of actual farming has done, especially of farming grass land. Correspondingly, while there is some difficulty met with in selling land at twenty-five to thirty years' purchase, there is little in letting such land to pay four or even five per cent. on the price at which men are now willing to buy it. It would be rash to predict what the coming years have in waiting for land, but, to say the least, the prospects of dairy farming are really encouraging for strong and shrewd young men who are themselves not unwilling to engage freely in the work of all kinds which farming demands.

Land Values.—The question of land values is inseparable from that of dairy farming, whether it should refer either to buying or renting. And it so happens in the current period that such values are, as it were, in the melting-pot to a degree which is more general than, perhaps, was ever the case before in this country. The whole question, indeed, is in a state of flux and transformation, and for the present one cannot venture, with any assumption of correctness, to predict what form it will take when it once more settles down. It is clear that, in many instances where landed estates are in the market on sale, something approaching a panic exists, at all events, sporadically. Men who sold estates in the 'seventies are now regarded as having been wise in their day and generation, or lucky, to say the least of it. But a reverse opinion is held in respect to those who held on to their land in the hope of inflated land values becoming still more distended. Whilst in cases where owners, large and small alike, held on to land that was mortgaged more or less heavily, the sequel has brought financial disaster. That it is notoriously easy to be wise after the event we know by long experience in the ways of men; but for all that, the old-time maxim, "buy property when it is cheap and sell when it is dear," is as true and sound to-day as it ever was, whatever it may become in the future. The difficulty of the business is to know when the cheapest point has been reached on the one hand, and the dearest on the other.

To give advice in such matters is risky, to say the mildest one can of it, but the maxim quoted holds good, and each man for himself must use his own faculty of slow and sure discrimination. It is known around that many good dairy farms are purchasable nowadays at about—or less than—half the price that could have been obtained for them in the 'seventies. That, indeed, was the time when most landowners—and even parsons with glebe land—were not willing to sell, and a still larger number of landless men, not farmers all, by any means, were anxious to buy. Many instances came within one's ken at the time, and it became clear enough in twenty years or fewer that it was generally those who sold to whom the chief advantages accrued.

In a third of a century—starting say from 1877—the whole matter of land values has been turned topsy-turvy, and now it occurs that advantages are likely to accrue to those who buy farms rather than to those who sell them.

It is a mere question of values reversed, and so far the situation is changed in favour of practical farmers who have pluck enough to purchase what for the present they cannot pay for without some borrowing. The whole situation is, of course, a problem which only time will unerringly solve. Never before in our time, or indeed in any other, has the question of land values been so full of potential benefits to dairy farmers in the British Islands as it is in this first quarter of the twentieth century so far.

Land Judging.—There is no royal road to success in appraising land for dairying purposes, save that which is founded on experience, and even on familiar acquaintance with the locality in which the land is situated, and, indeed, with the land itself. An outsider may come and value the land, and possibly he may value it fairly correctly; but it is mere guess-work, this, when compared with a valuation made by a competent local valuer. I give this as an opinion of a farmer for more than forty years in a district mainly devoted to dairying, and give it for what it may be worth—give it as the matured experience of one who has had something to do with the subject in all its bearings.

To assess permanent pasture and meadow at or near its true value requires knowledge of grass-yielding capacity of land, not in respect to any one year only, but in respect to half a dozen or more. For it so happens that seasons vary a good deal—sometimes a great deal—in so far as some of them encourage and others discourage the fertility of land in the growth of crops. This point of view is not original with the writer of these lines. Farmers of old were aware that, farm as well as they knew how to do in those days, still a first-class "growthy season," as it was termed, could easily beat the farmer at his own game. It may, perhaps, be less pertinent to say so nowadays, save in reference to old-fashioned, non-progressive farming, which is still very far from being a rarity.

It follows, therefore, that a new-comer into any given locality will be able to learn much more than he can in any other way by seeking information from local men of the soil—labourers as well as farmers—who have had their wits about them all the time, and who are mostly veterans on the land. There are not, it is true, many new-comers into any dairying section of the country, that is to say, new-comers from counties not adjacent, but there are more who come from other parts of the same county, or from parishes some miles away. And these are "new-comers" in the sense that they are, presumably, not intimately acquainted with the land of which they propose to become tenants or owners. Be they whom they may, however, and coming from whence they will, unless they know the land they are looking at they had better consult men on the spot about it.

There have been, and are likely still to be, farms enough on sale to suit all fancies, and generally at what, a quarter of a century ago, vendors would have considered ruination prices. Large and good farms, chiefly consisting of permanent grass land, have declined in price much more than small ones have done. The reason for this is obvious to all who are connected with land and farming. There has always been, as a rule, a much higher price per acre obtainable for small farms than for large ones, and for mere allotments as to area than for small farms, properly so-called. The whole thing, indeed, lies in a nutshell, in this wise: for one good customer to be had for a large farm there may be a dozen for a small one.

The landed interests of England are passing through a very remarkable phase in these early years of the twentieth century, a phase whose like has not aforetime been seen in this country. Numerous farms, portions of considerable estates, have been and are being offered by ducal and other landlords to the tenants of those farms, and in other cases to anybody who becomes the last bidder at an auction sale. Dairy lands in parcels under twenty acres have in very recent years changed ownership at prices ranging up to £90 and down to £30 an acre; one lot was purchased by the writer for an adjoining owner for over £120 an acre, just grass land without a building of any sort, and having no timber worth the name, but having a trout-stream boundary on one of its three sides. Yet another farm, a large one of nearly four hundred and fifty acres, well supplied with superior house and farm buildings, sold at about £25 an acre. This one is a grazing or dairy farm, as may be wished, with about one-fifth arable land.

Be it understood that it is to practical farmers only that the benefits of landowning in the future seem likely to accrue in the best and fullest sense. Whoever wins the retail should also win the wholesale profit of landowning, if only he will himself farm his own land. So, at all events, the eternal fitness of things would lead one to imagine should be the case. One cannot pretend—or be able—to say what the future has in store for the dairyers of this country, but the best promises held out to farming as a whole seem to be allocating themselves to the breeders of cattle and the producers of milk, so far as one can read the signs that are rising along the line of the horizon.

CHAPTER III

SOILS AND CLIMATES SUITABLE FOR DAIRYING

The practice and experience of ages have hitherto recognised the conditions of soil and climate which are naturally best adapted to dairy-farming, and under which it can be conducted with the greatest success; and though modern science, recent inventions, improved appliances, draining, artificial shelter, and the greatly improved systems of farming which have become common in these later days have had the effect of extending the range and area of dairy-farming, the natural advantages of soil and climate, which are found in a high degree in certain districts, still remain in force, and ever will. Whatever improvements modern husbandry, aided by scientific research and experiment, have effected already, or may effect in the future, it will always remain true that the soils best adapted to dairying are those included in the terms "loamy," "marly," and "alluvial." The last are found in valleys, plains, and low-lying districts generally, and they are best adapted to dairy-farming simply because the best natural pastures are found on them. They are usually formed of particles of various rocky and vegetable substances, so blended that all the elements of plant food are present in them in well-balanced proportion. All the mineral portions of soils have been derived from the decay and disintegration of rocks—a process that has been going slowly on through limitless ages, and is going on still; and as the value of a soil depends in a very large degree on these mineral constituents—their quality, kind, and variety—it follows that alluvial soils are most commonly the richest ones, because in the process of their formation and deposition, mainly by river action, a great variety of mineral fragments has been collected from the different strata through which the rivers forming them have run for ages.

Though tillage and dairy-farming districts are now less distinctly separated from each other than they formerly were, it is none the less true that where the finest natural pastures are, there will the most profitable dairying be found. Thus the flats of Cheshire, the undulating plains of Lancashire and Leicestershire, the valleys and lowlands of Derbyshire, Gloucestershire and Somersetshire, are, and ever will be, the natural homes of dairying in England. In these, and in portions of other counties having similar advantages, dairying has been carried on from the earliest days of our civilisation; and it is to them in the future, as it has been in the past, that we naturally look for our best and largest supplies of milk, cheese, and butter. Still, dairy-farming is not by any means confined to these districts and soils, but is practised by many farmers in localities where the soil and climate are not too obviously adapted to tillage rather than to grass-land farming. It is, however, more or less disappointing to attempt dairy-farming on soils which, thin and light in their physical character, and situated in a climate that is generally dry and subject to periodical droughts, are ill adapted to the growth of grasses of any kind, except the most temporary ones, which, for two years only, are taken in rotation.

But a mixed system of dairy and arable farming—the latter made to be subsidiary to the former—on mixed and medium soils, which admit of and combine many of the good qualities of both systems, has long been practised in many parts of both England and Scotland; and this mixed practice, viewed in the light of its influence towards an increased production of milk, can hardly fail to continue spreading so long as the demand for country milk in our cities and towns, which has sprung up in so wonderful a manner in the past thirty years, remains in its present active state, and especially if the demand goes on increasing, of which there seems to exist more than a probability. Nay, on the one hand, the mixed practice has penetrated extensively into many districts where tillage was aforetime held to be almost a sacrilegious encroachment on grass land; and, on the other hand, it is already far from uncommon in many localities which for generations past have been almost wholly given up to the growth of cereals.

Wet and Stiff Clays.—There are, however, some soils—to wit, our wettest and stiffest clays—on which a mixed system of arable and dairy farming cannot, with our present knowledge of the laws of husbandry, be easily or profitably carried out, and these are necessarily left in permanent pasture, the quality of which is always inferior, or are devoted wholly to wheat, beans, and other tillage crops suitable to stiff soils; they do not, with either pleasure or profit, admit of alternate tillage and semi-permanent pasture. And, on the other hand, there are certain fine-quality alluvial soils so excellently adapted to permanent pasture and meadow that it is pretty certain the plough, if used on them, would be one of the farmer's worst enemies. Fine old-turf land, wherever found, is well worth preserving, and to reduce such land to arable cultivation would be a piece of agricultural vandalism which could not easily be too much deplored.

Tillage *versus* Pasture.—In the present day, when the area of permanent grass land is rapidly increasing in this country, and when tillage is decreasing in a corresponding degree, a number of agricultural writers have sprung up who cry out loudly against the tendency of the age in favour of grass, and who declare their belief that land under tillage will produce more food for the people than land under grass. This is true as to some kinds of land, and untrue as to others. The late Sir H. M. Thompson, of Kirby Hall, York, than whom we had no better authority as to the relative productiveness of grass and arable land, laid down the proposition " that our grass lands, if properly managed, would be easily able to meet the demand made upon them for an increased production of meat, even if the supply required were greatly in excess of the present rate of consumption." And, again, "that money judiciously laid out in improving grass land makes a better return than money laid out on arable land." The fact of the matter is, there is truth in both these opposing opinions. The question is one of climate and kind of land. If the land is of a very light or of a very heavy character, and situated in a dry climate, it may be kept under arable cultivation, because it is not naturally adapted to be good grass land; but it would be a great mistake to plough up the deep loams and alluvial soils found in the valleys in so many parts of England, especially if they are in a moist climate, which is so essential to the growth of grass.

Mixed Husbandry.—The farms on which are found the mixed system already mentioned are most commonly those which, in hilly districts, stretch from the valleys to the uplands, the valleys being left in permanent grass, the uplands more or less devoted to tillage; those which are situated on loams varying from clayey to sandy; and those whose soils are on carboniferous or magnesian limestone, or on sandstone foundations, moderately deep, of good quality, and withal sound and firm. For dairy-farming especially, though also for other purposes, the best soils are the deep alluvial loams and drifts which, though situated in damp climates having a considerable rainfall, need little or no artificial draining—soils of considerable thickness, of an open texture, though firm, and withal sound and healthy. Very light, thin, dry soils, of any character whatever, are ill adapted to carry dairy stock; of these the light blowing sands are the worst for that purpose, because, though sound enough and healthy, they do not and cannot be made to contain within themselves in sufficient quantity the nitrates and phosphates which are necessary, on the one hand, to the production of milk in paying quantities, and, on the other, to the production of bone and flesh in young stock. These soils are best given up wholly to tillage-farming and to sheep-husbandry; or to rabbit warrens and poultry farms.

There are, however, between the rich alluvial soils of the one part, and the thin, sedentary ones of the other part, a great variety of soils which, as they vary in richness and in substance, and as they are favourably or unfavourably situated with respect to climate and to water advantages, are more or less adapted to dairy-farming; and it is on these soils, in varying degree, that a mixed system of dairy and tillage farming will be found to yield the best returns. On such soils it may be accepted as a truism that the plough and the milk-pail are by no means opposed to each other, but rather that they are each calculated to supplement the efficiency and profit of the other. Cereals, interspersed with clovers, rye-grasses, and other forage crops, with roots and other green crops for "soiling" purposes, including a due area of permanent pasture and meadow, are calculated to work so well hand in hand together that dairy-farming, by their united aid, may be as profitably followed as it may perhaps, under, any conditions whatever. And in the present day artificial manures and purchased feeding-stuffs enter so largely into farm practice and economy that they greatly modify some of the natural conditions which have aforetime had paramount influence. But, in any case, the soils which, either with assistance or without it, will produce the largest and best crops of green food of one kind or another, are far better adapted to dairying than are those whose speciality is the growth of cereals. Grass, either natural or artificial—that is to say, either permanent or temporary—is naturally of the first importance in dairy-farming; it is the foundation, in its capacity of green food in summer and of dry food in winter, on which the whole system of operations must in a greater or lesser degree be built.

The question, then, to be asked and answered in selecting a farm for dairying is, "Are the soil and climate well adapted for the growth of grasses?" The one is almost as important as the other, for, however well adapted the soil itself may be, grasses will not flourish as they ought—more particularly in permanent pastures—if the climate is very hot and dry; but if the soil and climate both are well suited to the growth of permanent and rotation grasses, it follows that they are also well suited to the growth of any cultivated crops which may be regarded as valuable accessories to dairy-farming—to wit, cabbages, turnips, rape, clovers, oats, etc.

Climate as a Leading Factor in Dairying.—The climates best adapted to dairying are naturally and essentially those which best promote the growth of grasses and of green crops generally. In the varying states of our weather they are cool rather than cold, warm rather than hot, and damp as opposed to dry—mild, humid climates, in fact, of which there are many shades and degrees in these islands, all of them more or less suited to dairying; and these varations include the range of climate wherein dairy-farming can be practised to the greatest advantage. A mild, humid climate, with a copious rainfall supplying an abundance of water to pools and running streams, not too burningly hot in summer nor too bitterly cold in winter, supplies, in conjunction with suitable soils, the best conditions for profitable dairying. Intense heat in summer, and correspondingly intense cold in winter, are so far detrimental that the yield of milk, and consequently of cheese and butter, is considerably less than it is under temperate climatic conditions; and as man can only, by such means as the draining of wet land and planting of forest trees, modify within limits the climate of a given district, it becomes necessary that he should counteract it as far as possible by providing adequate summer and winter shelter for dairy cattle. The latter is, of course, always the more necessary of the two, but summer shelter, in the months when the sun's rays are commonly very powerful, is a more valuable thing than we are in the habit of thinking.

It is not cruel only, it is also unprofitable, to expose milch-cows to extremes of heat in summer and of cold in winter. Shelter, especially against cold, stands in place of a given quantity of food which would otherwise be required. It is expedient to remember that one kind of food, having a definite composition, produces flesh and restores the waste of it which is continually going on in the animal system; the elements composing this kind are known under the names of albumen, fibrin, casein, gluten, etc., and are generally termed "albuminoids." Another kind, consisting of fats, oils, starch, sugar, gum, etc., supplies the materials by which the heat of the animal body is produced and sustained; and it follows that if animals are overmuch exposed to cold there is a corresponding waste of the latter class of food elements.

The first limit is placed on dairying by climate, and the next by the character of the soil, coupled with the supply of water. If the climate is either too hot or too cold to keep cows in a healthy, comfortable, and thriving condition, dairying cannot be carried on with a full measure of profit and success; and if the character of the soil is unsuitable, and there is a meagre supply of water, even though the climate be suitable, the objection of only partial success is sure to come in. It is true that dairying may be carried on outside these natural limits, but additional expense both of shelter and food will be incurred, and the profits will be correspondingly diminished; yet there are but few natural disadvantages which the ingenuity and energy of man cannot remove, or at all events greatly modify; the question of profit in so doing is another, but not a separate, consideration.

Food Supply.—Another limitation to dairying—but this depends on the foregoing ones—is the supply of food; and it is not quantity alone, but quality also, which must be taken into consideration. The pastures may be full of grass, but if it is of a poor, sour, and inferior kind, dairy cows will milk badly on it, the milk, cheese, and butter will be inferior, and the whole business will result in disappointment.

Characteristics of a Good Dairy District.—The characteristics of a naturally good dairy district will generally be found to be a rolling, undulating, somewhat hilly surface; a soil not too heavy and damp, nor too light and dry, but deep, loamy, and moderately retentive of moisture; a sweet and nutritious herbage of natural grasses, that springs up early, and continues to grow vigorously late on in the season—a herbage whose vigorous and luxuriant growth tends to shorten winter at both ends; a somewhat low average temperature, with frequent showers rather than periodical droughts in summer; and a never-failing supply of good water in springs and running streams. There are many districts in the British Islands which answer well to this description.

Improvement of Land.—Though the land in these islands is undoubtedly capable of producing very much more food for the people than it does produce at present, it is none the less true that many and great improvements, some of them of a very comprehensive character, have been made in the past half-century. A very large amount of draining, fencing, cultivation, reclaiming, planting, and general improvement has been done; and some districts have been completely changed in character by the process, as the inevitable "oldest inhabitant" can testify. But very much yet remains to be done. In many cases land has been not so much improved as prepared for improvement by such operations as draining, fencing, and planting. It is not enough merely to drain land, or fence or plant it. These operations, where necessary, are but the required foundations for subsequent improvements. If wet land, for instance, is merely drained, it will commonly do worse for the farmer—at all events for some years—than it did in its undrained state. By merely draining wet land you change the natural conditions under which the herbage has been for generations subsisting, and you do not provide the new conditions which the change has made necessary to the new class of herbage which, sooner or later, must take the place of the old.

Thus the draining of wet land is but the foundation of good husbandry, and such land is commonly very grateful for further improvements of a manurial character, improvements which may be expedited by scratching the surface and sowing seeds of grasses calculated to flourish under the new conditions. In many cases it may not be absolutely necessary to sow such seeds, for the better grasses will commonly spring up spontaneously after a time, and the sooner if they are encouraged by judicious manuring; but you save time by sowing them, and time is money to the farmer, as to anyone else.

But on wet soils improvements cannot well be made to pay *until* the primary one of draining has been done; and draining alone in many cases effects greater changes for good than any other single improvement that can be named. It completely changes the mechanical state of the soil, and greatly improves the climate. So long as water cannot percolate through the subsoil and pass away by subterranean ducts of one kind or another, through a stratum of sand or gravel, or through the crevices of rocks, the soil will be dense and sodden, and the climate cold and damp; and the water must needs pass away by one or both of two other means—over the surface of the land, or by evaporation, otherwise the district will become and remain a swamp. Now, to evaporate the thirty inches of rain which fall in a year in this part of the world, it has been calculated that a quantity of heat would be required equivalent to that produced by the combustion of ten times as many tons of coals per acre, so that an amazing volume of the sun's heat is thus wasted before any of it can be applied to the warming of the soil and the growth of vegetation. It is, of course, true that in very few cases does the whole of the rain-water pass away by evaporation; yet such a large proportion of it does so pass away from our flat and low-lying undrained soils that the summer's sun is to a large extent thrown away.

CHAPTER IV

LAND AND ITS BETTERMENT

"Good land can hardly be too dear to rent, and bad land can seldom be cheap enough." This is an ancient maxim, and as true to-day as it was in our forefather's days. There are limits in both points, but for all business purposes in dairy farming the maxim is as sound as the sayings usually are of old men who are gone. Land that is "thin-skinned" and too dry, and land that is deep-soiled but too wet, are both bad enough so far as they are defective, but the "thin-skinned" is generally worse than the other sort.

Draining.—The thin-skinned land can never be cultivated into good land, because there is not enough soil to work with; yet such land is surprisingly useful in a "dropping"—that is to say, a wet—summer, if only it has been fed fairly with light dressings of, say, superphosphate of lime, and of kainit, from time to time. Such land on, for instance, a carboniferous foundation, can hardly ever be too wet, no matter how "dropping" the season may be. For it is what is aptly termed "sound land," and its natural drainage will absorb any amount of rain. This is well known to be the case in the greater part of the Peak of Derbyshire. And sound land is the home of sound cattle, whilst sheep do not suffer much upon it, if indeed at all, from liver-rot, so long as they have not been pastured on unsound land elsewhere. Such land, too, is well known to yield milk which "keeps fresh" as long as any milk can be expected to do. This is owing simply to its immunity from germs of decay, to which milk elsewhere is only too commonly liable. And hence it is that milk from limestone pastures is much sought after by urban dairymen and the managers of public institutions generally.

It is also true that cheese and butter from "limestone" milk will keep sound and fresh, in substance and in flavour, as long as, or longer, than cheese and butter produced on heavy, wet land, if only they are manipulated as they ought to be. It were only to be expected that soils produced from and lying upon the limestone should not promote the spread of decay germs to anything approaching what is the case on very damp soils on any geological formation. Sound soils when deep enough can be made into the most profitable of land for dairying purposes, and partly so because they are quite sufficiently drained by nature, partly because the loam is always friable and easily cultivated if under an arable rotation, and partly because it is always amongst the soils that are most responsive to applications of suitable artificially-produced manures, such as lime, nitrate of lime, superphosphate of lime, basic slag, and also of natural manures, farm-yard manures and crushed bones.

Many naturally wet soils, soils resting on clay or other impervious subsoils, with no subsoil outlet for rain which falls upon them, are, however, excellent dairying soils when they have been properly drained. Draining, indeed, makes all the difference between profit and loss on wet soils. The transformation effected in the physical condition of water-logged soils, and, as a sequel, in the temperature of the crop-growing crust of the earth, and in the character and variety of the herbage, often provides an interesting and even striking revelation to him who has eyes to discern such manifestations of Nature's joy in having been relieved of a wet blanket!

Land which for generations beyond our ken has been growing rushes, sedges, and coarse vegetation generally which revels in a swamp, will at once begin to set itself in order to yield profit on a new state of things. Put its erstwhile stagnant water into circulation by providing means of automatic outlet, through a main drain which is fed by minor drains, and a change for the better at once sets in. Rushes and all other coarse vegetation begin to die down and, simultaneously, the growth of nutritious vegetation is being promoted. The burrowing and disintegrating action of worms is encouraged, and, with water constantly percolating downwards, the soil becomes ventilated and warmed as it could not have been under a state of continuous wetness.

Left to work out its own regeneration from this point, the transformation scene is not, as a rule, very quick in movement. Land recently drained—land that has been wet for centuries—finds itself face to face with wholly new conditions, to which it is usually somewhat slow to adapt itself in a full sense. The old vegetation dies down hardly, and the new cannot establish itself in a year. Room, indeed, is needed for the new vegetation before it can establish itself in possession, and the exchange needs facilitating by a further application of the farmer's skill.

What once recently drained land needs is ploughing up, cropping for two years whilst roots of disestablished vegetation rot away and decay, then fallowing thoroughly—during which process the decayed organic matter shall become intermingled with whatever there is that can be called soil or earth; and, lastly, all the old undecayed roots and other rubbish should be picked off, and the land sown with suitable grass, after a dressing of fresh lime has been incorporated for a few weeks with the reclaimed and fallowed soil.

This process (supplementing the cost of draining, which may be reckoned at £6 to £8 an acre) is too expensive, except for men who are their own landlords and have plenty of working capital to spare for the purpose. And as a rule the process is not followed, chiefly because of its costliness. One cannot easily find any process of soil-enrichment more economical and effective than that of fattening flocks of sheep upon it with a liberal supply of cake and corn.

And if such drained land is not to be ploughed, but to be left instead to form a good pasture as best it may with some assistance, the usual way is to give the surface a good dressing of fresh lime, to be followed a few years afterward by a 6 cwt. dressing of superphosphate of lime, or 10 cwt. of basic slag—if the slag, has been found by experiment to suit the land. Lime will suit almost any land that has required draining, and a great deal that has not. Even does it occur that farmers of long and laborious experience will give a sour pasture on the limestone a dressing of lime, and repeat it, if desirable, in fifteen or twenty years' time. But it is on soils which contain a good deal of dead roots of grasses and weeds—inert organic remains—that lime is as a rule, most effective.

Lime is a sweetener of gramineous herbage, a promoter of white clover, and also, alas! of the "creeping thistle" (*Cnicus arvensis*), which is so-named because of its roots creeping underground, by whose means it chiefly propagates itself perennially. The usual method adopted of killing it off in pastures is that of mowing it down twice,—in the summer and again in the autumn, each time when it has grown up tall enough. But if a pasture be changed into a meadow, the great mass of the thistles will disappear in three or four years' time, only to reappear, however, if the meadow again becomes a pasture. Were they to grow in meadows only, they would scarcely be objectionable, because, mown young with the hay-grass in June and early July, they make dried forage which cattle eat freely enough in winter time.

It goes without saying that irreclaimably wet land is unsuitable for dairying. If land can be drained, drain it. If not, fight shy of it for dairying. Yet dairying will not flourish well on a soil that is destitute, or even only deficient in capacity of retaining a reasonable amount of moisture, as most sandy and chalk soils are. Rather than this, indeed—unless wholly arable dairy farming is contemplated —a heavy land farm, well drained, but still retentive of sufficient moisture to resist a burning sun in a hot, dry summer, is much to be preferred. Though well drained, perhaps—allowing indeed that this has been well done and not "scamped," as was too often the case in bygone times, by bush drains, sod drains, mole drains, rubble stone drains, or "chuck drains"—there are some kinds of heavy clay land that "tread-up" badly in a wet season, and that cannot be made dry enough by any system of draining so far advocated.

"Chuck" and Deep Drains.—"Chuck drains" are narrow trenches about a foot to a foot and a half deep, into which a layer of stones about as big as one's fist have been "chucked"—not laid—filling the trench six or seven inches deep along the bottom, and having an outlet into an adjacent ditch, or into a main drain, which itself is often enough a mere "chuck" drain on a larger scale. In time, these inferior drains generally become choked; they cannot wash themselves clean all the while, as a pipe drain can and will. The writer has recently had occasion to drain several fields which, always aforetime damp but not wet, had become too damp in the wet seasons of 1908–9–10. Rubble or "chuck" drains were found and cut through in various places. They were choked, and water stood in them six or eight inches deep. They did not hesitate to empty themselves into our new drains once they got the opportunity.

In other cases deep drains of six to seven feet were cut into. They, too, were choked, and as the labour of opening out drains of that depth would have been a stiff piece of work, they were left to stew in their own juice, and new main drains about half as deep were put in parallel to the old ones. It could not be solved, that mystery of main drains, as deep as a tall man, in a soil not difficult to drain.

In the first half of the nineteenth century there was a craze for deep drains all over the place,—deep minor drains, and still deeper main drains, whether they were or were not really required by the character of the subsoil. The only sufficient reasons for very deep drains are, first, the necessity of going down until a stratum hard enough to carry a drain without sagging it is found; and, second, where the surface of the land is so unlevel that deep drains here and there are absolutely necessary to secure an even gradient—a *sine qua non* in all cases.

Given a stratum of earth 6 inches to 1 foot in depth, with clay immediately beneath it, drains of 2 feet 6 inches deep and 6 yards apart, in parallels, emptying into main drains an inch or two deeper—not more—have been generally found to drain such land sufficiently well, and at a minimum cost. This may be regarded as the boiled-down experience of many practical men—amongst whom the writer enrols himself—during the second half of the nineteenth century, and up to date.

Stone and Pipe Drains.—Stone drains, forming three sides of a square tube, 2 feet 6 inches below the surface, resting on a firm bottom, and having a fall of about 6 inches in 100 yards, will last interminably—one cannot assign a duration limit to them. The one detrimental point about them is that, owing to their inherent fault of structure, their flat floor and square sides, they cannot continuously wash themselves clean of silt, and are, therefore, apt at times to become choked by sedimentary matter percolating into them from above. For all that, they are more durable than any other sort, so far as concerns the material of which they are built.

Pipe drains may be regarded as the best of all kinds, wherever the bed on which they lie remains firm. But there are good pipes and bad ones, with many of intermediate quality. Let it be understood, once for all, that hard-burnt pipes are the only really good ones. Half-cooked pipes will crumble into flakes and fragments down there in the earth, in a few years' time, after which falling bits of soil will soon choke the drain.

One may sum up the question of stone *versus* pipes for the draining of land in this way: If there is plenty of suitable stone available and cheap, use it if you like; if not, then use pipes, if you can get them of the best quality and at a moderate price. It is generally a good plan to consult practical men on these points, and labourers as well as farmers.

The cost of draining, including pipes and carriage thereon, will vary according to depth of drain, diameter of pipe, and cost of labour in the district. The following statements are for actual draining done :—

1.—Depth, 3 feet; width apart, 19 feet.

	£	s.	d.
93 roods, at 9d. per rood of 8 yards, cutting out and filling in of drains	3	9	9
2,300 pipes, $2\frac{1}{2}$ inch diameter, at 30s. per 1,000	3	9	0
Carriage on pipes	0	10	0
Total cost per acre	£7	8	9

2.—Depth, 4 feet; width apart, 24 feet.

	£	s.	d.
82 roods, at 1s. 2d. per rood of 8 yards .	4	15	8
2,000 pipes, 3-inch, at 40s. per 1,000 . .	4	0	0
Carriage on pipes	0	10	0
Total cost per acre	£9	5	8

The foregoing statements of costs are for work effectually done, in a district where wages are higher than in most parts of England.

The Action of Worms.—There is also the friability of soil to be reckoned to the credit of draining, where draining is required. Excess of water held up in it obviously tends to consolidate a soil, whereas the free admission of air will tend to disintegrate it instead, rendering it the more easily permeable by the roots of grass, of straw, and, indeed, of vegetation generally. And in connection with these points of ventilation and friability of soils, we must not omit to consider the action of earth-worms, which is most effective in a soil that is neither too dry nor too wet.

These subterranean burrowers assist materially in ventilating soils that have been drained, or have not required draining, by making tunnels all about in the soil, from which they have excavated—and swallowed, and digested—the "castings" which they raise up to the surface. Terrestrial animals are these Annelids of the species of Lumbricus (Darwin), but still are they semi-aquatic, or amphibious. The great naturalist tells us how much we owe to the work of worms in the formation of so-called vegetable mould. On the other hand, as I have seen in Mexico, there are tracts of land covered with stones, small and large, which, for lack of water held in suspension, has never been under the operation of worms. Water in soils, therefore, is necessary to the stupendous services which worms are constantly performing in converting vegetable—and also mineral—matter into earth, or soil, as we know it. During keen and prolonged frosts in winter, and long, dry spells in summer, worms burrow down until they are out of reach of either of these influences. And they take down into their burrows all kinds of things which they can get hold of on the surface, which things are for the most part vegetable—grass, leaves, straw, twigs of trees; anything in fact that is negotiable in that way. How often has one seen a twig, or a straw, curiously standing upright with the lower end an inch or two into the earth. Well, these twigs and straws were in process of being taken down below, where in time they would become vegetable mould. All these processes need a soil in which water is not stagnant but circulative, and which is permeated to a considerable extent by air.

Benefits of Drainage.—Manifold, indeed, are the benefits arising out of the draining of wet land. The more salient of these may be now recited: Bearing in mind that wet land is always very cold in itself, at the surface as well as beneath, because of evaporation, it is consequently ill-suited for live stock, and this not on account of its low temperature only, but from its wetness and from the dampness of the air above it. In constantly wet land the finer and more nutritious herbage cannot flourish; indeed, can hardly exist at all. Coarse, aqueous vegetation finds this sort of land a congenial home, but live stock do not find it attractive, and seldom thrive much upon it. In addition thereto, it must be borne in mind that the trampling of cattle crushes and soils a large proportion of the vegetation, whatever its badness or goodness may be. It is on wet land subject to inundations that sheep are attacked by the liver fluke; draining, however, makes the land at all events relatively sound, and the fluke scourge disappears. Immediately after draining—that is to say, in the following winter or before—land begins to prepare itself for yielding an increased and improved herbage, and this improvement becomes very marked after a dressing of lime or of basic slag, and, indeed, of superphosphate of lime or of bones. And last, though perhaps not least, the land becomes comparatively firm to the tread of animals, and an appreciable saving of herbage is found to be the sequel, even when wet weather ensues, as at times it does in this country. If, indeed, any improvement whatever of land can be made to pay, draining may be reckoned among the certainties, if it is done in good form. Surface draining, by means of shallow ditches, is only to be recommended for sheep farms away amongst the mountains, and not in all cases for them.

CHAPTER V

SOILS: ORIGIN AND CHARACTERISTICS: MANURING AND TREATMENT

NOT on any other equivalent portion of the surface of this mundane spheroid is there to be found, I believe, so much geological variety and diversity, with so large a proportion of good soil resting upon it, as we enjoy here on these islands called Britain. The character of the soil partakes in each division of the nature of the rock from which it has been derived by erosion of particles, except in the cases of transported soils, which may be either alluvial or diluvial, but generally the former, and indeed, sometimes both together. Soils in valleys generally, and around tidal beaches of sea estuaries, are of these classes, and are made up of particles from various geological formations; consequently they possess a catholicity of composition which accounts, as a rule, for their superior inherent fertility. These soils are usually of more or less considerable thickness, resting commonly on lateral or terminal moraines, and having, therefore, gravelly or sandy subsoils, the soils themselves having been to a great extent created in their present form, and thrown up by earth worms to form a continually increasing crust of earth.

As forming contrasts to transported soils, there are upland soils, whose composition is simple instead of complex, coming as they do from the one or other kind of rock on which nature has allowed them to remain at rest. These are, for the most part, found on tablelands that are either flat and horizontal, or nearly so. Wherever, indeed, land has a surface which is more or less a slope, an inclination is present for soils to find a lower level, by means of copious showers of rain succeeding disintegration by frosts. Many of these upland soils, especially on limestone formations; are valuable, if only the crust of them is thick enough. And, indeed, in depressions and small valleys amongst the tablelands, which in point of fact occur pretty frequently, the soils brought down are commonly deep enough, and are, therefore, the best of their kind in respect to their inherent fertility, whilst at the same time they are almost always of a fairly friable texture, and readily culturable.

Varying Kinds and Qualities.—In some districts—indeed, in nearly all—it will be found that different kinds and qualities of soil exist. Even in individual fields, and these not seldom to be met with, the same phenomenon is manifested. This sort of thing is one of the consequences of different geological formations. It may occur, too, in diluvial soils that have been transported by flood-water, and less often in alluvial soils which are the result of river-agency in conveying to a lower level all kinds of detritus from mountain and upland districts. On my own farm I have fields in which are two and even three totally different kinds of soil—sandy, clay loams, and peaty soils.

Manuring and Treatment of the Soil.—The exhaustion of soils is a process whose effect is everywhere to be found, though but few farmers are familiar with the details of the process by which the effect is produced. It is evident that, with an exhaustive system of cropping or grazing, or from lack of that periodical assistance which most grass land requires, many soils gradually become poorer, until at length they cease to yield a profitable return. It is not only on arable land or on meadow land which is not adequately manured that this exhaustion occurs, but the great bulk of pasture land, especially that which is grazed by young stock, also becomes impoverished in course of time, unless it is periodically restored to condition by manuring.

Professor Anderson wrote on the subject as follows:—

"In order that we may have definite data to go upon, let us, in the first instance, consider the cause of the exhaustion of soil and the different modes in which it may be brought about. It is to be observed, then, that all plants require for their growth an adequate supply of carbonic acid, ammonia, nitric acid, sulphuric acid, chlorine and silicas, which are all indispensable, although some of them are required in larger quantities than others. They are divisible into two classes—one including the first four substances, which, being all either gaseous or volatile, are found not only in the soil but in the atmosphere; the remainder are confined, at least in quantity, to the soil. These two great classes are usually distinguished as the organic and inorganic elements of the plant food, by which it is to be understood that the former, though they are in a chemical sense inorganic, are the source of the organic or combustible part of the plant, while the latter supply the constituents of the ash. They may also, however, and with more advantage, be described as the movable and the immovable elements of the plant, because the former, existing in the air, are conveyed backwards and forwards by the wind; while the latter, being fixed in the soil, cannot be removed and replaced by ordinary natural causes. It is sufficiently obvious that if a crop be grown for a succession of years, and be systematically removed from the soil, the quantity of these substances must be gradually diminished, and if this course be persisted in the soil must eventually become incapable of supporting the vitality of plants. The period at which this will occur must necessarily differ very greatly in different soils, and depend upon the quantity of available plant food; for the air, constantly shifting, is always prepared to yield a practically inexhaustible supply of the movable elements, so that the exhaustion must in all cases be due to the removal of the fixed or mineral substances; and, consequently, when it is wished to restore to the soil its power of supporting vegetation, it is not *necessary* to add to it all the elements of the plant, but it will suffice to give those which it cannot otherwise obtain—that is, the fixed substances—and leave it entirely to depend on the air for a supply of those which can be derived from it. We do not mean here to discuss whether this method would reproduce the highest degree of fertility, but only to point out that a soil thus treated would regain, more or less completely, the power of supporting plant life, of which it would have been deprived by the supposed system of management.

"In point of fact, then, the complete exhaustion of a soil in its natural state must always be due to the want of mineral matters, because, practically, no method of treatment can deprive it of those which the air supplies. As far, also, as these matters are concerned, it must be obvious that they would rarely, if ever, be exhausted simultaneously, but that in general, some one substance being present in relatively small proportion, the soil becomes incapable of supporting the life of plants when it is entirely withdrawn, although there may be still an abundant supply of all the others. If, for example, a soil contain a sufficient quantity of potash to yield, say, twenty full crops of wheat, and of the other constituents of that plant enough to yield forty crops, the excess of the latter would be unavailing, and the soil would be exhausted by twenty crops. If now we added to such a soil a supply of potash, it would again become capable of producing a crop, and would go on doing so until some other substance had been entirely consumed, when it also would have to be added; and so on until, all being removed, the soil would at length end in a complete infertility, which would only be retarded, and not be prevented, by this mode of operation. To maintain during an unlimited series of years a uniform amount of produce it would be necessary to add, year by year, a quantity of the elements of plant food equal to that which the crop removes; and the necessity for doing this is so obvious that it cannot be controverted, and it may safely be asserted that it is a point on which all scientific and practical men are entirely at one.

"This being the principle on which the exhaustion of the soil is to be avoided, we have only to carry it out a little farther to draw the conclusion that if we add to it a larger quantity of the elements of plant food than is requisite to replace what has been removed, its productive capacity must be increased, and it will become capable of yielding a larger crop than it did in its original state. This is, in fact, the foundation of the use of manures; and if it were possible to carry out these theoretical principles in their integrity, the soil might be made to produce, during an unlimited succession of years, a crop greatly exceeding anything known in actual practice. Practically, however, there is a limit which cannot be exceeded, and this depends upon several circumstances.

"In the first place, the effect of a manure is not due to its composition alone, but is dependent to no small extent upon the different constituents existing in it in a state in which they are readily available to the plant. And, in the second place, the composition of manures is not entirely under our control. Although farmyard manure, which is, and will always continue to be, the foundation of agricultural practice, is a mixture containing all the elements of plant food, and generally in proportions not very far removed from those in which the plant requires them, yet it is impossible not to recognise the fact that differences occur in it, and that part of its constituents are not directly available to the plant, but only become so by virtue of certain changes which occur in it after it has been deposited in the soil, and do not necessarily proceed exactly as we could desire. It is a familiar fact that, owing to these decompositions proceeding in an imperfect manner, manure may, and often does, accumulate in the soil, and remains there in an inert and dormant condition. If from this or any other circumstances the supply of one or more of the substances required by the plant is deficient in the manure, then either the crop is thereby limited, or it is forced to derive the requisite supply of that substance from the natural resources of the soil itself. In fact, a manure which is deficient in any one element of the crop does not improve the soil; and, though it may produce a greatly increased crop, its effect is merely temporary, and eventually it only causes its more rapid exhaustion. In the case of farmyard manure, which necessarily contains all the elements of plants, this is, of course, less likely to occur than in special manures, containing only one or two of these substances. Thus, for example, the opposite effect would be conspicuously seen in the case of a soil manured during a series of years with a salt of ammonia. In that case, though the crop might be greatly increased in any one year, the total amount of produce would be no larger than it would have been without that addition, but it would have been obtained within a shorter period of time.

"The general conclusion to which all these considerations lead is that we can only maintain the fertility of the soil by returning to it all the substances which the crop removes, and that we can increase it by applying these in larger quantity; but when the mixture supplied is deficient in any one substance, it does not prevent, but hastens exhaustion."

Artificial Manures.—The question has often been raised whether, in the use of artificial manures, which in recent years has become so extensive, we restore all the elements of fertility, or only those which enable the crop to draw more largely than it would otherwise do on the natural productiveness of the soil. It is a question which can be satisfactorily answered by nothing less than a series of carefully conducted experiments, extending over a long period of time. The application of partial manures, and the constant selling of the crops, would no doubt in course of time so impoverish the soil of those constituents which the manures did not contain that it would cease to yield good crops; but where the crops are consumed on the farm, and the farmyard manure, liquid and solid, is all returned to the soil from which it was derived in the form of a crop, little or no exhaustion, but a gradual, and in some cases a rapid improvement, as a rule, will ensue. When used to supplement the manure produced on a farm, artificial manures are of great benefit; but it is open to doubt if they can be successfully made to take the place of farmyard manure wholly through a long series of years. Properly compounded and genuine artificial manures, when used alternately with farmyard manure on meadow land, give to the grasses a fillip which is very beneficial; and when used as an occasional top-dressing to pasture land, supplementing thereon the excreta of cattle, the result is equally satisfactory.

The elements of fertility, if any, which farmyard manure would fail to return to the land in sufficient quantity, as compared with the remainder, are nitrogen, phosphoric acid, potash, and chlorine; and it would appear to be expedient—in practice we know it to be beneficial in a high degree—occasionally to supplement farmyard by an application of artificial manure which is specially compounded in reference to those elements in which farmyard manure is more or less deficient. The nitrogen is specially contained, in a most readily available form, in *nitrate of soda;* the phosphoric acid in *superphosphate* of lime or bones; the potash in *kainite;* and the chlorine in *common salt.* The first three are the elements on which plants chiefly subsist, and the soil is naturally very grateful for an artificial supply of them over and above what farmyard manure contains. But farmyard manure, if produced in part by the consumption by animals of various kinds of cake and corn—of which decorticated cotton-cake is the richest in manurial residue—may be so much improved that it will contain sufficient of every element that the land requires for its fertility.

There is a steady exhaustion of the soil going on upon a dairy, as well as upon an arable, farm, but it is much less rapid. It consists chiefly of phosphates, which are carried away in the milk, but also of nitrogen and potash, and these may be restored by an application of ground bones, superphosphate of lime, nitrate of soda, and kainite. Prof. J. F. W. Johnston says: "Every 40 gallons of milk contain 1 lb. of bone earth, besides other phosphates. Estimating a cow to yield 750 gallons per year, it will require 19 lb. of phosphate—equivalent to 30 lb. of bone dust. If the calf is sold off we may assume there is a loss of 20 lb. of bone, and the waste of phosphates in the urine equals 4 lb. And thus, for every cow a dairy-farm maintains it will lose of earthy phosphates as much as is contained in 56 lb. of bone dust." Dr. Voelcker says: "In the cultivation of remote districts, in the reclamation of wastes, and in the restoration of fertility to the worn-out pasture lands, which had been *exhausted by the constant removal of milk, butter*, etc., from their surface, bone manure has been scarcely less beneficial than in turnip husbandry."

Where much young stock is reared the phosphates in the soil diminish more rapidly than where the pastures are kept for the production of milk only; these phosphates serve to build up the bony and muscular structure of the young animals, and a smaller proportion of them is returned to the soil in the form of animal excreta than is the case with adult animals which are in milk or are being fattened for the butcher; hence it follows that to young-stock pastures the phosphatic elements require to be more frequently restored than to milking pastures, and more frequently to the latter than to fattening pastures. There are, however, some pastures that are so rich in all the elements of plant and of animal nutrition that for g[illegible] tions no, or very little, exhaustion has become perceptible, and they are as rich now as anyone would wish them to be. The excreta of the animals grazing on them, together with the genial climate in which they are usually situated, are to all appearance amply sufficient to maintain them in a very high state of fertility. On these soils farming is always a simple, pleasant, and profitable occupation, so far, at all events, as the land itself is concerned. But the quantity of such land is very limited.

Use of Lime.—Mr. Falconer King writes as follows on the use and abuse of lime in agriculture:—" It is an old, and to a certain extent a true, saying that

> 'Much lime and no manure
> Will make both farm and farmer poor.'

The converse, however, is also true, and is worthy of remembrance by those who are desirous of making the most of their farms. If much lime and no manure make poor farmers, it is no less true that much manure and no lime will have precisely the same effect. It appears to me, however, that the majority of Scotch farmers err in this matter neither by liming their land too liberally nor yet too scantily, but if they err at all in the operation of applying lime it is by doing so at an unseasonable time, or by relying too much upon lime to the exclusion of other manure. This last-named error, however, if it ever is committed in the present day, is by no means a common one, at all events with the better class of farmers.

" In considering the part played by lime in agricultural operations it should always be remembered that that substance acts in the soil in two perfectly distinct and separate ways. First, lime acts as a manure by supplying necessary calcareous food directly to the plant; and second, it acts by supplying food indirectly to the plant, either by unlocking the storehouses of plant food already existing in the soil, or by converting useless or even deleterious ingredients thereof into substances useful, or at all events harmless, to vegetation.

" Lime, as is well known, is required directly by all cultivated plants as food, and therefore a soil which is totally devoid of lime is simply barren, and the obvious remedy by which to render such a soil fertile would be, of course, a dose of lime. Such a case as this, however, is extremely rare. Of all the suspicious soils which I have analysed, I cannot recall one to mind which was proved to owe its barrenness to being completely devoid of lime.

"In most cases, therefore, in which lime acts beneficially when applied to the soil, it does so either by supplying food to the crop indirectly or by destroying some noxious constituent already existing in the soil.

"The plant food which lime supplies indirectly may be divided into two classes—first, mineral or inorganic, and secondly, vegetable or organic.

"The principal members of the first class seem to be silica and potash. These substances, however, it should be borne in mind, are not in any way contributed to the soil by the lime—they are merely changed by its action from their hard, stony, insoluble nature into a condition in which they are available to plants as food. These two substances, silica and potash, are found in greater or less proportion in almost all fertile soils, but in some soils they exist principally in an insoluble or locked-up condition, if I may use the expression, and are therefore of no use as plant food until they have been set free, either by the action of lime or by some other suitable agent.

"The principal member of the second or vegetable class of food materials which lime prepares for the use of plants is nitrogen. Now this substance nitrogen, as is well known, is an indispensable and most valuable ingredient of plant food, and therefore any substance which can apply it to plants in a readily available form is an agent of very great utility. This office is performed, and performed very satisfactorily, by lime. The lime does not, indeed, add or contribute nitrogen any more than it adds potash to soils, but it converts the nitrogen, which, though it already exists in the soils, is present in a comparatively inert state, into a form in which it is easily assimilated by plants. In these different ways, therefore, may lime be used with great benefit, viz. on soils which contain a large quantity of undecomposed mineral matter, and on soils which contain an excess of vegetable matter.

"Lime, however, is useful in another way, and that is by destroying substances hurtful to vegetation, such as, for example, certain compounds of iron and certain acids, which are alleged to be the cause of the peculiar evil known as sourness. A soil, it is well known, may contain all the ingredients necessary for supporting plant life, and yet be infertile, in consequence of containing some deleterious or poisonous ingredient. Lime may act, therefore, very beneficially on some soils, not by providing an increased supply of plant food, but merely by neutralising or destroying some such hurtful substance which may be present.

"In all the instances I have mentioned, lime, we have seen, acts beneficially; and it now remains for me, before concluding this short note, to point out in a very few words how lime may act prejudicially—so act, indeed, that its continued application may not only be useless, but actually be hurtful. It is an old idea that lime is a very exhausting substance, and that its continued and extensive use must sooner or later greatly impoverish a soil, or even reduce it to perfect sterility. This idea is not altogether erroneous, but it is only true in a certain sense.

"I do not mean, of course, to assert that a soil may not be over-limed. Such an occurrence, although not I should think by any means a common one, is not impossible. It can be done; and the immediate effect of over-liming is to cause a great diminution in the amount of the organic constituents of the soil, thereby rendering grain crops grown on it uncertain. When I say, however, that there need not be much fear of rendering a soil sterile by means of lime, I refer to the impossibility of destroying the natural or mineral constituents of a soil, such as potash, silica, phosphoric acid, sulphuric acid, etc. When lime is added to the soil it does not eliminate or destroy these substances, it merely effects certain changes by bringing some of them into a more valuable condition; so that as long as we do not remove, by injudicious cropping or by some similar method, these valuable constituents of plant food from our soils, we may apply lime as freely as is deemed necessary without incurring any danger of thereby rendering them sterile—at least, of doing so by exhausting the mineral food elements. The principal evil to be apprehended from over-liming is too great a destruction of organic matter, which, as I have already pointed out, unsuits the soil for the growth of grain crops. It should also be borne in mind that lime almost always produces the most profitable and marked effect on new land, or on land which has not been fully exposed to the air, or on such land as is rich in organic remains, as, for example, on peaty or boggy land, and that it may be of very little use if applied alone to arable land which has just been cropped. The greatest mistake, though, which I have ever seen committed in connection with the employment of lime is that of mixing it with manure before application. In these days of enlightenment it is almost incredible that such an egregious error as this should be committed, and yet I myself have actually seen the perpetration of this species of absolutely inexcusable wastage. When farmyard manure, at least after it has been kept for some time, is so treated with lime it is almost entirely destroyed, and the value of many other manures, by similar treatment, would be very much lessened. Lime should never be allowed to come in contact with the manure at all; and, if it can be arranged conveniently, these two substances should be applied to the land at different times.

"As I have been frequently asked to give an opinion as to the value of waste products containing lime, such as the so-called gas-lime and the refuse lime from paper-works, it may be of some use if I state here that none of these substances are of any great value, except for the lime which they contain; and I should say, further, that neither of these substances should on any account be used for agricultural purposes in their fresh state. Gas-lime, when it is newly made, contains certain compounds of sulphur which are positively inimical to plant life; and much the same may be said of the waste lime from paper mills, which, when it is new, is apt to contain some caustic soda, a substance which may seriously injure a plant, and even destroy entirely the vitality of seeds. By sufficient weathering, however, the noxious constituents of both of these substances may be rendered quite harmless, and either or both of them may then be safely used as a means of applying lime to the soil."

Mosses.—In many old pastures mosses are formidable enemies to the farmer. They are to be found thriving more or less in almost all situations and on every description of soil, but more particularly on moist, inferior soils. Where it is inconvenient or undesirable to plough up and crop land thus overrun with coarse grass and moss, something may be done to eradicate them by going over the surface with sharp, close-teethed harrows, crossing and re-crossing till the moss is thoroughly scratched up; clean off the rubbish, and thereafter apply a good top-dressing of lime or lime compost. Unquestionably, pure lime is preferable, and put on as hot as it can be conveniently applied, at the rate of from five to six tons per imperial acre. The month of February and up to the middle of March would seem to be the best time for this operation. After a good shower of rain, brush or chain harrow the lime well into the ground, removing all rubbish gathered up by the harrows, refuse of the lime, etc. In about a month afterwards, and not later than the middle of April, sow a mixture of the best permanent grass seeds, at the rate of from 20 lb. to 30 lb. per acre, which can be obtained mixed and ready, and suitable for the nature of the soil, from the seedsman with whom you are in the habit of dealing. If there be any tufts or tussocks of coarse grass, it would be well to root them out. Brush harrow again, and finish up by rolling with a heavy roller.

Improvement of Grass Land.—The improvement of grass land—not alone of land that has been drained, but also of other land that has not required draining—is a subject of interest and importance. While arable land is, as a rule, fairly well attended to with periodical dressings of manure of one kind or another, and is commonly cleared from weeds more or less thoroughly once at all events in the course of the rotation, grass land is too generally left to take care of itself; and this widespread neglect, being the rule rather than the exception, is a matter which causes but little surprise. Though it is, no doubt, true that there is some grass land in our best districts which, so far as manuring with anything beyond what the cattle leave upon it in grazing, may safely be left to take care of itself—land which is naturally so rich in all the elements of plant nutrition that to manure it at all in an artificial manner would do more harm than good, so long as it is kept for grazing purposes—such land is very scarce, and is found only in the most favoured localities. It may be laid down as a truism that most of our grass land not only needs improving, but would pay well for it; and in view of the prices which the products of arable and of grass land relatively bear to each other, and which they are likely to bear for a long time to come, it may be said that the neglect of our grass land cannot with impunity be suffered to go on much longer. Dairy-farming, in conjunction with the rearing of young stock and the fattening of cattle and sheep for the butcher, is, beyond all doubt, quite the most profitable occupation which the English farmer can follow, wherever land is suitable to it.

Treatment of Grass Land.—The late Sir H. M. Thompson wrote so well and wisely "On the Management of Grass Land" that we cannot do better than quote from the able paper which he contributed to the *Journal* of the Royal Agricultural Society:—"It may seem a work of supererogation to make suggestions for the improvement of pastures which already produce great results, but the holders of first-class land may learn something by observing the practice of those skilful and experienced graziers who find it worth their while to give extreme prices for the occupation of land. In order to reimburse themselves it is necessary that every yard of land should be productive, and the greatest care is taken to mow the thistles whilst still young and succulent, in which state they are (when mown) readily eaten by all kinds of stock. Coarse patches of grass, too, are occasionally switched over with the scythe, or, if necessary, an old horse is tethered in the worst places, until they are cropped down sufficiently to be again grazed regularly by the feeding stock. The loss of grass caused by neglecting to mow thistles and other large weeds would never be permitted if farmers would only consider how largely the fertility of the soil is taxed to nourish these intruders, and how cheaply they may be kept down. An old man and a hard-worn scythe, neither of them fit for regular work, will keep a large acreage of grass free from this constant source of loss.*

"One of the advantages of giving cake to finish beasts which, on the unassisted grass, would come out in October only half beef, is that the grazier is thus enabled to send his beasts to the butcher at full prices, instead of fattening them in the yards at great cost, or of selling them as store beasts when many others are doing the same and the markets are crowded and depressed.

"Another advantage which arises from giving artificial food to grazing cattle is that the pastures themselves are gradually improved, until land that is only fit for rearing store cattle becomes capable of fattening stock with a moderate amount of help toward the end of the season.

"Since the days of Jethro Tull there have been two recognised methods of keeping up the fertility of land, viz. either manuring at short intervals or thorough disintegration produced by frequent stirrings of the soil. It cannot be too strongly urged that as grass land is neces-

* Thistles are no doubt an eyesore and a nuisance, but a great deal of valuable labour has been wasted in mowing them down. The difficult kind to get rid of is the *Cnicus arvensis*, the small thistle, to which reference has already been made. Mowing it twice in the season is, as we have previously stated, declared to be a certain remedy, on pasture land; it is seldom seen on permanent meadows. Pulling it up by the roots is an illusion and a snare. After years of hard pulling, it is as likely as not to be as persistent as if it had been let alone; perhaps more so. But it is not all bad: its roots aerate and ventilate, and even drain, the soil. On stiff, retentive soils it does more good than harm. If only we can curb our hatred of it as an eyesore, we might perhaps be gainers if we just left it severely alone.

sarily deprived of the advantage received by arable land from frequent exposure to the atmosphere, it ought to be furnished in some way with the minerals required to produce good crops of nutritive herbage. The use of artificial manures has given the grass-land farmer complete command over the supply of nitrogen, but a perfect restoration of the mineral ingredients removed by grazing, and still more by mowing, cannot be effected without an occasional application of farmyard manure, or of compost in which farmyard manure holds an important part; so that it would really be better practice, so far as farmyard dung is concerned, to let the grass starve the arable land than the arable land starve the grass, since the arable land can receive its mineral supply from other sources, viz. deep cultivation and thorough aeration. The slovenly management of grass land which a few years ago was general, and is still too common, would never have been seen if the quality of grass could be appraised as easily and certainly as that of corn. But it is notorious that even the most experienced farmers and graziers can only distinguish between good, moderate, and bad; no man living can distinguish by the eye the subtle difference in the quality of the herbage which makes one very good field worth £1 an acre more rent than another very good field, or one bad field worth less than another equally bad-looking field. So long as a grass field grows about the usual quantity of grass, and the cattle eat it, the occupier is too apt to rest content with the good or bad reputation earned by particular fields, without any attempt to alter it for the better, or even to ascertain whether it is not gradually getting worse.

"On first-rate grass land there is comparatively little to be done. Deep alluvial soils contain such store of the elements of plant growth, and are for the most part so easily penetrated by the roots of the grasses, that many years' successive pasturing seems to produce but little change in the quality of the herbage. But even here there are gradations of goodness. If the occupier carefully scrutinises his fields in early spring, he will find backward patches, and in early autumn places that turn brown before the rest. These evidently want helping up; and in midsummer he will generally meet with places more or less avoided by the cattle when making their regular grazing rounds. In all these cases a slight dressing of the mixture hereafter mentioned may be put on at any time, being perfectly harmless to the cattle if taken up with their food. No dressing, however, should ever be applied in droughty weather. Where a piece has grown coarse from not being eaten, it should be switched over with the scythe, in order that the tillage may quickly reach the roots of the grass. In this way the land may be kept up to its full producing power.

"There is in the country a large quantity of grass land which is not considered feeding land, but yet will fatten young heifers or small Irish beasts if the occupier is not in a hurry, and does not put them too thick on the ground. This kind of land is the most inviting to the improver; and if the occupier cannot screw up his courage to face the whole at once, he should till ten acres well rather than twenty in a half-and-half way. Let him give a sufficient dressing to change the character of the herbage at once, so that he may have one field at least on which he can finish off his forward beasts. Sir J. B. Lawes, on his experimental grass-plots at Rothamsted, first taught the world that on a piece of old pasture, neither very good nor very bad, different kinds of tillage, repeated on the same ground for a few successive years, will produce as many different kinds of crops as there are kinds of tillage used, the character of the plants in the different plots varying as much as the quantity and quality of the produce. It is quite safe to assert that any occupier may, if he pleases, convert his grass into feeding land.

"The three worst kinds of pasture are generally supposed to be those on *light sands*, on *strong clays*, and on *black peaty soils*. The light sands I give up to the plough, unless in parks or ornamental grounds, where it is important to preserve the turf; ammoniacal dressings will produce a sudden appearance of improvement on light sandy land, but the effect is not lasting, and the dry benty grasses soon reassume their sway. A mixed top-dressing will, for a time, increase the clovers, but a heavy dressing of compost, containing road-scrapings or any other tolerably strong soil,* is the most permanently useful. Improving pasture on really light sand is, however, one of the most thankless and ceaseless of agricultural operations, and ought to be the next task for Sisyphus, if ever his rolling stone should wear out.

"The strong clays are much more promising. Most clay contains an abundant supply of the minerals which make a soil fertile, but they are in a crude state, and require air to make them fit for plant food.† The cracks caused by drought and worm-holes partially effect this, but the mineral supply from clay land that has long been in pasture is not sufficient to support heavy crops, and it should be a fundamental maxim with all clay-land farmers that their grass should never remain long without a dressing of farmyard manure. Even the poorest, worse made manure, which is little better than straw, is of great value, as it furnishes the requisite minerals, and though deficient in ammonia, that can be supplied in soot, nitrate of soda, guano, etc. The grass grown on clay is wholesome and nutritive, unless the drain-

* The chief fault of light sandy land is that it lacks consistency, density, and power of retaining moisture in a dry season. On such land a heavy dressing of strong clay, wherever possible, has a most beneficial effect; it improves the texture of the sandy soil, gives it the power of retaining moisture, and contributes many valuable elements of plant food in which it was before deficient. By this means sandy soil may be made into good pasture land. It is, if well done, a permanent improvement.

† Clay soils are valuable for the alkalies they contain; these are present in them in an insoluble state, and only become soluble, or fitted to be food for plants, when they have been chemically acted upon by carbonic acid and oxygen dissolved in water, and when they have been chemically and mechanically disintegrated by draining, by the processes of cultivation, by atmospheric influences, and by changes of temperature. Their natural impervious density is their chief fault; this may be greatly modified by draining, by cultivation, and by burning a considerable portion of the surface and mixing it with the remainder.

age is defective or the land has been robbed; and with a little extra top-dressing clay pastures may be made to get moderate-sized beasts fit for market, especially if helped with cake or corn in the latter end of summer.

"The third kind of inferior pasture mentioned above is that on black peaty soils. Where the depth of peat is considerable, or where it lies on white or yellow sand, it is very unpromising; but even in these cases I have seen instances where nitrate of soda or soot had a striking effect, and made the cattle eat the rough herbage greedily. The varieties of peaty soils are so numerous, and the results of applying tillage differ so widely, that it is generally advisable to try it experimentally in the first instance, putting a heavy dressing of the artificial manure intended to be used on a small portion of land. Where the peat lies upon clay it can always be made good land if the situation is such as to admit of efficient drainage. Should the thickness of peat be inconsiderable, so that the roots of the grass can reach the clay, a dressing of the manure already mentioned will almost always succeed in making black land very useful for rearing young stock, with which it seems to agree remarkably well.

"Frequent mention has been made of a mixed top-dressing which has been found to be a valuable application to grass land. It has been gradually arrived at, after many trials and modifications, and consists of *nitrogen*, *phosphoric acid*, and *potash*. These substances may be supplied in the form in which they can be most readily and cheaply obtained at the time and place required. The nitrogen may be furnished in guano, soot, nitrate of soda, or in the more specific form of muriate or sulphate of ammonia. The phosphoric acid may be obtained from bones, mineral superphosphate, or some of the poorer guanos. The potash similarly may be applied in the form of kainite, sulphate of potash, etc. The particular substances I am employing are nitrate of soda, mineral superphosphate, and kainite, in the following proportions: 1 cwt. of nitrate of soda, 2 cwt.

of mineral superphosphate, and 3 cwt. of kainite per acre for pasture. For mowing land, where no manure is used, I add to the above quantities ½ cwt. of nitrate of soda. Where land is annually mown a dressing of this manurial value is required every year to prevent deterioration, save in exceptional cases, such as deep alluvial land, water-side meadows subject to flooding, etc. The best practice is, no doubt, to manure mowing land regularly with good farmyard manure; but in the numerous instances in which this cannot be done the meadow may be maintained in full productiveness by a good farmyard manuring once in three or four years, and a dressing of the above mixture in the intermediate seasons. For pastures it cannot be contended that a dressing of this character is required year by year, but after laying down a field to permanent grass it is absolutely necessary to treat it well for three or four years, in order to keep it steadily progressive; and when grass land has been long neglected, and is thoroughly out of condition, one dressing will not suffice. It requires following up for two or three successive years before the traces of long neglect will be completely obliterated."

The foregoing was written mainly from a grazier's point of view as to the manner of treating grass land, but it applies equally to dairy-farming. The land, in fact, which is well adapted to fattening cattle is, as a rule, equally suitable for the production of milk. Dairy-cows will, of course, milk fairly well on land that will hardly fatten stock, and such land is commonly used for dairy purposes; but it is none the less true, on that account, that the better the land the greater will be the production of milk.

Experimental Manuring.—Assuming that the clay loams—that is to say, loams resting on clay subsoils—and the peaty soils have been artificially but substantially and effectively under-drained, they may be treated like ordinary soils, so far as manuring them is concerned. Should there be any uncertainty on this point, however, the best plan to follow is to experiment on plots, that are easily identified afterwards, with two or three kinds of artificial manures, side by side, with a small margin separating each pair of plots. And, in point of fact, not to experiment in this way, wherever it is desirable to experiment at all, is to run a risk of wasting money on unsuitable manures. To analyse a soil with the object of discovering in what kinds of fertilising constituents it has been well enough supplied by nature, is a good thing to do, but an expert analyst is needed to supply a valuable report. This process costs money, but will pay if properly followed up. Whatever may be done in the way of qualitative analysis, however; whatever may be the report on such analysis, it is well that it should be verified—or disproved, as the case may be—by experiments made on the land from which was taken the sample of soil for analysis.

Naturally dry soils, such as are chiefly typified by limestone, chalk, and sand, will respond very well to most sorts of manure, natural or artificial. These soils are usually denoted by the practical term, "sound soils." Ground or crushed bones, dissolved bones, superphosphate of lime, and so on, generally give a good account of themselves on these soils, but basic slag does not always do justice to its own reputation upon them. Be it understood that no kind or quality of manure will give more than half as good an account of itself on wet land—if even half—as it will on land that is dry and sound, but not too dry. The writer may say that his long experience as a farmer leads him to believe that deep-soiled land that rests on a clay subsoil and has required thorough under-draining, will respond better to lime, to basic slag, and to superphosphate of lime or of bones, than, generally speaking, will be found to be the case in respect to naturally sound soils. Really good land, for dairying purposes, will have a soil from ten to fifteen or eighteen inches thick before coming to the stratum which is generally known as "subsoil," whatever the composition of this latter may be. On this topic of manuring we may well advise all beginners to make experiments before going in heavily for the use of purchased fertilisers.

"Nothing is so cheap as land" is an argument used by some farmers against going to the expense of improving pastures either for grazing or dairying. Whether or not this is true as to some kinds of land, or as to land which is held at a low rent, the argument does not interfere with the soundness of our position as to the improvement of grass land. The root of the argument lies in the fact that many farmers are afraid to improve their land lest they be called on by the landlord, after a time, to pay an increase of rent commensurate with those improvements. This has often been done, and it has made tenant-farmers very cautious how they improve their farms. But where a man can repose confidence in his landlord—and the majority of landlords merit this confidence—where he feels conscious that he is secure against being raised in rent on the basis of his own improvements, there can be no doubt that money judiciously laid out in the improvement of grass land will pay the farmer well. Let us admit that nothing is so cheap as land, and it follows that, as land is limited in quantity, the thing next in cheapness is to improve that land. When a man can feel sure of reaping the reward of his improvements he is more than merely justified in making them; for by those very improvements he practically extends the area of his farm, he increases its stock-carrying capacity, and he improves the quality as well as increases the quantity of his productions. His security now is improved.

Farmyard Manure.—Farmyard manure, strictly speaking, is the residue of various kinds of vegetable productions, either as forage or as corn, which are used as food and litter by the animals in the farmyard. The animal system uses up a portion of these, and the remainder is ejected in the forms of liquid and solid excreta. The quantity and quality of the manure will vary according to the kinds of food consumed and the method of consuming it. If much forage be used as food, and also as bedding, along with a large proportion of roots or other green food, and with little or no corn or cake, the manure produced will be large in quantity, but it will be poor in quality. But if a large quantity of corn or cake, especially decorticated cottoncake, be consumed along with the forage, instead of roots and other green food, the manure will be less in quantity, but very much better in quality. Again, the conditions under which the food and litter are used will materially influence the quality of the manure: thus, if they are given to the cattle in open yards or courts, a large quantity of rain-water falls on the manure, and if this rain-water be not absorbed by an adequate quantity of dry litter it must pass away into the drains, and in passing it dissolves and carries along a large portion of the soluble and more valuable elements of the manure, thus reducing the quality of it; in fact, the bulk of this liquid is only too commonly allowed to run mostly to waste.

Liquid manure, indeed, is thought too little about. Generally, however, its effects are disappointing, because when applied it has been in most cases so diluted with rain and other water as to be almost powerless for good. The drains from all buildings should run into one tank, which should be completely protected from surface water, and from thence the liquid manure may be conducted by pipes and sluices on to the meadows or wherever it is required, and in suitable weather. Failing such care, liquid manure is commonly of small value on a farm. It is most appreciated when it can be flooded over the land, at any given time, out of a tank, in suitable weather. Pumping it out of a tank into a barrel on wheels is commonly regarded as costing more in time and in wear and tear than the liquid is worth as a manure.

A knowledge of chemistry and physiology is not needed to enable us to comprehend that the quality and quantity of dung voided by any description of fattening stock or milk-cows is the balance between the food consumed and that portion of it which is retained in their bodies as flesh, fat, etc., or withdrawn in the form of milk, perspiration, respiration, etc. The dung is therefore inferior to the food, from a fertilising point of view, just in proportion to the substances extracted from the food by the animal economy; but it is improved in form as food for plants by having been consumed by animals—they prepare it for the plants, which in turn again prepare it for the animals. A four-year-old beast extracts from the food given him only those substances which go to increase the soft portions of his body and to maintain the various processes of which his life is made up; but a young beast not only does both these, but also extracts what is required for developing his bone, hence the dung of a mature animal is more valuable than that of a young one just in proportion to the amount of matter which the young one keeps to build up the bony and muscular structure of his frame. It follows, consequently, that the quantity of manure produced on a farm will depend on the quantity of food grown and consumed on it, and on the quantity of feeding-stuffs purchased to supplement and improve the food produced on the farm itself; and that the quality of the manure will in like manner depend on the kind of stock kept, and on the kind of food purchased in addition to that produced.

To Increase the Bulk of the Manure Heap.—It is always true policy on a farmer's part as well to augment the quantity as to conserve the quality of the manure produced on his farm. Leaves of trees, coarse grass, unripe thistles, nettles, charlock, the dead roots of couch-grass, peat-soil, burnt clay, and other products of the farm, well rotted together, all serve to increase the bulk of the manure heap, and if well dried they will absorb volatile and liquid portions of it. It must ever be borne in mind that farmyard manure and lime should never be applied together on land, for the lime has a destructive influence over the valuable elements of the manure; thus, it drives off all the ammonia, which is one of the most precious constituents. If it is desired to apply both lime and farmyard manure to the growth of any one crop, an interval of two or three months should be allowed to occur between the dressings.

Quite recently a new domain of study and of interest stands revealed before us, but as yet it is far from being thoroughly explored. It is a world of the infinitely little in old Mother Earth, and may be denoted by the term "soil-physiology." This new development may perchance bring about a transformation in the art of manuring, such as that in butter-making and cheese-making, which has been accomplished by the study of bacteriology in its relation to milk. Professor E. J. Russell tells us that in an ounce of soil there are one or more hundreds of millions of bacteria of several kinds, "all alive and kicking," if one may employ an ancient phrase. And it is now anticipated that these soil-ferments may be made more than merely useful in regard to increasing the fertility of soils. The solution of a micro-organism problem of tremendous potentiality is, however, hardly yet begun, and we must possess ourselves in patience for awhile.

CHAPTER VI

BREEDS OF CATTLE: SHORTHORNS—LINCOLNSHIRE RED SHORTHORN CATTLE—HEREFORDS

Shorthorns.—Like the rest of our native and distinct breeds of cattle, the Shorthorns—to a greater extent than can ever be determined after so long a lapse of time—owe their special features and characteristics to the influence of soil and climate in that part of the country which may be regarded as their original home. Nowadays their home is everywhere; but the counties of Durham, York, and Northumberland claim the proud distinction of having produced them as a breed, and for a long time they bore the name of "Durham Cattle," as, indeed, they still do in a number of the British Colonies and foreign countries to which they have been introduced. By the climate and geological influences, whatever they may be, of the district covered by those counties, they were originally, to an uncertain extent, moulded; yet, more than most of our other breeds, they are supposed to be indebted to long bygone crosses with foreign cattle. "Saxon, and Norman, and Dane are *we*"; and, in an extended sense, the same may be said of Shorthorn cattle; for the old Scandinavian conquerors of Britain, coming from the west and north of Europe, not only mingled their own blood with ours, but it is known that they brought some of their large, raw-boned, coarse-fleshed, short-horned, heavy milking, strong and hardy cattle, and grafted them on the native stock of the north-eastern counties of England. There is no need to doubt that the people from the opposite shores of Jutland, Holstein, and Friesland, when they invaded Britain between the years 449 and 667, brought their cattle with them, together with their families and household stuff, for, as Professor Boyd Dawkins says: "The three keels which landed at Richborough, full of armed men from Jutland, was the advanced guard of a great migration, which was so complete that, according to the 'Anglo-Saxon Chronicle,' the ancient home of the old race was left desolate for four centuries." They effected as great a revolution in husbandry in Britain as in its language and its whole political system, and with them appeared the massive hreed of cattle from which, by a continual process of natural and artificial selection, both in all probability more or less haphazard as to system, our larger and more valuable hreeds are descended. Ohviously, we have no definite reason to believe that these cattle were brought with the view of improving the native varieties in this country. We have no evidence, indeed, that the art of hreeding was either understood or valued in those days; but the larger animals were then introduced by the colonists for their own uses, and probahly their size would have recommended them to others.

In the early part of the eighteenth century there was a tradition floating among the Shorthorn breeders of the Teeswater district that a breed of cattle, much resembling in size, shape, and colour the cattle of North-Western Europe—of Holland, Holstein, and Denmark—had existed many centuries before in Yorkshire, chiefly in the district of Holderness. Yet nothing was certainly known as to the people by whom, or the period when, they were introduced into Britain, beyond the historical fact just mentioned—if fact it was—and they were popularly supposed to have been brought by the warlike and adventurous natives of Denmark, Sweden, and Norway, who repeatedly invaded this country, settling in portions of it many centuries before the Norman Conquest. The imported cattle of the early English settlers would probably have formed only one element in the amalgamation of that long-distant period, the varieties descended from the aboriginal stock of the country being also incorporated. There were subsequent importations of cattle from Holland, but these could scarcely have exerted much influence on what had by that time become to some extent the fixed breed of the district.

Shorthorn Colour.—It is curious to find that Gervase Markham, early in the seventeenth century, described the cattle of Yorkshire as "generally all black of colour." An explanation of this remark is given in the work of Thomas Hale, entitled "A Compleat Body of Husbandry," published in 1756, in which he says:—"The Yorkshire oxen are in general black all over, and they are a very large, firm, and valuable kind in every respect." He, however, immediately afterwards remarks that the reader is not to suppose from what has been said that "all the Yorkshire oxen were black." Doubtless they were of several colours. Mr. Bates considers that by the middle of the eighteenth century a considerable mixture had certainly taken place, and that there was a large sprinkling of other colours. It may be assumed that, amid all these changes and importations, the valuable race of Shorthorned cattle was carefully preserved by the farmers of Holderness and Teeswater, other strains being added if they were deemed to be advantageous.

The Development of the Breed.—Whatever amount of influence we may accord to the soil and climate of Northumbria in the development of the Shorthorn breed, it is not to be supposed—though we have no records bearing on the subject—that no one during these long centuries preceding and following the Norman Conquest had tried to improve the quality and form of these cattle. The spirit of agricultural progress existed in the Northern counties long enough before it was either generally recognised or reduced to anything like order or system; and we are therefore justified, by the ancient excellence of Shorthorns, in presuming that many breeders greatly assisted nature in the improvement and development of this noble race of cattle. Be this as it may, however, we have no clear records of any systematic attempts at improvement earlier than the eighteenth century. Yet the country was not wholly asleep in those days; progress, or the foundation for it, was being surely though slowly and obscurely made. Improvement well begun has been continued throughout the intervening centuries.

Whether by art or nature, or both these combined, the Teeswater cattle were celebrated many centuries ago as yielding, under generous treatment, larger quantities of milk than any other breed of cattle yet known in these islands. Though late to mature, they afterwards laid on flesh rapidly, and fattened into heavy weights of coarse-grained, dark-coloured flesh, whose flavour was inferior to that of the smaller breeds. They had coarse heads, with short stubby horns, heavy masculine necks, high coarse shoulders, flat sides, wide hips, long rumps, and thick thighs loaded with flesh. They were, as now, of various colours, deep red, pure white, red and white, roan, and not uncommonly light dun and yellow-red.

An ancient record, which is said to be still preserved in Durham, states that cattle of great excellence existed in that county so long ago as the middle of the fifteenth century. And a tradition was current a hundred and fifty years ago among the breeders of Durham and Yorkshire that a superior race of Shorthorns had existed on the estates of the Earls and Dukes of Northumberland since the latter part of the sixteenth century. Sir Hugh Smithson, who had married the heiress of that celebrated family, and was subsequently raised to the dukedom of Northumberland in 1766, was a great breeder of Shorthorns. He was in the habit of weighing his cattle and the food they ate, so as to ascertain the improvement they made for the food consumed; and so fond was he of his Shorthorns that his peers jokingly dubbed him "the Yorkshire grazier." A century earlier than the time of Sir Hugh, the Aislabies of Studley Park and the Blacketts of Newby Hall had very fine Shorthorn cattle, and had paid great attention to their breeding. Even at that early day, portraits of these cattle adorned the entrance halls of their owners' residences.

There had thus existed, time out of mind, on both sides of the River Tees, from Barnard Castle downwards to Yarm, a distinctive breed of cattle, the Teeswater or old-fashioned Durham Shorthorns. And long before Messrs. Robert and Charles Colling had been heard of, the names of certain breeders and improvers had obtained celebrity, namely, Milbank, St. Quintin, Pennyman, Dobinson, Brown, Hall, Wright, Hill, Charge, Maynard, Jolly, Hutchinson, Sharter, Fawcett, Waistell, Stephenson, Hunter, Appleby, Snowdon and others. Long also before Ketton or Barmpton were known as Shorthorn localities, the following places were in repute—namely, Barningham, Aldburgh, Barton, Cleasby, Manfield, Stapleton, Dalton, Newton, Morrell, Blackwell, Oxenfield, Hurworth, Eryholme, Great Burdon, Worsell, Sockburn, Haughton, etc.; so that even in the beginning of the eighteenth century Shorthorns had attained to fame, and landowners as well as farmers were alive to the expediency of improving these cattle. The oldest animal entered in the Herd Book is the Studley Bull 626, calved in 1737.

The year 1780 is usually considered to mark the beginning of a new era in the history of Shorthorns. At this period a fresh impetus was given and a new interest added to the pursuit of breeding these already famous cattle. Many causes, no doubt, contributed to this. The country was advancing in prosperity, and population was increasing; Shorthorn interests, previously more or less scattered, were becoming sufficiently numerous to command a sort of systematic unity and recognition. Changes in the system of agriculture exercised a great influence, the extension of field cultivation of the turnip making it practicable to winter live stock in a way that had never previously been possible. This led to a demand for stock from districts that had first adopted the practice and where it had been developed. Cattle, which had been formerly used for ploughing and had only been fattened when they were removed from the yoke, were then required primarily for beef and milk, so that early maturity and deep milking properties were receiving consideration. The celebrated Robert Bakewell, of Dishley, in his management of Longhorn cattle and Leicester sheep, had reduced the art of breeding to a system, in which the results could be predicted with tolerable certainty, and his genius was attracting many followers and admirers. His principles were applied not to sheep only, but to horses and cattle, and usually with marked success. It was evident that this extraordinary man had discovered the secret of moulding and improving domestic animals almost at will, as a potter moulds his clay. They improved visibly in each successive generation, until, in a sport space of time, animal forms were built up possessing such beauty, symmetry, and general excellence, that they have not easily been surpassed in more modern times.

Bakewell's System of Breeding.—Bakewell's system was, to a large extent, the creation of his own genius, and differed widely from the usual practice of English stock-breeders of his day. He dissected some carcases of his cattle and sheep, minutely examined the flesh, bones, and sinews, and so obtained a practical knowledge of animal physiology. He put his anatomical specimens into pickle, and afterwards hung them up in his hall for subsequent reference. From this scientific investigation he deduced a system of the laws of animal nutrition and economy, at once sound, accurate, and practical. His method in breeding was to select animals, wherever he could find them, of the best blood, and possessing as nearly as possible the form he needed for the objects he had in view; he then bred them strictly in their own family alone, only going out of it when he found specimens elsewhere which he considered would still further improve his stock. His judgment was sound, clear, accurate, and penetrating; and he was at once a profound scholar and a master of the principles which he had formulated into a system. In the strict sense of the word, he was a man of "genius"; and, more than to any other man, England owes to him the initiative of the marvellous improvements in her cattle and sheep which have been made in the past hundred years. The old farm at Dishley, which his commanding genius elevated into a shrine, has passed into the hands of a stranger, but, like that of its old tenant, its name is immortal. "Bakewell of Dishley" is known wherever the science of agriculture is studied, and his name is, and ever will be, revered by those who take a delight in the improvement of cattle, sheep, and horses. He died in 1795 at the age of sixty-nine.

The Collings.—Some little time—about the year 1780—after Bakewell's fame had reached a high position, two young men, Robert and Charles Colling, the sons of a substantial Teeswater farmer, were about to start business on their own account. These young men had heard of Bakewell's extraordinary genius as a breeder; they paid him repeated visits, carefully examined his stock, noted the improvements he had effected in them, gathered all the knowledge they could of his system, bought some of his improved sheep and continued breeding them to his model, and applied his principles of breeding to Shorthorn cattle. Their success was complete; their names are known in Shorthorn circles all over the world, and the farms of Barmpton and Ketton, on which they subsequently settled, are almost as celebrated as Bakewell's old farm at Dishley. Though Bakewell never took in hand the breeding of Shorthorns, the principles he had previously applied to Leicester sheep and Longhorn cattle were found to be equally successful with other breeds of animals; and it was reserved for the brothers Colling to apply them to the special and composite breed of cattle which has since become the most famous the world has ever known.

Under the management of the Collings, Shorthorn cattle soon attained a popularity they had not previously enjoyed, and that popularity has gone on increasing till the present day. The system which they established on Bakewell's principles was that of breeding "in-and-in," so long as constitution, size, vigour, quality, health, and fecundity were not injured by it. This, in moderation, appears to be the surest way of raising superior stock—the breeding together of animals of the same strain of blood. Attention to pedigree is found to be more effective than attention to form without pedigree. And this fact, coupled with fashion and high prices, had a strong tendency to perpetuate pure blood and to prevent the ill-effects which follow "raw crossing"; while, on the other hand, it doubtless had the effect of causing far too little weeding-out to be done of unfit specimens. The practice of close "in-and-in" breeding in some cases produced phenomenal results, and it is no doubt true that uniformity of type and quality may be sooner and more certainly attained by this system than any other; but experience has proved that the number of families on which this system can be long practised with safety and success is very limited, and that in the majority of cases it has, when carried on too long, resulted in more or less of disaster and disappointment.

It has been seen that many breeders in Durham and Yorkshire possessed fine herds of Shorthorns before the brothers Colling commenced their operations. On their return from Dishley the elder brother, Robert Colling, settled at the farm of Barmpton, and the younger, Charles Colling, at Ketton. Having decided to improve the Shorthorn on the principles so successfully carried out by Bakewell with the Longhorn, they proceeded to select such animals as were suitable for their purpose. The first quest was for a good sire. Charles Colling, on the occasion of his weekly visits to Darlington market, used to notice some excellent veal, and upon inquiry ascertained that the calves were procreated by a bull belonging to Mr. Fawcett, of Haughton Hill. Charles did not at first purchase the bull: he was bought by Robert and a neighbour, Mr. Waistell. This bull was Hubback 319, described in Vol. I. of "Coates's Herd Book" as yellow, red, and white, calved in 1777, bred by Mr. John Hunter, of Hurworth, got by Snowdon's Bull 612, dam from the stock of Sir James Pennyman, and these from the stock of Sir William St. Quintin, of Scampston.

Robert Colling and Waistell had secured this noted sire in April, 1783. In the following November he was purchased from them by Charles Colling for eight guineas, the price that had originally been paid for him, and kept in service in his herd at Ketton for two years. Several cows of the same breeding were selected. In June, 1784, the Stanwick cow was driven from the Stanwick estate of the Duke of Northumberland in Yorkshire, to be sold in Darlington market, and was bought by Charles Colling for £13. She was the foundress of the celebrated Duchess tribe. Being still in search of good cows, Charles Colling in 1785 bought the cow Favourite, or Old Favourite (afterwards called Lady Maynard) from Mr. Maynard, of Eryholme. Her calf, Young Strawberry, by Dalton Duke 188, was also bought from Mr. Maynard, and another purchase was the cow Haughton by Hubback 319, the dam of a noted bull called Foljambe 263.

These were the chief materials with which Charles Colling set to work. To succeed Hubback as a sire he used Foljambe just mentioned; this bull got Bolingbroke 86, and Bolingbroke became the sire of the celebrated bull Favourite 252, calved in 1793. Favourite was closely inbred; his sire Bolingbroke and his dam Phœnix were half-brother and sister on the sire's side, and both were descended from Lady Maynard, the one being a grandson and the other a daughter of that cow. The Ketton herd was then becoming famous, and further to extend its reputation Charles Colling exhibited his stock, not only as breeding animals, but also as prodigies of feeding. One of the earliest calves got by Favourite 252 became known as "The Durham Ox." This calf was steered and fed until he was nearly five years old. He was then purchased in 1801 for £140 to be exhibited by Mr. Bulmer, of Harmby, and was afterwards sold for £250 to Mr. John Day. He was exhibited for six years, and on his death the four quarters weighed 2,322 lb.; tallow, 156 lb.; hide, 142 lb.; total, 2,620 lb. At ten years old his live weight is said to have been nearly 3,400 lb.

Robert Colling at Barmpton was also achieving distinction, and founded the Wildair, Red Rose, Princess, and Bright Eyes families. About 1806 he bred "The White Heifer that Travelled," this renowned animal being sent through the country for exhibition. She was got by Favourite 252, and it is estimated that her live weight was 2,300 lb., and her dead weight 1,820 lb. The Barmpton Shorthorns differed from those at Ketton mostly in style, and particularly in the character of the head. One of the most famous bulls bred by Charles Colling was Comet 155, sold at the Ketton sale in 1810 for 1,000 guineas. Comet was considered by his breeder to be the best bull he ever saw, and was regarded as the great triumph of the new system of breeding.

We have not space to enter into a detailed history of the progress of the breed, but it should be mentioned that contemporary with the Collings, or continuing the breeding of Shorthorns of their blood after the dispersion of the Ketton and Barmpton herds, were Thomas Booth, succeeded by his sons and further descendants up to recent times at Studley, Warlaby, and Killerby; Thomas Bates, Kirklevington; Christopher Mason, Chilton; William Raine, Samuel Wiley; Mr. Duncombe, afterwards Lord Feversham; Sir Henry Vane Tempest, Mr. Jonas Whitaker, Sir Charles Knightley, Lord Althorp, and many others.

The Windsor Herd.—From the sale of Sir Charles Knightley at Fawsley in 1856 two beautiful cows were purchased for the Prince Consort, and under His Royal Highness's directions the herd at Windsor was established on sound lines. The herd was brought to a high degree of excellence while in the possession of Queen Victoria. When fresh blood was required it was introduced by the purchase of two famous sires bred in Scotland, Field-Marshal and New Year's Gift, the use of which proved very successful. The latter bull was sold by auction in 1892 for 1,000 guineas to the Earl of Feversham. Numerous prizes have been won at the shows of breeding animals and at the exhibitions of fat stock by specimens bred in the Royal herd at Windsor. When Prince of Wales, the late King, Edward VII., formed herds both of Booth and Bates blood at Sandringham. The Royal herds at Windsor and Sandringham were continued by His Majesty.

Remarkable Shorthorn Sales.—Scientific and elaborate principles of breeding have, perhaps, been more extensively employed on Shorthorn cattle than on any kind or breed of animals, and the money value attached to the best specimens of the most fashionable families for a time became fabulous.

At Mr. Charles Colling's sale on October 11th, 1810, seventeen cows fetched 2,669 guineas, or an average of 157 guineas; eleven bulls realised 2,249 guineas, or an average of 204½ guineas; seven heifers made 808 guineas, or an average of nearly 115½ guineas; and twelve heifer- and bull-calves, under one year old, fetched 961 guineas, or an average of 80 guineas. Among these animals the highest priced ones were the bull Comet, 1,000 guineas; the bull Petrarch, 365 guineas; the cow Lily, 410 guineas; the cow Countess, 400 guineas; the heifer Young Countess, 206 guineas; and the bull-calf Young Favourite, 140 guineas. In all forty-seven animals realised £7,115 17s., or an average of £151 8s. Such prices were in those days considered to be enormous, and they were not sustained at Mr. Robert Colling's sale on September 29th, 1818, when sixty-one animals made 7,484 guineas, or an average of £128 16s. 6d. After a period of depression prices again began to advance, in 1850; but it was a good many years later when it became a common occurrence for specimens of the fashionable tribes to command 1,000 guineas to 1,500 guineas, while in some cases prices rose into several thousand guineas for single animals.

In September, 1873, the stock-breeding world was startled by the results of a sale of Mr. Campbell's Shorthorns at New York Mills, near Utica, New York, America. At that sale six females of the Bates' Oxford tribe averaged £1,087 10s., and the bull-calves £396 16s. 8d. Eleven females of the Bates' Duchess tribe made the prodigious

Shorthorn Dairy Cow, Hawthorn VII

average of £4,522 14s. 2d., one cow fetching the unparalleled sum of 40,600 dollars, or in our money £8,458 6s. 8d. This last, however, is understood to have been an instance in which an agent exceeded his instructions. It was the writer's good fortune to inspect Mr. Campbell's herd two years before they were sold, and a rare treat it was! Those were "booming" days in the Shorthorn world.

On September 4th, 1887, Mr. John Thornton sold at Bowness forty-five Shorthorns which Mr. Cochrane, of Canada, had sent over to this country for disposal. The sum total of the sale amounted to £17,150, or an average of £381 2s. 2d. per animal. The average price for thirty-seven cows, heifers, and calves was over £420, and of eight bulls over £300. The heifer Third Duchess of Hillhurst, red, calved December 25th, 1875, and consequently only twenty months old, was sold to Sir R. Loder, of Towcester, for 4,100 guineas; and the heifer Fifth Duchess of Hillhurst, red, calved May 1st, 1876, and consequently only sixteen months old, was bought by Lord Bective for the still larger sum of 4,300 guineas.

On September 19th, 1878, the late Duke of Devonshire's periodical sale of Shorthorns was held at Holker Hall, Lancashire. In all, thirty animals were sold, and the sum realised was £19,922 14s., or an average of £664 1s. 9d. per head. Eighteen cows made £14,302 1s., or an average of £794 11s. 2d., and twelve bulls made £5,620, or an average of £468 6s. 8d. Though trade in the country was then in a depressed condition, and Shorthorn sales during the year had shown a marked decline in prices, the sale at Holker was a great success.

Points of Shorthorns.—Mr. John Thornton, the celebrated auctioneer, in an article which he contributed to the work entitled "The Cattle, Sheep, and Pigs of Great Britain," describes Shorthorn cattle as follows: "The breed is distinguished by its symmetrical proportions, and by its great bulk on a comparatively small frame, the offal being very light, and the limbs small and fine. The head is expressive, being rather broad across the forehead, tapering gracefully below the eyes to an open nostril and fine flesh-coloured muzzle. The eyes are bright, prominent, and of a particularly placid, sweet expression, the whole countenance being remarkably gentle. The horns (whence comes the name) are unusually short, springing well from the head, with a graceful downward curl, and are of a creamy white or yellowish colour; the ears being fine, erect, and hairy. The neck is moderately thick (muscular in the male), and set straight and well into the shoulders, which when viewed in front are wide, showing thickness through the heart, the breast coming well forward, and the fore-legs standing short and wide apart. The back, among the higher-bred animals, is remarkably broad and flat; the ribs, barrel-like, spring well out of it and with little space between them and the hip-bones, which are soft and well covered. The hind-quarters are long and well filled in, the tail being set square on to them; the thighs meet low down, forming the full and deep twist; the flank should be deep so as partially to cover the udder, which should not be too large, but placed forward, the teats being well formed, square-set, and of a medium size; the hind-legs should be very short and stand wide and quite straight to the ground. The general appearance should show even outlines. The whole body is covered with long soft hair, there frequently being a fine under-coat, and this hair is of the most pleasing variety of colour, from a soft creamy white to a full deep red. Occasionally the animal is red and white, the white being found principally on the forehead, underneath the belly, and a few spots on the hind-quarters and legs. In another group the body is nearly white, with the neck and head partially covered with roan; while, again, the body is most beautifully variegated, of a rich deep purple or plum-coloured hue. On touching the beef points, the skin is found to be soft and mellow, as if lying on a soft cushion. In animals thin in condition a kind of inner skin is felt, which is the 'quality' or 'handling' indicative of those great fattening propensities for which the breed is so famous."

Qualities of Shorthorns.—One of the chief merits of Shorthorns—perhaps the most striking and practical merit—is their power of improving in a marvellous manner and in a very short time most other breeds of cattle with which they are allowed freely to mingle their blood. But qualities recently acquired are soon lost, if there is a lack of physical vigour amongst the inter-breeding animals. The qualities of the more vigorous male—or female, as the case may be—will be found in the offspring—for when health and vital force are full to overflowing, individual characteristics, of whatever kind, are most likely to be transmitted; but if the vital force diminishes, and the animal becomes weak and delicate, the qualities last acquired will be the first to disappear, so important are strength and soundness of constitution. Leaving out the various breeds which still remain distinct, Shorthorns have greatly improved the whole of the cattle of these islands. In Ireland, Wales, and Scotland their influence is seen almost everywhere. In the Isle of Man, and in the Orkneys and Shetland, they are found. In the United States of America, in Canada, and in South America, their influence has been very marked on the old breeds of these countries, and there are numerous pure-bred herds in existence there from which young bulls are drafted for use in continuing the improvement of the "grade cattle." In Australia and New Zealand they have been long established, and have done remarkably well. They have been exported to South Africa, where no doubt a great future is before them. On the Continent of Europe they have made their home, and even in Japan they are to be found; indeed, they are strangers in no country which can lay claim to civilisation. Wherever they have gone they have conferred improvement, and the breed has made an immense contribution to the increase of the meat and milk supply of the world.

Milking Properties.—It is to be regretted that in the breeding of some families of Shorthorns milking properties were for a time sacrificed to early maturity and aptitude to fatten, and the reputation of the breed as milk producers suffered somewhat in consequence. This was due to the fact that certain strains became very popular for exportation, and breeders studied only, or mainly, the foreign demand. To such a length was this tendency of considering only the beef-producing properties carried, that at one period it was well known that in some cases "wet nurses" had to be employed to help milkless pedigree mothers to rear their offspring. Now, a cow that cannot support her own calf forfeits in the economy of nature her claim to existence. In many districts deep milking properties have always been cultivated, and this use of a cow has been made one of the main considerations in breeding, for it has been recognised that a poor milker fails to give to her owner that larger portion of profit which, under proper conditions, she is specially designed to yield.

There is no reason why the Shorthorn breed should not continue that superior reputation for both beef and milk of which we know the race is capable. There are instances on record of Shorthorn cows giving thirty or more quarts of milk per day for a length of time, and being, at the same time, possessed of superior fattening properties. And it is no disparagement to any other breed that Shorthorns should take high rank in both these departments of usefulness and profit. They have a place to fill which no other breed can fill so well; and the other breeds, on their part, are well suited to some districts and purposes, in and for which the Shorthorn could not be kept with profit.

One of the chief sources of profit to a Shorthorn breeder lies in the sale of his young bulls at good round prices, and experience proves that he depends each year more than before (especially when the exportation trade is slack) on finding among bona fide dairy farmers at home the great bulk of his customers for such young bulls. It also proves that, as the market is now so well filled with good pedigree stock, the supply having so far overtaken the demand that the price of well-descended bulls is within the reach of even small dairy farmers, it is more than ever necessary that breeders should make their stock popular with practical rent-paying dairy farmers. This can only be done by cultivating the milking properties, so that Shorthorns may everywhere be regarded as thorough-going dairy as well as grazing stock; and it will only be done when breeders generally clearly discern in the signs of the times (as many have already done) the fact that the most profitable continuous market is that in which the demand is for animals descended from herds which are noted as being not only good grazers but deep milkers. Many families of pure-bred Shorthorns are known to be deep milkers, and though their milk is less rich than that of the Jerseys and Guernseys, both in colour and quality, the milk globules are of a good size, so that the cream rises quickly. In the majority of Shorthorn herds the milking properties have within the last few years received increased attention, as it is recognised, even when beef-making is more particularly the object in view, that the good milking cow is the best dam and is likely to produce and nourish the best calf. The needs of the buyer for exportation are frequently at variance with those of the farmer at home, but as population increases, even in new countries, the good milking Shorthorns will be held in greatest esteem.

Live Weight.—As an indication of the average live weight of selected and carefully fattened specimens of the breed the following figures are given from the records of the Smithfield Club show:—Steers under two years old, 1,415 lb.; steers under three years old, 1,835 lb.; and heifers under three years old, 1,735 lb. The average daily gain in live weight of animals exhibited at these shows has been:—Steers under two years old, 1·93 lb.; steers under three years old, 1·67 lb.; and heifers under three years old, 1·58 lb. The statistics of live weights and daily gains have been carefully tabulated, in the

"Agricultural Note-Book,"* by Mr. Primrose McConnell, whose calculations the writer follows, here and elsewhere. A yield of 1,460 gallons of milk is not uncommon; while the average yields of whole herds have been reported at 885 gallons per cow. At the London Dairy Shows the milk produced by Shorthorns (pedigree and non-pedigree) has averaged 49·2 lb. per day, with total solids showing a percentage of 12·99, of which 3·91 was fat and 9·08 other solids.

The first volume of the Herd Book (still called "Coates's Herd Book") was edited by Mr. George Coates, and published in 1822. Mr. Coates was assisted by his son, who, after his death, continued the work to the fifth volume inclusive, when Mr. Henry Strafford became proprietor and editor. In 1872 the Shorthorn Society of Great Britain and Ireland was established, and it has published the subsequent volumes.

The Breed during the last Forty Years.—At the commencement of the period under notice the Shorthorn breed was apparently in the highest state of prosperity that any variety of the bovine race had ever enjoyed. Some of the highest prices paid for specimens of the fashionable tribes have already been quoted on a former page.

About 1879, however, a fall in values set in seriously, and with the depression in agriculture generally, which then became acute, there was a rapid decline, the gloom being relieved, as we have seen, by an occasional break in the clouds. Apart from the general depreciation in the value of everything connected with the land which was then experienced, several other circumstances contributed to the reaction in the prices of Shorthorns. The noblemen and county gentlemen of means, who first took up the pursuit of breeding, did so with an earnest desire to benefit agriculture and assist their tenants and others by encouraging them in the improvement of their cattle. A number of

* "The Agricultural Note-Book," by Primrose McConnell, B.Sc. Crosby Lockwood & Co., London.

gentlemen who had amassed wealth in commerce invested a portion of their money in land, and they, too, wished to do what they could in the same direction; they also established herds of Shorthorns, and, as fashion had set its seal on the Bates strains, those who could afford to do so were eager to purchase specimens of the families that had been established during the first half of the nineteenth century by Mr. Thomas Bates, at Kirklevington, and had been brought to a state of great perfection by that talented breeder. The demand being exceedingly keen, representatives of these strains consequently became very dear, and the sums given in competition by rich men soon lifted the bulk of the animals beyond the reach of ordinary farmers. The value of an article is what it will realise in the open market, and, judged by that standard, Shorthorns of the families then so much in vogue certainly fetched remarkable prices. It has been seen, however, that at the sales held by the brothers Colling—from 1810 to 1818—the best Shorthorns went at sums vastly in excess of those given for ordinary stock. From the point of view of those who considered that the butcher's block or the milk-pail should be the sole tests of value, the prices for Shorthorns in what has been called the "golden age" were held to be extravagant. But other elements should be taken into consideration, and it is not easy to assess the real money value of first-class impressive sires of long and proved descent, or of cows that are good in themselves and that represent the results of many years of able and systematic breeding.

It is considered by some that during the time of inflated values the actual improvement of the breed did not progress proportionately. The prices of the fashionably bred animals were so high that many of the farmer breeders were unable to purchase them, and their powerful influence was thus to a certain extent lost. While a number of the herds were ably and prudently managed, in other cases consideration was given to purity of blood and quality rather than to the beef-making and milk-producing properties, upon which the fame of a breed of cattle must ultimately rest. The weeding out of those inferior specimens, which occasionally make their unwelcome appearance in all herds, was not always sufficiently drastic. There was also a good deal of long-continued breeding among animals nearly allied, out-crosses being tabooed as decreasing the value of the tribes. It is no discredit to the blood that it should not (in instances where errors of management took place) have come altogether scathless out of the ordeal to which it was subjected. Doubtless it emerged quite as well as any other would have done in similar circumstances. The merit of these fine cattle, representing many generations of recorded ancestry and careful breeding (descended from stock of undoubted excellence), survives, and when the cattle are taken in hand on practical lines and judiciously mated the results still prove satisfactory. We may in the not distant future see a decided revival of these old tribes, and it would rejoice many admirers of the breed if they should again take the high place which they occupied when the banners of Kirklevington and Warlaby led to victory in the peaceful contests of the show-yards and the sale-rings.

Demand for Shorthorns from the United States.—It was the demand from the United States that originally gave such a stimulus to the breeding of Bates Shorthorns. From a very early date North America had shown appreciation of the breed, and many animals were imported when the nineteenth century was still young. The Eastern States took the first of the lots, the combination of beef and milk rendering the breed of special value where the country was settled and the population was increasing. When the Western States were opened up the Shorthorns spread rapidly. Bates blood was a fashion—the lengthy frames and the stylish appearance of the animals being much admired, as were also their milking and flesh-bearing qualities and their impressiveness. The development of the ranching industry led to an increased demand. The earlier imports of cattle to this country from the States clearly proved what a beneficial influence the Shorthorn had exercised, the American steers being massive, well-fleshed animals, that laid the foundation of what has since become a trade of great magnitude.

In a review of the period it has been impossible to avoid giving prominence to the ups and downs of prices, especially when these were so abnormal. But there is a danger that this feature should be made too prominent. During all these years a large number of hreeders engaged in the work of Shorthorn improvement, with a strict regard to economical results. Their proceedings at the time were somewhat overshadowed, and attracted comparatively little attention from the puhlic. To some extent they were discouraged, and here and there they discontinued the registration of their stock; hut this was hy no means common, and, though working under a cloud, the majority of them stuck firmly to the hreed, and duly recorded the pedigrees of their animals in "Coates's Herd Book." With these farmer breeders beef and milk were the main considerations, and a high standard in both respects was maintained. After all, it is the farmer hreeders who are usually the practical and life-long supporters of well-hred stock, and it is in their hands that the greatest improvements are effected. The supremacy of the Shorthorn for the comhined qualities of beef and milk secured it against any real danger, and this has been proved in the days of depression, for, notwithstanding keener competition, it still holds its place as the great source of the improvement of cattle all over the world.

Milk Production and Beef-bearing.—Many practical hreeders in England devoted their attention to the milking properties rather than to the beef-making qualities, being induced to do so hy the great demand in populous centres for new milk. Of course, the flesh-producing qualities were not overlooked; hut, speaking generally, the aim was guided hy the fact that good milkers were necessary to produce hulls suitable for dairy herds. Thus in Cumberland, Westmorland, and Lancashire, and also in Gloucestershire, milking herds of Shorthorns abounded. Some of the older men had neglected registration, but their sons did not, and were able to comply with the "Herd Book" requirements, pure-bred bulls having always been used in the herds. In other districts, beef and not milk was the chief consideration.

Commencing in 1901, the Shorthorn Society, looking shrewdly to the continued and increased usefulness of the breed under their care, offered prizes for "dairy Shorthorns"; and in 1905 an important step in advance was taken when the Dairy Shorthorn Association was started on what, there is ample reason already to hope and expect, will ripen out into a most useful and prosperous career. Prizes have been awarded at many important shows to milking Shorthorns whose breed pedigrees entitled them to rank as pure-bred animals. In this and in other ways the breed is being rehabilitated in its ancient reputation for copious milk. This reputation, indeed, it did not wholly lose, for milking capacity was maintained in some well-known tribes throughout the long boom period by this most useful attribute of bovine females of the order mammalia.

The sequel has already been beneficial to the breed, inasmuch as breeders realise, as they might well have done a quarter of a century ago—as, indeed, they ought to have done all along persistently for a century and a quarter, or longer—that large milk yields of good quality stamp even a "blue-blooded" cow with an additional claim to respect in the domain of maternity.

The possibility of being able to combine in these cattle the dual capacity of producing milk and beef—and both of a high degree of merit—is now confidently regarded as being well founded on experience. When we reflect that copious milking is to all intents and purposes a well-developed natural function, we must not forget that the natural function or property exists as a basis in all breeds of cattle, and that in some breeds it has remained undeveloped whilst in others, as in the Shorthorns, it was once well developed, and afterwards to a great extent allowed to relapse into a mere animal characteristic, or less even than that.

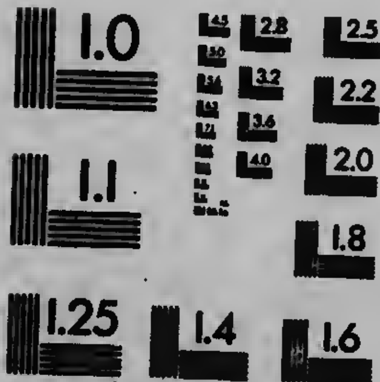
Mr. C. R. W. Adeane, of Babraham, one of the chief practical exponents of this return to first principles in regard to breeding Shorthorns for milk as well as beef, is not in doubt on the subject, though he is aware of the "scarcity of pure-bred Shorthorns which still retain the milking properties." "There are, however," he says, "many herds now in existence where such animals can be found true to type, and containing the beef and milk properties so much desired. It is not impossible in one and the same animal to get the perfect butcher's beast and the perfect dairy cow. This is the ideal which we aim at, but shall not attain. But we certainly can produce a Shorthorn which is capable of carrying a great amount of meat and milk also."

No one is accounted worthier of credence than Mr. Richard Stratton, who writes: "I have no hesitation in asserting that deep-milking and quick-feeding properties can be combined in many herds of pure-bred Shorthorns at the present time. Furthermore, I would say that I think good milking properties are essential for all practical purposes in this country. I have always found the best milkers the most regular breeders, and that when dry they will lay on flesh as rapidly as those of inferior milking propensities. . . . The dual purpose cow is the one for this country. Milk pays better than beef. A gallon of milk is worth more than 1 lb. of beef, and a good milking cow will produce from three to four gallons of milk on the same food that would go to produce 1 lb. of beef. I think the prizes offered by the Shorthorn Society and by the Shorthorn Dairy Association are doing good, and will greatly develop in the near future."

Shorthorns in North Scotland.—In the North of Scotland beef production held the premier place. The

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



APPLIED IMAGE Inc

1653 East Main Street
Rochester, New York 14609 USA
(716) 482 – 0300 – Phone
(716) 288 – 5989 – Fax

breed had been introduced to Scotland towards the close of the eighteenth century by Mr. Robertson of Ladykirk and General Simson of Pitcorthie, both of whom purchased from the Collings. The beef qualities were attended to with the utmost care, because beef is the chief agricultural product of that part of the country. For many years these breeders had as their customers the farmers who fed cattle for the London and other large markets, and it was essential that the bulls bought by them should be eminently suited for this purpose. It was found in the United States and Canada that the Shorthorns were becoming less wealthy in flesh, and a large number of Scotch-bred bulls were imported. Several English breeders (notably Mr. J. Deane Willis and the late Philo L. Mills) resorted to the same source for a fresh strain. In the Royal herd at Windsor the blood was also successfully introduced. A widespread demand sprang up for these bulls, and the prices rose rapidly. Mr. Duthie, Collynie, in 1900, had an average of £150 8s. 6d. for his bull calves, and £157 11s. 11d. in 1901; while Mr. Marr, Uppermill, had an average of £126 3s. 2d. in 1900, and £119 17s. 3d. in 1901, the highest price having been 650 guineas in 1901 for one of the Collynie bulls. In 1910 the average for Mr. Duthie's bull calves was £378, and the highest price 1,050 guineas. In the same year bull calves belonging to Captain A. T. Gordon and Mr. John Wilson sold at 1,300 guineas and 1,000 guineas. High prices have also been made at sales in England.

The Demand from South America.—Another influence that has made itself greatly felt since about the year 1905 has been the demand from South America. The estancieros of the Argentine Republic decided to improve their cattle, and for that purpose they imported largely. In 1882 the exports to South America numbered only 29; in 1884 they had risen to 142; in 1888 to 661; while in 1897 the number was 686, and in 1900 479. The total number sent to South America from 1882 to 1900 was 6,076. During the same period Canada took 831, the largest number in any year being 490 in 1900. The United States took 403, Germany 334, and France 192. Altogether there were exported from 1882 to 1900 as many as 8,278 Shorthorns. These interesting figures were communicated by the Secretary of the Shorthorn Society to Mr. R. H. Rew, and are given in a paper by him in the *Transactions* of the Highland Society for 1901. Unfortunately, in 1901 there was no export trade to the Argentine, and this caused heavy loss to breeders. In the meantime the Shorthorns bred in the Argentine have been selling at high prices. Imports from this country were resumed, and in 1906 the number sent to South America was 2,357. In the United States Shorthorns again made excellent prices. The imported heifer Cicely, bred by Queen Victoria at Windsor, was sold at Chicago in November, 1901, for 1,000 guineas, and a bull named Lord Banff, imported from Scotland, also realised 1,000 guineas. Later in the same year a heifer bred by Mr. W. S. Marr, Uppermill, was sold at Chicago for 1,200 guineas.

The Future.—There is every reason to hope that the future of this grand race of cattle will be bright, and that the Shorthorn will continue to exert a highly beneficial influence, as it has already done, both at home and abroad. While welcoming foreign buyers, breeders should give the first consideration to the demand at home, and to its special requirements, which are not always identical with those of agriculturists who are farming vast tracts of land in countries that are being newly opened up.

Lincolnshire Red Shorthorn Cattle.—The county of Lincoln has long possessed a variety of short-horned cattle noted for excellent grazing and dairying properties. Gervase Markham, in his book "A Way to get Wealth," published in 1695, stated that in colour the cattle in Lincolnshire were, for the most part, "pied," with more white than the other colours (black or red). "Their horns," he said, "were little, and crooked; of bodies exceeding tall, long and large, lean and thin thighed, strong hoved, not apt to sorbate, and indeed fittest to labour and draught."

In the "Compleat Body of Husbandry," published in 1756, it is mentioned that "the oxen of Lincolnshire are in general red and white; they are very bulky, and equal to any in value." George Culley, in his work on "Cattle," dated 1794, describes the Lincoln stock under the heading, "The Short-horned or Dutch breed," this country, he remarked, being the farthest south in which that kind of cattle were met with in any numbers. He adds, in a footnote, that "in a journey through Lincolnshire in 1784 he was happy to find that many sensible breeders had improved their breed of short-horned cattle very much (since his visit to the county ten years previously) by good bulls and heifers brought from the counties of Durham and York, on both sides of the Tees, where the best were confessedly bred." In another excursion, in 1789, he met with a Mr. Tindale, of Ewerby, near Sleaford, who "has the best breed of cattle that I ever saw in that county, and perhaps inferior to few in any part of the kingdom. I was shown an ox (near Lincoln) of his breed that for true form and nice handling exceeded any bullock I ever remember to have seen."

At the outset colour was not specially studied, and no attempt seems then to have been made to lay down an arbitrary rule on the subject. Red has always been more or less popular, however, and in several of the herds it predominated. The reds, according to tradition, originated with Mr. Turnell of Reasby, who started what is spoken of as the "Turnell Reds," a name by which the best specimens of the Lincolnshire breed were long known. Arthur Young mentions that he heard that Mr. Thomas Turnell of Reasby, near Wragby, had a breed of cattle "which are not surpassed by any in the county for points highly valuable, or their disposition at any time to fatten rapidly."

In 1850, when Mr. J. Algernon Clarke wrote his essay on the Agriculture of Lincolnshire, for the *Journal* of the Royal Agricultural Society, he said: "The only sort of cattle bred in Lincolnshire are Shorthorns, and the usual appellation of 'Lincolnshire Shorthorns' is truly applicable

Lincolnshire Red Shorthorn Cow, Benniworth Bloom

to the majority of the animals, inasmuch as they partake largely of the old Lincoln breed, possessing the quality of the Durham Shorthorns and retaining the size and majestic proportions, without the clumsiness, of the 'old Lincolnshire ox.' It is owing to this combination that the proportion of lean flesh, compared with fat, is greater in this breed than probably in any other, whilst the weight to which individual oxen have attained has, perhaps, never been exceeded." Writing in the same journal in 1888, Mr. F. J. Cooke, in his report on the farm prize competition for the counties of Lincoln and Nottingham, says: "The prevailing breed of cattle is the Shorthorn, although the term is, perhaps, a little too general to describe them with accuracy and justice. There is no doubt that many of them still retain, in some degree, the distinctive points of the 'old Lincolnshire ox.' The constant use of pure-bred bulls—[by "pure-bred" Mr. Cooke evidently meant the registered Durham-Yorkshire Shorthorns]—upon cows with some of this blood about them has at last developed the celebrated modern animal, which has for so many years been shown in great perfection at the large fairs of the country, whence they have been eagerly bought and widely distributed. The best cattle of to-day are of the rich red colour, which has been prized and preserved for so many generations. They are both deep and wide in frame, have for the most part down-pitched horns, and develop into great size and weight, if allowed time to do so. But perhaps they are most of all remarkable for the fleshiness of carcase which the butcher is sure to find with them, a matter of increasing importance in catering for modern tastes."

A register for these cattle was started in 1895 by the Lincolnshire Red Shorthorn Association, and in 1901 classes were first given for them at the show of the Royal Agricultural Society of England, the prizes being provided by the Lincolnshire Red Shorthorn Association. Cows of the breed have frequently won prizes at the Dairy Show of the British Dairy Farmers' Association, and in the classes for dairy cattle at the meetings of the Royal Agricultural Society.

Herefords.—The county of Hereford has always been noted for the excellence of its cattle, and the celebrated breed, so highly esteemed throughout the world for its unsurpassed grazing properties, doubtless owes much to the superior soil and climate of the district in which it originated and has been developed. John Speed, the historian, writing in 1627, remarks that "the climate of Herefordshire is most healthful, and the soil so fertile, for corn and cattle, that no place in England yieldeth more, or better conditioned"; while a hundred and sixty years later another agricultural annalist declared that "the Herefordshire breed of cattle, taking it all in all, may without risk, I believe, be deemed the first breed of cattle in this island." Thus wrote William Marshall, in his "Rural Economy of Gloucestershire," dated 1788–89, and many other testimonies to the same effect could be quoted from contemporary writers.

The very distinctive colour markings—red body, with white face—and the large size of the animals have given rise to a good deal of speculation, in view of the general opinion that the breed is descended from the aboriginal stock of the southern portion of England, which are all red and of smaller dimensions. It would occupy too much space to enter into a detailed examination of the subject, and it will be sufficient to summarise the conclusions arrived at by the historians of the breed.* They state that a review of all the known circumstances connected with the origin and early development of Hereford cattle seems to establish the fact that it was founded on a variety of the aboriginal cattle of the country, of the type from which the Devon and Sussex breeds have been derived, and that the original colour was probably a whole red. At an early period the Welsh white cattle with red ears, which were not

* "History of Hereford Cattle," by James Macdonald and James Sinclair. Vinton & Co., Ltd., London, 1886.

only different in colour but larger in size than the county variety, and probably of foreign extraction, were introduced, and mixed with the stock of Herefordshire, imparting a tendency to white markings, and enlarging the frames of the native breed. Lord Scudamore also imported red cattle with white faces from Flanders during the seventeenth century, and these, it may be reasonably assumed, further accentuated the white face, but did not render it universal, because late in the eighteenth century and early in the nineteenth there were Hereford cattle of dark red or brown colour, with scarcely any white, as well as red cattle with mottled faces. The cross with the large Flanders cattle may also have increased the bulk of the county breed. At the same time, it should be added, Marshall (1788) stated that "the colour was a middle red with a bald face, the last being esteemed characteristic of the true Herefordshire breed." The general idea that prevailed among farmers throughout the country prior to the time of Bakewell was that the best way to improve live stock was to resort to crossing; and probably, when the improvement of Herefords was commenced, about 1750, a few animals may have been brought from other counties and mixed with the breed; but it is not unlikely that these external strains had comparatively little influence in moulding the character of the breed, the great merits of which are due to its own properties, to a singularly fine climate and soil, and to the skill of a race of able improvers, who have especially distinguished themselves by the practical system of management which they have always pursued.

It is evident from records that have been preserved tracing back to the early years of the eighteenth century that the breed had attained a high reputation for the production of superior plough oxen, the operations of husbandry having then to be performed chiefly by cattle, which were used rather than horses for draught.

Distinguished Breeders of Herefords.—In his will, which was proved in 1723, Mr. Richard Tomkins left to his son Richard "one yoke of oxen called Spark and Merchant," and to his son Benjamin "one cow called Silver and her calf." This Benjamin Tomkins (who was born in 1714, and died in 1789) was, along with William Galliers of Wigmore Grange, Tully of Huntington, Skyrme of Stretton, and Haywood of Clifton-on-Teme, among the earliest prominent breeders, they having all acquired much celebrity for their cattle. The first to attract attention to the breed outside its own district was, however, Benjamin Tomkins (born 1745, died 1815), who was a son of the Benjamin Tomkins just referred to. He began business as a farmer, in early life, at Blackhall, King's Pyon, and on his father's death took also the Wellington Court Farm, to which he removed from Blackhall in 1798, remaining at Wellington Court until about three years before his death, which took place at Brook House, King's Pyon, in 1815, so that his life's work as a breeder extended over a period of forty-nine years. He so greatly overshadowed all his contemporaries and predecessors that it was the custom at one time to speak of him as "the founder of the breed"—a claim, however, which cannot be conceded in its entirety; but he certainly did much to improve it and enhance its reputation.

It is understood that the younger Tomkins commenced to breed Herefords about 1766, and Professor Low states that his herd originated with two cows purchased by him at Kington Fair; others, however, assert that these cows were acquired from a wheelwright in the village after they had been specially noticed by Mr. Tomkins on account of their singular aptitude to fatten. One was a grey, and the other was dark red with a spotted face, the former being called Pigeon and the latter Mottle. It is considered to be more probable, however, that Low's references apply to the proceedings of the father rather than to those of the son. A noted cow named Silver was also the foundress of a choice strain in the herd. Tomkins had a brother, George, who was an excellent judge, and frequented the fairs of the country, and from him Benjamin selected many of his best cattle. Mr. Eyton, founder of the "Hereford Herd Book," says: "During the latter portion of Mr. Tomkins' life he used none but bulls bred by himself, and did not cross with any other stocks, which system many of the breeders into whose hands his stock have fallen have since carried on. So justly confident does Mr. Tomkins appear to have been in the superiority of his stock that he once drove twenty of his cows to Hereford, on the day of the Agricultural Show, and offered 100 guineas to anyone who would show an equal number superior to them; but the offer was not accepted.

In the later period of his career Tomkins relied exclusively upon his own stock, and he did not scruple to breed from closely related animals. In fact, it would appear that he adopted, to some extent, the principles of breeding which were at the same time being carried out by Bakewell, and thus he rendered his cattle capable of producing a great effect upon other herds into which they were introduced, —the loose system of breeding being changed by him in favour of concentration. His herd was sold in 1819, four years after his death, when high prices were realised, the average for twenty-eight breeding animals being £149; cows made up to £262, and bulls up to £588, this latter price being paid by Lord Talbot for the mottled-face bull Phœnix 55.

The greatest supporter of Benjamin Tomkins was Mr. John Price, of Ryall, near Upton-on-Severn, Worcestershire (born 1776), who purchased many of his best animals, and bred on much the same lines, while by his energy and enterprise he spread the fame of the breed throughout the country. He held a number of successful sales, at which upwards of £20,000 was realised.

Mr. Thomas Andrew Knight, of Downton (born 1759), bred a very fine strain of grey Herefords, his original stock having been purchased from Mr. Tully, Mr. George Tomkins, and Mr. Skyrme.

From the foregoing notes it will be seen that in the earlier days of the breed's history no attempt was made to procure uniformity of colour. Some of the herds were red with white faces; others had mottled faces, and a few were grey in colour. Gradually, however, the toleration of varied colours came to an end. Many of the breeders outside the county who had purchased specimens of the Tomkins blood, through Mr. John Price, maintained that the correct colour was red with mottled face, and it was asserted that Mr. Benjamin Tomkins had given his *imprimatur* to these markings. It is clear, however, that neither Mr. Tomkins nor Mr. Price attached much importance to colour, as they had both the white face and the mottled face varieties in their herds. The breeders in the native county of the Hereford gave their preference to the white face, and as the mottled face type had become smaller in size, while animals of large scale were in chief request, the result was that ultimately the mottled face disappeared, and the universal colour became red with white face. Among the breeders who exerted themselves to obtain the predominance of the red with white face may be mentioned the Hewers, the Yarworths, the Yeomans, and the Jeffries.

Mr. William Hewer, Great Hardwick, Abergavenny (born 1757, died 1825), was a distinguished breeder of the red-with-white-face variety, working very successfully with the strains of Tomkins and Tully, his aim being to secure uniformity of colour combined with massive size and fine quality. His bull Wellington weighed 1 ton 6 cwt. (2,912 lb.); a steer of his breeding weighed 1 ton 6 cwt. (2,912 lb.), and a bull, Hamlet, 1 ton 5 cwt. (2,800 lb.). William Hewer was succeeded by Mr. John Hewer, to whom it was left to finish what his ancestors began, viz. "to produce a race of cattle which were beautiful to look at, and good rent-paying animals, of great scale and splendid quality." Some of his cattle developed great size; his bull General, when six years old, weighed 32½ cwt. (3,640 lb.).

As many as thirty-five bulls belonging to Mr. Hewer

Hereford Cow, Noble Frolic

Photograph by G. H. Parsons, Alsager

s
I
t
I
c
r
L
r

le

were out in service at one time. His famous bull Sovereign 404, calved in 1820, besides being used by his father (Mr. W. Hewer), and in his own herd, was let to many prominent breeders of his day, including Sir Hungerford Hoskyns, Bart., whose fine old herd is well represented in that of Mr. John Hungerford Arkwright, of Hampton Court, Leominster, the breeder of many prize winners. Lord Sherborne, the Hon. H. Morton, and Messrs. Jeffries of The Grove and Cotmore, R. Yeomans and J. Turner were also among the breeders who used Sovereign, whose various lettings realised the aggregate of £640 18s. When the first show of the Royal Agricultural Society of England was held at Oxford in 1839, the leading winner in the bull classes was Mr. T. Jeffries' Cotmore 376, got by Sovereign, and the first prize cow Spot, bred by Mr. John Turner, of The Noke, was by a son of Sovereign. Cotmore's live weight was 35 cwt. (3,920 lb.).

Two of the most successful bulls of their day were Sir David 349, first-prize winner in 1849, and Walford 871, first in 1851. In more recent times a decided impress was made on the breed by two other prepotent and valuable sires. One of these was Horace 3877, calved in 1867, bred by Mr. J. Davies, Preston Court, the sire and dam being by Shamrock 2nd 2210. Mr. John Price, Court House, discovered the merits of this bull, and selected him for use in his herd, in spite of his rather dark colour, in order to impart greater wealth and quality of flesh. The other sire was Lord Wilton 4740, calved in 1874, and bred by the late Mr. William Tudge, Adforton. This bull was full of the blood of Sir Thomas 2228, Sir Benjamin 1387, and Sir David 349, tracing back to the best Hewer strains. The chief characteristics of Lord Wilton's stock were their marked uniformity of colour and shape; though not so large as some others, their style and refinement were remarkable.

Characteristics of Herefords.—Herefords are noble-looking cattle, having a free and easy gait. Their characteristics are stated by Mr. Thomas Duckham in the following terms: "The face, throat, chest, lower part of the body and legs, together with the crest or mane and tip of the tail, a beautifully clear white; a small red spot on the eye, and a round red spot in the middle of the white on the throat are distinctive marks that have many admirers. The countenance is at once pleasant, cheerful, and open, denoting good temper and that quietude of disposition which are so essential to the successful grazing of all ruminating animals; yet the eye is full and lively; the head small in comparison to the substance of the body; the chest deep and full, the bosom sufficiently prominent, the shoulder-blades thin, flat and sloping towards the chine, well covered on the outside with mellow flesh, and so beautifully do the blades bend into the body, that it is difficult to tell, in a well-fed animal, where they are set on; the chine and loin broad; hips long and moderately broad, legs straight and small, the rump forming a straight line with the back; thighs full of flesh to the hocks; a well-sprung rib and deep flank; the whole carcase well and evenly covered with rich, mellow flesh; the hide thick yet mellow, well covered with soft glossy hair, having a tendency to curl." Mr. John Hill, in his description, attaches great importance to quality, and to beauty of form and symmetry.

The beef of this race of cattle is held in high estimation on account of the pleasant admixture of fat and lean, and its excellent flavour, and male and female alike are said to be second to no other breed in rapid fattening on a given quantity of food. They have the special merit of becoming fat on a grass ration, and in the summer season especially they take a foremost place in the greatest markets, on account of the value of their grass-fed beef.

Hereford cows, as a rule, are not very good milkers. Having in the past been only required to rear their own offspring, as the custom of their native district is, they have in this respect been left almost wholly in a state of nature. Hence in a large number of cases their milking properties have been left to take care of themselves, aptitude to fatten having been cultivated instead. When the requirements of the offspring are the sole medium by which the parent's milk is regulated, it follows that no great quantity of milk will be given, and the period of its flow will be of limited duration; this is what nature dictates. And deep-milking characteristics are the result of treatment tending that way, of breeding for that object, and of domestication generally. This treatment has not usually been applied to the Herefords in time gone by. But in some parts they are now being bred with a view to the dairy, and their milking properties are being specially developed; their calves are not allowed to suck from them, and they are being hand-milked instead. They are already, under training in this direction, gaining favour as dairy cows, and are proving themselves to be well qualified for the production of cheese and butter, for their milk, though not very abundant in quantity, is rich in quality. The natural system of management, and the long time spent in the open air, have tended to the preservation of exceptional robustness of constitution, for which the breed is noted. The chief change in the pedigree breeding herds is a recognition of the fact that the good milking dam usually produces the best calf, and, without neglecting the beef-making qualities, more attention to milking properties is found to be an advantage.

The Hereford Herd Book was established by Mr. Eyton in 1846, and was carried on by Mr. Thomas Duckham from 1857 to 1878. Since 1878 it has been published by the Hereford Herd Book Society.

Herefords in the States and the Colonies.—In the United States, in Canada, in New Zealand and in Australia the Herefords are great favourites, and many have been also exported to South America. They are found to acclimatise readily and adapt themselves to new conditions, retaining all the while their character, form and quality. These facts go far to prove the antiquity of the type, for recently acquired qualities do not stand the test of other countries and climates. Of course, it is always well to introduce a dash of blood from the fountain-head to keep up the type, and this breeders in distant lands recognise. The Herefords are a noble race of cattle, handsome and picturesque, docile and profitable.

The increased demand from the United States and Canada led to a great advance in value, and in 1884, at the Stocktonbury sale (Mr. T. J. Carwardine's), the average for 183 head was £125. The purchase price of a number of the lots, however, was not completed, but upon being offered again these, except the bull Lord Wilton, made about the same prices. This famous animal, which had been knocked down for exportation at the first sale for 3,800 guineas, fetched 1,000 guineas on the second occasion. The American demand subsequently slackened and prices fell, but there was a revival of trade in the United States in 1900, when bulls sold there made up to £1,500 and £1,200, and cows up to £600. In 1901 a cow was sold at £1,010 in the States, and high prices were paid for several successful bulls in this country to go to America, while one lot of 228 Herefords was selected for exportation to the late Mr. Kirk B. Armour, Kansas.

As, indeed, is the case with most breeds of cattle, the Herefords are "looking up." A revival of interest in the popular "white faces" is not, however, to the special credit of the breed, because the revival is simply a valuable piece of evidence to the effect that farming generally is more encouraging than it has been for more than twenty years. That is to say, the symptoms which generally precede a revival seem to be more persistent than for a long time past. This revival is most clearly seen, as a rule, in the auction ring, where prices recently obtained appear to have given promise of a tide fairly turned, and of better times to come. Values that were current in the 'eighties of last century may not perhaps be seen again for some years to come; but as to that, none can tell.

Among the more important dispersion sales in 1909 may be mentioned that of Mr. W. T. Barnaby of Saltmarshe Castle, where the average for 68 cows with calves was £59 10s.; for 31 two-year-old heifers, £37 16s.; and for 19 yearling heifers, £25 8s. The average for 178 animals was over £33. Another was that of Mr. Richard Bright's herd at Ivingtonbury, where 81 cows with 76 calves averaged £44 7s. 6d.; 25 two-year-old heifers, £38 9s. 10d.; and 27 yearlings, £25 19s. 5d.

In 1910 the number of Herefords exported to South America, South Africa and Australia collectively was more than double that of the previous year, notwithstanding the fact that the United States of America have not at present resumed the formerly liberal importations of the breed. But the longer Americans of the northern half of the vast Continent of the west refrain from freely purchasing, the higher prices they will have to pay, and the worse will it be for breed already domiciled there, so far as the infusion of fresh blood from the fountain-head is concerned. Presently, therefore, we may expect an increased demand from that quarter of the globe. The Argentine, which promises ere long to possess the largest Hereford population, took more than twice the number that was exported to all countries the year before.

A remarkable incident occurred in July, 1910, at Palermo in the Argentine. Five steers, winners of the first prize in their class, and of the cup given by the Argentine Frigorifico, excited keen competition in the sale ring. An opening bid of 7,500 dollars each was electrical, for it was followed like an echo by a still higher bid. Then followed a sharp contest between the representatives of two great companies—the La Palmas Frigorifico and the La Plata Company—the latter securing the bunch at the fabulous price of 11,500 dollars* for each animal. The price of £5,020 for five steers—animals deprived of fecundity—is not unlikely to remain unmatched for some time to come.

* A paper dollar = 1s. 9$\frac{1}{10}$d.

CHAPTER VII

BREEDS OF CATTLE (*continued*)

DEVONS—SOUTH DEVONS—SUSSEX—RED POLLED—LONG-HORN WELSH

Devons.—The northern part of the county of Devon has long possessed a breed of cattle whose compactness and general beauty, activity as workers, and aptitude to fatten have made the county and cattle alike famous. In some of the lower-lying parts of the county, as well as in portions of Somersetshire and Dorsetshire, the same race of cattle prevails, possessing similar general characteristics of form and colour to those of the northern districts, but somewhat larger and coarser. The difference is chiefly caused by the variations of soil and climate. In North Devon there is much poor land, which is bleak, wet and exposed, and it is here that the North Devons have acquired their compactness hardiness, and activity. In the southern and western counties of England, when it was common to use steers for draught purposes, both on the road and in the fields, the North Devons were said to be unequalled by any other breed for this purpose.

If it is true that "self-colour"—that is, the same colour throughout—is a proof of the antiquity of the race, then the Devons may fairly be regarded as one of our aboriginal breeds of cattle. Red is the true Devon colour, though the red varies from a rich dark red to an almost pale chestnut; still the colour prevails all over the animal and no other colour is found among it in patches, as is the case with most of the Northern breeds of cattle—to wit, the Shorthorns, the Longhorns, and the Ayrshires. Domestication has not caused much, if any, deviation from the true original colour. At the famous Smithfield Club show the singular neatness, compactness and symmetry of the Devons always command the admiration of the visitors. They have, too, a thoroughbred look which is very attractive, as is also their gentle and placid appearance; and while their hardiness enables them to stand a cold climate and to thrive on a herbage where the larger breeds would starve, they always do remarkably well when removed to a warmer climate and a richer soil. The North Devons may be regarded as the true Devons.

Early descriptions of Devons.—The earliest written references to the breed describe the Devon cattle very much as they are to-day, so that it is not necessary in their case to search for explanations as to how noticeable changes have been brought about. They have been improved by systematic breeding, and those bred in districts possessing richer soil have increased in size, but the type remains the same. A history of the breed published in 1893,* and recently republished with ample revisions, collects all the known historical allusions to the Devon cattle, and from these it is evident that during the latter half of the eighteenth century the main features of the race were similar to those by which they are now distinguished. Thus, in Arthur Young's "Annals of Agriculture" there is a letter by Mr. Paul Treby Treby, of Plympton, Devonshire, dated October, 1791, in which he says: "The best breed is in the vicinity of Barnstaple, North Molton and South Molton, where rearing of cattle ever has been the chief return to the farmer; consequently it has been their aim to get as perfect a breed as possible, on which they are still anxious to improve. The best bullocks are of a bright red colour; round a very prominent eye a ring of bright yellow; the nose round the nostril the same colour; the neck and head small, with an upright taper, gently curved, clear horn (not tipped with black); their bones

* "History of the Devon Breed of Cattle," edited by James Sinclair. Published by Vinton & Co., Ltd., London.

well proportioned and carrying their weight in the best cuts. I have mentioned what certainly is their chief merit last; but though the graziers may be of the same opinion, they appear not the less solicitous concerning their other peculiarities, looking on them as certain signs of good proof." The writer contrasted the uniformity of type (subject to some variations in colour) found at the North and South Molton and Barnstaple fairs, with the motley collections of animals in the fairs and markets on the South Hams side of the county.

The Quartly Improvements.—The uniformity of the North Devon breed and the merit of the best specimens from early times are thus clearly established. In the work of improvement a leading place was taken at the outset by the Quartly family.[1] They originally resided at Exton, a small village and parish in Somersetshire, situated near the main road from Dunster to Dulverton. In 1704, James Quartly purchased the estate of Great Champson, in Molland, North Devon, which has since been occupied by members of the Quartly family. He was succeeded by his son Henry Quartly, who died in 1725, and the inventory and valuation for probate of his effects show that he possessed a herd of cattle. A son named James succeeded him, and it appears that in 1776 this James Quartly founded the Devon herd at Champson, and that he was a careful breeder of cattle. When Arthur Young visited Devonshire in 1796 to gather information about the Devons, he called at Champson, and there found Francis Quartly (who was the great improver of the breed, son of James Quartly just mentioned), together with his brother the Rev. William Quartly. Young mentions that two years previously (in 1794) "the Devons had attracted notice enough to become fashionable, which gave some spirit to the breeders; but till then they had gone on from father to son without being sensible that they possessed anything superior to other breeds, and without attention to breeding with care and selection." "The case," he added, "was changed at present, for much

South Devon Cow, Countess

higher prices than ever known before having been given, a new spirit is kindled, emulation is awakened, and improvements will doubtless be the consequence."

A minute account is then given by Arthur Young of the operations of Francis Quartly and his brother in the improvement of the breed. He observed that the points they had aimed at in breeding had chiefly been to gain as great a width as possible between the hips; to have the hip-bones round, not pointed; that the space from the catch to the hips should be as long as possible; the catch itself full but not square; that the tail should fall plumb, without a projection of catch and rump; to have the tail not set on high, not to rise, but be snug and the line to be straight with the backbone—no pillow just before the cross-line from pin to pin; thick through the heart under the chine; that the shoulder-point be not seen, no projection of bone, but to bevel off to the neck, all elbowing being very bad; all the bones to be as small as possible, the rib-bones round, not flat; the leg as small as possible under the knee; not an atom of the side to have any flatness. In respect to size, if other points be the same, he preferred a small cow rather than a large one for breeding a bull, because it was very rare to see any very large one handsome; but to breed oxen he liked a large cow. He desired to have them sharp and thin from the throat to the nose; in the throat, the cleanest had small variations from the perfect make; though fat there it should not bag. To be thin under the eyes and tapering to the nose, which should be white. Between the eyes to be rather wide; the eyes themselves to be very prominent, like those of a blood-horse, and no change of colour round them. The horns to be white with yellow tips, thin at the root and long, spreading at the points. The breast or bosom should project as much as possible before the shoulder and legs, and the wider between the legs the better. To have the line of the neck from the horns to the withers straight with that of the backbone. The belly to be light and rather tucked up; if fat before the udder it is a sign of a good milker. "Such," added Young, "are the points which these gentlemen describe as desirable to breed from in this race of cattle, which they consider the best in England. A pair of these oxen will plough an acre of stiff land per diem, and the smaller the bone they are universally the best movers. Of their fattening qualities, they observe the Somersetshire graziers are the best judges, who are known to prefer them. As milkers they are represented as possessing much merit. They have now two cows that give each seventeen pints at a meal, and will make in general 10½ lb. of butter per week in the flow of the season."

It is clear from these remarks that even so early as 1796 the Quartlys had very sensible ideas as to the correct form of animals for the production of beef and milk. In 1850, Sir Thomas Dyke Acland, in his report on the farming of West Somersetshire, in the *Journal* of the Royal Agricultural Society of England, bore testimony to the successful results of Mr. Francis Quartly's work as a breeder and improver. Sir Thomas wrote as follows: "It is remarkable how entirely the reputation, and it may be said the present existence, of the Devon breed is wholly owing to tenant farmers, and above all to one man, Mr. Francis Quartly of Molland. The account which he gave in answer to my inquiries was to the following effect. More than fifty years ago the principal North Devon yeomen were all breeders, and every week you might see in the Molton markets animals that would now be called choice; there were no cattle shows in those days, and therefore the relative value of animals was not easily tested. The war prices tempted many farmers to sell their best bulls and cows out of the district. Mr. Quartly in his youth perceived that good animals were becoming scarce, and the breed generally going back. He, therefore, determined to buy quietly all the good stock he could meet with. He often picked up a cow from a farmer who wanted to get rid of her because she would get so fat she would give no milk. After buying all the best animals he could find, he continued for many years, with that skill and judgment which great breeders can alone appreciate, to improve his stock till he got it to perfection. About 1831 cattle shows began at Exeter. Some good Devon breeders carried off the early prizes, but a year or two afterwards Mr. Quartly allowed his nephews (Henry and James Quartly) to enter in all the eleven classes at Exeter, and they brought home the eleven prizes."

Among the finest specimens bred by Mr. Francis Quartly were the bull Prize 108 and the cow Longhorned Curly. The former was sold in 1823 to Mr. William Childe, Kinlet Hall, Shropshire. Longhorned Curly was calved about 1815, her dam and granddam having been bred by Mr. F. Quartly. The only registered produce of this cow were Flower 187, calved in 1820, sire Prize 108, and Curly 92, calved in 1830, sire Forester 46. Mr. Francis Quartly asserted that he considered Longhorned Curly and her daughter Curly 92 to be the best cows he ever bred. The first Champson herd was sold in 1836. Another brother of Francis Quartly, named Henry Quartly, resided at West Molland, and bred some excellent cattle, among them being the bull Forester 46 and the cow Lilly, by a son of Longhorned Curly and Forester. Flower 189 was also bred by him, and she became the ancestress of the celebrated Actress and Temptress tribes. Another generation of the Quartly family were very successful at the leading shows. Messrs. Davy, Flitton Barton; George Turner, Barton; and Merson, Brinsworthy, were among many other prominent breeders and improvers; while numerous prizes were won at shows with Quartly cattle by the late Viscount Falmouth, Mrs. Langdon, Sir William Williams, Mr. J. C. Williams, etc.

The North Devon has been blended successfully with the larger variety of the breed developed in Somersetshire, Dorsetshire and Cornwall, giving quality and style. The size of the Devons has been considerably increased in Somersetshire, and the steers fed in first-class herds are of great merit, both for weight and quality of beef.

The Points of Devons.—The standard of excellence drawn up by the Devon Cattle Breeders' Society places registered pedigree at the top of the list of requisites; and for perfect personal merit prescribes for the cow a head of moderate length with a broad indented forehead, tapering considerably towards the nostrils, which should be high and open; the nose creamy white; jaws and throat clean; eyes bright, lively and prominent, and the expression gentle and intelligent; ears thin; horns long, well matched and spreading, gracefully turned up, of a waxy colour, tipped with a darker shade. The neck should be of medium length, growing from the head to the shoulders and spreading out to meet them; the withers fine; shoulders flat, sloping and well covered; ribs well sprung from the backbone, nicely arched, deep and fully developed; back straight and level from the withers to the tail; loin broad and full; hips of medium width and level with the back; rump level and moderately long; hind-quarters deep, thick and square. The tail should be thick at the root and tapering, with a brush of strong hair reaching to the hocks and hanging at right angles with the back; the udder not fleshy, coming well forward in line with the under part of the body and well up behind; teats moderately large and squarely placed. The underline should as nearly as possible be parallel with the top; the legs straight, squarely placed when viewed from behind, and not to cross or sweep when walking. The skin should be moderately thick, and should be mellow; the hair rich, mossy and of a red colour; white about the udder is admissible, but not to extend forward beyond the navel, nor be found on the outside of the flanks, nor on any other part of the limbs or the body.

The points of the bull are identical with those used in the standard of female excellence, with a few necessary exceptions on account of characteristics peculiar to the sexes. Thus the bull's head is described as masculine, with broad forehead, tapering to the nose, which should be flesh-coloured; the nostrils, like the cow's, should be high and open; muzzle broad; eyes full and placid; ears of medium size and thickness, fringed with hair; horns growing at right angles from the head or slightly elevated, stout and waxy at the base, tipped with a darker shade. The cheek full and broad at the root of the tongue; the throat clean. And a description of the neck is the same as in the standard for cows, with the sole difference that the bull's should also be muscular. The bull's chest must be deep, broad, and somewhat circular; the rumps like those of the cow, and "full" is added. Then the arms and thighs of the bull should be muscular. The description of the colour is the same for the bull as for the cow, the distinction of sex making the only difference in the words.

Devons as Milk and Beef Producers.—Except in the dairy districts, where the cows' milking properties are very well developed, the breed is not celebrated for giving large quantities of milk, but the milk is rich in quality, and Devonshire cream is known far and wide. As beef-makers the Devons are not easily excelled by any breed whatever, and comparisons have been made which prove that on a given quantity and quality of food they will make more beef than almost any other breed, while the beef is of splendid quality, compact, sweet and juicy. A well-bred fat Devon presents a form as nearly faultless as anything we can hope to attain, and it may, in fact, be taken as a model in the breeding of bovine stock.

The Devons have long occupied the first position in the catalogues of the shows of the Smithfield Club, and they are always admired. The Royal Farm at Windsor (where a herd of the breed has been maintained for many years) usually contributes some choice animals. The average live weight of Devons at four of the recent shows of the Smithfield Club has been as follows: steers under two years old, 1,100 lb.; steers under three years old, 1,530 lb.; and heifers under three years old, 1,300 lb. Steers under two years old have given an average daily gain of 1·50 lb.;

steers under three years old, 1·39 lb.; and heifers under three years old, 1·18 lb. As has been stated, the milk of the Devon cows is of the very finest quality, and in the dairy herds the yields are large. There are instances of 17 lb. of butter from one cow in a week. Mr. J. G. Davis's cow Cherry gave 33 pints of milk in one day, from which 2 lb. 1 oz. of butter was made. Mr. Francis Risdon had a cow which gave 28 quarts of milk daily.

The "Devon Herd Book" was established in 1851 by the late Colonel J. Tanner Davy. It is now issued by the Devon Cattle Breeders' Society under the title of "Davy's Devon Herd Book."

Devons were exported to America in 1817 by the late Earl of Leicester, who had a fine herd in Norfolk. They have extended widely over the United States, and many have also gone from this country to Canada, Australia, South America, South Africa, Jamaica, France, and other countries.

South Devon Cattle.—The South Devon breed of cattle (which formerly went under the alternative names of "South Hams" or "South Hammers") apparently traces from the same original source as the Devon or North Devon breed just described. Its wide variation from the Devon breed is ascribed partly to climatic influences and other differences in the conditions of life, but also to the introduction of crosses. The red colour is, however, maintained, though it is of a lighter shade, and, as has been remarked, "through all the changes the modern breed has undergone, evidences of its origin in the root of the ancient red breed of the county may be very clearly traced." The breed (which largely prevails in that part of the southern division of Devonshire which lies along and extends seaward from the line of railway connecting Plymouth with the south-eastern coast of the county) is held in high esteem by its supporters, being both a deep-milking variety and furnishing an excellent carcase of beef.

In an article on "The Farming in Devon and Cornwall," which Mr. F. Punchard contributed to the *Journal* of the

Royal Agricultural Society of England, in 1890, he said: "The animals are a large-framed and useful race, with excellent milking qualities, and an aptitude, when arrived at maturity, for putting on flesh rapidly."

In the same *Journal*, in 1845, Mr. Tanner stated that it was a frequent practice to keep one Guernsey cow to every ten or twelve Devons to improve both the quality and the appearance of the milk produced. Probably these Guernseys cows would be served by a "South Ham" bull, and the progeny be retained for further breeding. Mr. Punchard says: "Then the succeeding generations would get so mixed up with the local breed that it could hardly be distinguished or severed from it. The establishment of a Herd Book would prevent future repetitions of this, though it might be at the expense of gradually losing the milking qualities, which the cross has undoubtedly added. For milk the present race cannot be surpassed—24 quarts daily is no unusual quantity for a South Hammer to give."

Shortly after Mr. Punchard wrote in 1890, the South Devon Herd Book Society was established, and several volumes of the "South Devon Herd Book" have been produced. Since then, too, the breed has been further improved and bred on more systematic lines. At Plymouth in 1890 the Royal Agricultural Society of England gave classes for South Devons, and the collection of the breed was much admired. The official report of the exhibition remarked that they presented little external resemblance to the "Rubies" of to-day, for "their colour was far more suggestive of the yellowish coats of the Guernseys. They possessed good milking properties, but they were larger, coarser, and less compact" than the North Devons.

At present the breed is not frequently seen in England outside its own districts, except at the shows of the Devon Agricultural Society, and sometimes at those of the Bath and West Society. Since the Herd Book Society was instituted, however, increased attention has been attracted to the breed, and an effort is being made to have it more widely exhibited at the larger shows. A considerable number of South Devons have been exported to Cape Colony and Natal, where they soon become acclimatised and answer remarkably well.

Sussex Cattle.—Leaving out the question of size, the resemblance between the Sussex and the Devon breeds is striking. They are of the same colour; and they are much the same in form, except that the Sussex is larger, coarser, and somewhat less proportionate, though in this last respect there has been considerable improvement in recent years. The resemblance, indeed, is so great that, taking into consideration the effect of locality and other circumstances, it is obvious that they have at some period been derived from the same original foundation. The earliest references to the Sussex breed represent it as having been of large size, of somewhat ungainly proportions, with great adaptability for the plough and possessing very fine quality of beef. As is still the case, these cattle were red in colour, but the shade was sometimes so dark as almost to approach a black hue, whereas now the cherry red is preferred. It is evident that the breed is a branch of the great race of red cattle which for a long period has prevailed throughout the South and West of England, and its special excellence was for ploughing the clays of the Weald of Sussex and Kent, comprising some of the heaviest tilled land in the kingdom.

As an early description of the breed we select an account by Arthur Young, who, in his "General View of the Agriculture of the County of Sussex," dated 1793, wrote: "The cattle of this county are universally allowed to be equal to any in the kingdom. The true cow has a deep red colour, the hair fine, and the skin mellow, thin, and soft; a fine horn, thin, clean, and transparent, which should run out horizontally, and afterwards turn up at the tips; the neck very thin and clean made; a small leg; a straight top and bottom with round and springing ribs; thick chine; loin, hips, and rump wide; the projection of the round bone is a defect, as the cattle subject to this are usually coarse;

Sussex Cow, Apsley Fairy

sh
is
to
ba
br
m
th
wh
un
ex
cia
sto
adv

bre
dev
cip
oth
fatt
dire

the
of I
was
bree
Engl
T
large
of ab
to q
to yi
also
big a
and
C
breed
as is

shoulder flat, but the projection of the point of the shoulders is not liked; the legs should be rather short; carcase not too large; the tail should be level with the rump; a ridged backbone, thin and hollow chines, are great defects in this breed. The cow gives usually from one to two gallons of milk at a meal, and from three to four pounds of butter in the summer twice a week; but butter and milk are no objects where the system of raising their young stock is so well understood and so much more profitable." Young also expressed the opinion that if Bakewell or any of his associates had adopted the Sussex in preference to "the inferior stock which enjoyed the reputation of his name," the advantage would have been great to the nation.

Traditions and records do not show that any of the breeders of Sussex cattle achieved special distinction by developing the merits of the race upon the improved principles followed by Bakewell. For a longer time than any other variety they were kept chiefly as plough teams, being fattened off after they had completed their labours in this direction, and they attained great weights.

A Herd Book was established in 1855, largely through the efforts of Mr. A. Heasman, of Angmering; Mr. C. Cane, of Berwick Court; and Mr. G. Coote, of Tortington. It was not until 1874 that prizes were regularly given for the breed at the shows of the Royal Agricultural Society of England.

The use of the ox for ploughing had by that time been largely abandoned, though not in all cases, and a number of able breeders had begun to improve the breed with regard to quality of flesh, early maturity, readiness to fatten and to yield a large proportion of lean with fat in the beef, and also with respect to shape and symmetry. The cows were big and thick-fleshed, and the bulls massive, their hardiness and robust constitutions being proverbial.

Characteristics and Points of the Sussex.—The breed is noted for early maturity and weight for age, as is indicated very conclusively by the records of the weights of animals exhibited at the shows of the Smithfield Club. The butchers and consumers alike testify in their favour. They are also very hardy, and do remarkably well on the poorest pastures of their native county. Their robust constitution is a special point in their favour, and the manner in which they have held their own in the districts of Sussex, Kent and Surrey, in which they are chiefly cultivated, says a great deal for them. They cross well with other breeds, the calves got by a Sussex sire from cows of other varieties retaining substance and firmness of flesh, and usually the colour is red. In recent years there has been progressive improvement in symmetry and quality, and the former unevenness that was occasionally apparent has been removed, Sussex cattle being now better proportioned in frame, with other evidences of more careful and systematic breeding.

Some of the older breeders were apprehensive that with this refinement the former characteristics of the Sussex cattle in respect of massiveness and hardiness might be lost, but this fear has proved to be unfounded. As regards the special breed points aimed at, we cannot improve upon the description which Mr. A. Heasman, the founder of the "Sussex Herd Book," contributed to the work on "The Cattle, Sheep and Pigs of Great Britain." In this he stated that the nose should be tolerably wide, the muzzle of a golden colour, thin between the nostril and the eye, the eye rather prominent, the forehead somewhat wide, the neck not too long, the sides straight and not coarse at the point of the shoulder. They should be wide and open in the breast, which should project forward; the girth somewhat deep, the legs not too long; the chine-bone straight, ribs broad; loin full of flesh and wide; hip-bone not too large, but well covered; rump flat and long. The tail should drop perpendicularly; thigh flat outside and full inside; the coat soft and silky, with a mellow touch.

The breed made a very favourable appearance in America in the hands of Mr. Overton Lea, Nashville, who exhibited at the fat stock shows in the United States some magnificent specimens which came out well when they were entered in the carcase competitions.

Taking an average of four years at the shows of the Smithfield Club, the live weights of Sussex steers under two years old have been 1,430 lb., steers under three years old 1,850 lb., and heifers under three years old 1,720 lb. The average daily gains have been for steers under two years old, 1·95 lb.; steers under three years old, 1·68 lb.; and heifers under three years old, 1·57 lb.

The Sussex Herd Book Society now publish the Herd Book of the breed.

Red Polled Cattle.—The valuable breed of dual-purpose cattle—i.e. superior for beef and milk—which has been developed in the counties of Norfolk and Suffolk, and which is now well known as the Red Polled, possesses an interesting history, which, however, in its earlier stages is not very clear. This district was the first in the United Kingdom in which advanced systems of agriculture were carried out. It was here that the turnip was first extensively cultivated as a field crop, the result being that with facilities for winter feeding of stock it was necessary to import cattle extensively from distant counties. A large area was devoted to the growth of wheat during the years when that crop paid well, and the four-course system of husbandry was widely adopted. The land was prepared for wheat by a turnip crop, and many cattle were required to eat the turnips and to provide the farmyard manure required to produce a bumper yield of wheat, which was the great aim of the farmer. Consequently, it was to Norfolk especially that cattle were driven, first from the Border country and the south of Scotland, then from the north of Scotland, and then from Ireland. Such large numbers of travelling animals were apt to carry disease with them if any prevailed in their own districts or along the route, and the Norfolk farmers had a frequent battle with the various pests that afflict cattle. This discouraged breeding for a number of years, but through it all the Red Polled breed was maintained, and in recent years, when the wheat crop has ceased to be profitable, many new herds have been established.

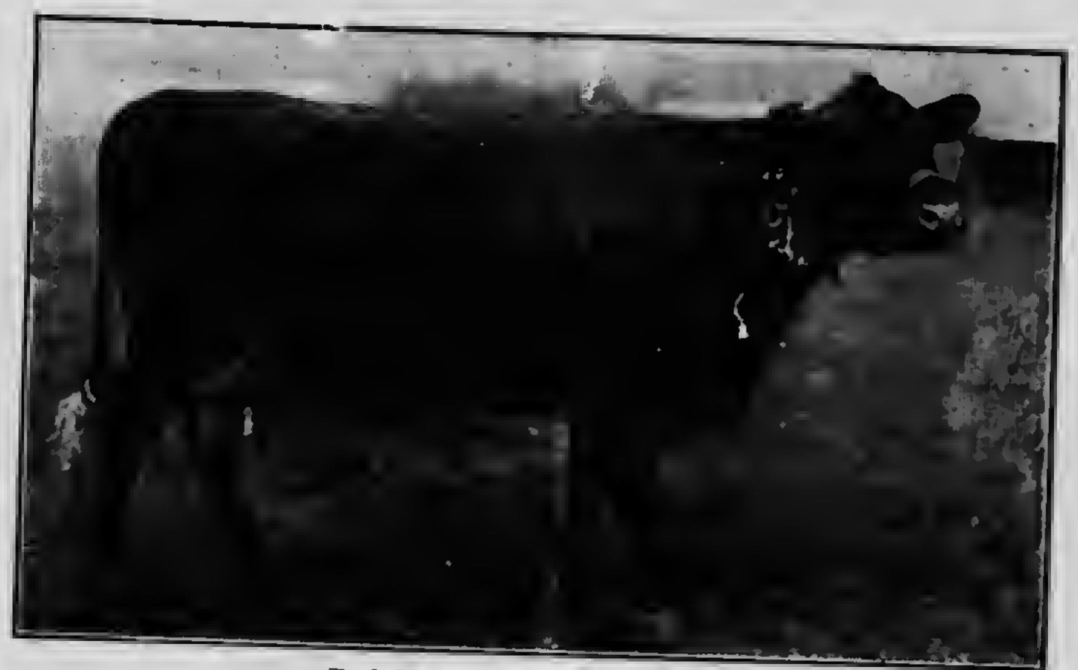
The breed seems to have been founded by an amalgamation of the native stocks of Norfolk and Suffolk. The prevailing Norfolk variety in the eighteenth century was of the middle-horned type; red in colour, with a white or mottled face. But there were also numbers of polled cattle in the county from time immemorial. Suffolk was the home of a breed of polled cattle called variously the Suffolk Polled or the Suffolk Duns—they being of a dun colour. The Norfolks were noted for beef, and the Suffolks for milk, so that the union effected combined the two qualities, Norfolk giving the beef-making qualities and the red colour, and Suffolk the milking properties and the uniform polled character. As so many cattle of all descriptions were introduced into East Anglia towards the close of the eighteenth and the beginning of the nineteenth centuries, doubtless crosses of these breeds were attempted, but the predominant influences in the fixing of the type were the native cattle of Norfolk and Suffolk.

The Early Norfolk and Suffolk Cattle.—As regards the cattle of Norfolk prior to the union of the breeds, Marshall (one of the earliest writers on the agriculture of the county), who resided there from 1780 to 1782, described those of East Norfolk as "small-boned, short-legged, thin-thighed, clean-chapped; the head in general fine, and the horns clean, middle-sized, and bent upwards; the favourite colour a blood-red, with a white or mottled face." He called them "Herefords in miniature," except that the chine and quarter of the Norfolk were oftener deficient than in the Hereford. They made only about 40 stone, but were easily fattened at an early age, and no better fleshed beasts went to Smithfield. He knew that at different times Polled Suffolk bulls had been used for crossing Norfolk Middle-horn herds. The results were increase of size and improvement of form; but he feared that the hardiness and early fattening of the Norfolk were impaired by the cross. There were also, as we have said, numbers of polled cattle in Norfolk prior to 1778.

As to the Suffolk Polled cattle of the same period, Arthur Young, in his "General View of Agriculture of the County of Suffolk," dated 1794, wrote: "The cows of Suffolk have long been celebrated for the great quantity of their milk, which, I believe, much exceeds, on an average, that of any other breed in the island, if quantity of food and size of animal are taken into account. The breed is universally polled, that is, without horns; the size small; few rise when fattened to above 50 stone (14 lb.). The points admired are—a springing rib and large carcase; a flat loin, the hip bones to be square and even; the tail to rise high from the rump. This is the description of some considerable dairymen. But if I were to describe the merits of certain individuals which were very famous for their quantity of milk, it would vary in some points, and these would be such as are applicable to great numbers:—a clean throat, with little dewlap; a thin clean snake head; thin legs; a very large carcase; ribs tolerably springing from the centre of the back, but with a heavy belly; backbone ridged; chine thin and hollow; loin narrow; udder large, loose, and creased when empty; milk veins remarkably large, and rising in knotted puffs to the eye. This is so general that I scarcely ever saw amongst them a famous milker that did not possess this point. A general habit of leanness, hip bones high and ill covered, and scarcely any part of the carcase so formed and covered as to please an eye that is accustomed to fat beasts of the finer breeds. But something of a contradiction to this, in appearance, is that many of these beasts fatten remarkably well, the flesh of a fine quality, and in that state will feed well enough to satisfy the touch of skilful butchers. The best milkers I have known have been either red, brindled, or yellowish cream coloured. The quantity of milk given is very considerable indeed. There is hardly a dairy of any consideration in the district that does not contain cows which give in the height of the season —that is, in the beginning of June—eight gallons of milk in the day, and six are common among many for a large part of the season. For two or three months a whole dairy will give, for all that give milk at all, five gallons a day as an average, if the season is not unfavourable, which for cows of this size is very considerable. When the quantity of milk in any breed is very great, that of butter is rarely equal. It is thus in Suffolk; the quantity of milk is more extraordinary than that of butter. The average of all the dairies of the district may be estimated at three firkins and three-fourths of a wey of cheese per cow clear to the factor's hands, after supplying the consumption of the family."

In connection with the Polled character in these cattle, it is interesting to read in the valuable work by the late Rev. John Storer, "The Wild White Cattle of Great Britain," of the existence of a race of white polled cattle, which, springing directly from the ancient forest cattle of the country, had become more or less domesticated, and were excellent milkers. The Norfolk branch of the race was brought by the first Lord Suffield from Middleton Park, in Lancashire, to Gunton Park, in Norfolk. The Gunton Park herd no longer exists, but we are told in the work alluded to that this had a great effect upon the cattle of the district. It is probable that the Red Polls have other polled blood in their veins than that of the Suffolk Polls, the Norfolk Polls, and the Galloways, to which last-named breed some of the early historians traced their origin, though, as we have remarked, it is far more likely that the main components were the old Suffolks and Norfolks.

Mr. Henry F. Euren, the founder of the "Red Polled Herd Book" (of which the first volume was published in 1873), has devoted much attention to the study of the history of the breed. From his investigations it appears that polled cattle were certainly found in Norfolk in the latter part of the eighteenth century. Advertisements of



Red Polled Cow, Waxlight II

s
t

d
a
a
th
sr
by
w
ar
Fo
Po
of
no
thr
ov
a
par
In
a s
cat

goo
mat
of t
year
1,59
aver
1·59
unde
T
of 1
in n
full
whic
and

sales held in and from the year 1778 show that there were then dairies of polled cattle in the county.

Standard Description of Red Polls.—The standard description of the breed as given in the Herd Book is as follows:—"Essentials: Colour red; the tip of the tail and the udder may be white. The extension of the white of the udder a few inches along the inside of the flank, or a small white spot or mark on the under part of the belly by the milk veins, shall not be held to disqualify an animal whose sire and dam form part of an established herd or answer all other essentials of this standard description. Form: There should be no horns, slugs or abortive horns. Points of a superior animal: Colour, a deep red, with udder of the same colour, but the tip of the tail may be white; nose not too dark or cloudy. Form: A neat head and throat; a full eye; a tuft or crest of hair should hang over the forehead; the frontal bones should begin to contract a little above the eye, and should terminate in a comparatively narrow prominence at the summit of the head. In all other particulars the commonly accepted points of a superior animal are taken as applying to the Red Polled cattle."

In quality of beef the Red Polled continues to be very good, and there has been a great improvement in early maturity. Taking an average of four years at the shows of the Smithfield Club, the live weight of steers under two years old has been 1,165 lb., steers under three years old 1,590 lb., and heifers under three years old 1,470 lb. The average daily gain for steers under two years old has been 1·59 lb.; steers under three years old, 1·45 lb.; and heifers under three years old, 1·34 lb.

The volume of the Herd Book issued in the summer of 1901 contained the milk record of 305 cows of all ages in nine herds. The average of the 235 cows that were in full profit during the year was 6,382·62 lb. of milk. Those which had to their credit 6,000 lb. or over numbered 132, and the number in milk 300 days or over was 148. One of the cows milked 757 days before drying and gave a total yield of 12,727 lb. Lord Rothschild, Mr. Harvey Mason, Mr. Garrett Taylor, and others bestowed great attention to the dairy properties of their herds.

The breed was introduced into the United States in 1873, and many specimens have since been transferred. They have also been sent to New South Wales and other countries. In 1869, Prince Leichtenstein purchased from the herd of the late Lord Sondes a number of animals to introduce fresh blood into a herd of Red Polled cattle in Bohemia, which is understood to be in type exactly like our Red Polls.

The Herd Book is now published by the Red Polled Cattle Society.

Longhorns.—Yorkshire is a famous county! To have produced, or at all events to have greatly helped in producing, the noblest breed of cattle the world has yet seen —the Shorthorns—was enough to lend to the county a lustre which time will not efface. But this is not all, for the Longhorns, too, sprang from "the district of Craven, a fertile corner of the West Riding of Yorkshire, bordering on Lancashire," while their puissant rivals, the Shorthorns, came from the other side of the county. The Ayrshires, too, are said to owe much of their early blood to Yorkshire. We may again regret that nothing more definite than tradition exists to supply us with a record of the early doings of these Yorkshire cattle. Beyond the fact that there were in early times importations of cattle of larger size than the aboriginal breeds, it is not known with certainty whether the Longhorns were imported into Yorkshire from some foreign country, or whether to some peculiarities of the soil and climate of the Craven district we are to give the credit of developing them out of the ancient roaming cattle of the north of England. One thing, we think, is circumstantially clear, viz. that the farmers of Yorkshire, several centuries ago, were ahead of almost all others in the country in their ideas as to the improvement of the bovine race; for, however much soil and climate may have had to do in the matter, it is not to be supposed that only in those two limited districts were the natural influences so active as to produce, unaided by man, two of the most famous breeds of cattle that have yet been known.

Be these things as they may, the Longhorns had spread over most of the Midland counties, and become the prevailing stock therein, long before the Shorthorns had migrated far from their original home. Looking at the stock which now prevails in these counties, it is difficult to realise that Longhorns were universal in them but little more than a century ago. But it is a fact, nevertheless; and the great change that has taken place in so short a space of time speaks volumes in favour of the prepotency of the Shorthorns.

The earliest record we have of a systematic attempt to improve Longhorns relates to that of Sir Thomas Gresley, of Drakelow House, Burton-on-Trent, and this dates back to the early years of the eighteenth century. The next refers to a farmer and farrier named Welby, also a Derbyshire man, who had obtained his "valuable breed of cows" from Sir Thomas, and took a pride in "improving them and keeping the breed pure." The next improver of the breed, so far as we know, was a Mr. Webster, of Canley, near Coventry; he, too, had some of the stock of Sir Thomas Gresley, and was at great pains to procure bulls from Lancashire and Westmorland. His success was so marked that he is said to have had the best cattle then known; and one of his admirers says, "he possessed the best stock, especially of *beace*, that ever were, or ever will be, bred in the kingdom." The word "beace," by the way, meaning dairy-cattle, is commonly used in some parts of the Midland counties.

We come next to the most famous of all breeders, Robert Bakewell, of Dishley, who was born in 1725, and died in 1795, at the place whose name will never be forgotten. It is not to Longhorn cattle, however, so much as to Leicester sheep, that Bakewell's fame attaches; yet he did so much even for the cattle that posterity have awarded him the merit of having created, as it were, a new breed. He took in hand the Longhorns, because the Shorthorns were then but little known; and we can but regret not only that he did not try his hand on the Shorthorns as well, but that he left behind him no record of the eminently sound principles which guided him in his selection and classification of animals in breeding. The results he attained we know—they were, a small proportion of bone and offal, and a large one of meat, utility and beauty of form, superior quality of flesh, early maturity, and aptitude to fatten—but of his own unique system we know little as described by himself. He made excursions into various parts of England, inspecting celebrated herds of different breeds, but less to buy stock than to ascertain the highest possibilities of breeding.

Bakewell thus formed in his own mind a sort of eclectic model of what an animal ought to be, and, under his perfect skill of classing certain animals together, the various excellences he sought to attain soon fell into the one mould he had made for them. His Longhorns trace back to those of Sir Thomas Gresley, for he bought two heifers from Mr. Webster of Canley, and procured a promising bull of the same breed from Westmorland. To these and their offspring he chiefly confined himself, so mating them together as to develop and establish the desired points of excellence, and as his stock increased in number he was able to do this without too close in-breeding. In a very few years his stock were unapproachable for fineness of bone, smallness of offal, quality of flesh, and symmetry and beauty of form, but—not for milk. And yet Longhorns are not inferior milkers, but, as in too many Shorthorn families of the present day, milk was sacrificed to other qualities in the famous herd of Longhorns at Dishley. The farms at Drakelow, Canley and Dishley stand in relation to Longhorns much in the same way that those of Ketton, Kirklevington and Warlaby do to Shorthorns; but the influence of the former has not radiated like unto that of the latter trio of bovine shrines, though these have borrowed some of their light from the former.

Mr. Bakewell was a man of surpassing kindness. His servants remained with him twenty, thirty, and even forty years, and his treatment of the cattle is described by Arthur Young in these terms: "Another peculiarity is the amazing gentleness with which he brings up these animals. All his bulls stand still in the field to be examined; the way of driving them from one field to another, or home, is by a little switch; he or his men walk by their side, and guide them with a stick wherever they please, and they are accustomed to this method from being calves. A lad, with a stick three feet long and as big as his finger, will conduct a bull away from other bulls, and his cows, from one end of the farm to the other. All this gentleness is merely the effect of management; and the mischief often done by bulls is undoubtedly owing to practices very contrary, or else to a total neglect." To this we may add that a good deal depends on the natural disposition of the bull.

We have said that the prevailing stock in the Midland counties a hundred years ago were Longhorns, and that they have been displaced by Shorthorns. Writing in 1809, William Pitt says,* "The natural breed of cattle in Leicestershire is now the Longhorns." He also makes similar statements with regard to Derbyshire and Staffordshire. The change from Longhorns has been effected by repeatedly crossing with Shorthorn bulls the ordinary dairy-cattle of the country. The home of the Longhorns is still in the Midland counties, but there are only a few pure-bred herds; we are, however, glad to know that these grand old cattle are coming once more into favour, and a "Herd Book" was established in 1880 to promote and systematise the breeding of pedigree Longhorns. A well-written account of the breed, by the first hon. secretary, Mr. John B. Lythall, appears in Vol. I. of the "Herd Book." There were 286

* "A General View of the Agriculture of Leicester," p. 216.

bulls and a still larger number of cows entered in that volume. These form *nuclei* from which the Longhorns may, if desirable, still be disseminated throughout the country, though we can hardly expect that they will again occupy the relative position they once did.

Many Longhorn cows have been famous for giving very large quantities of milk, but the breed, generally speaking, is more celebrated for the quality than for the quantity of it. Mr. R. H. Chapman of St. Asaph, a famous breeder of Longhorns, informed us of a herd of twenty of these cattle, belonging to Mr. Taverner of Upton, making 4½ tons of cheese in the season without any extra keep, and of one cow that gave 16 quarts of milk at a meal.

After a long interval the second volume of the "Herd Book" was published in 1900, and in addition to the pedigrees of a fair number of animals it contained an essay by the hon. secretary (Mr. T. H. Weetman), in which he referred to the early fame of the breed and to the position it then occupied. Among other facts, he mentioned that at the show of the Royal Agricultural Society at Birmingham in 1898 the first and second prizes for cows were awarded to Mr. W. H. Sales' Fradley Beauty and Moss Rose. Each of these cows produced live calves in the spring of 1899, when their milk and butter yields were very carefully tested, the first prize cow producing 50 lb. of milk per day, which yielded 2 lb. of butter on the shallow setting system; and the second prize cow produced 30 lb. of milk, from which 1 lb. 7 oz. of butter was made up. The last-named cow, not being retained for breeding again, owing to a misfortune, continued to milk up to September of that year and was then fattened for the Birmingham Christmas Show, when her live weight was 17 cwt. 2 qrs., and she gave an excellent carcase of beef.

Description of Longhorns.—The following is Mr. Weetman's description of the Longhorn, which he remarks is undoubtedly a general purpose animal, being suitable for the production of both milk and meat of the best quality:

"In shape the best animals of the breed are long and low, with wide and level backs, and well-sprung ribs. Their hides, which are mellow to the touch, are covered with a coat of hair of great thickness and silky texture, though in the winter time standing somewhat roughly. This gives them the ability to withstand practically any reasonable degree of cold and wet. In colour there is room for diversity of tastes, as, though the white line along the back, with a white patch or mark on the thigh, is looked upon as strictly orthodox, occasionally pure-bred animals are found entirely self-coloured, whilst in others the sides of the body may be either red, brindled, a grizzled roan, or any of these colours intermixed with small white specks or flakes, and be perfectly orthodox in every way. The colour most admired by many breeders, and certainly a very hardy one, is the dark brindle with rather a bluish tint, or the white one along the back; animals of this colour are very beautiful, their coats when in health and condition being covered with a bloom almost resembling that upon ripe grapes, and with the bluish hue are most attractive. The horns must be long, and may grow in any possible shape; some striking straight at right angles with the poll, others curving round and meeting even under the jaws, or the horns may twist in varied shapes, as they frequently do, and with graceful turnings give the animal a most picturesque appearance. It is on this account that the breed have generally been in request as an ornament to so many of the stately homes that adorn the Midland counties of England. In the females of the breed the udders should be square and the teats of good size, without coarseness."

Up to this second decade of the twentieth century the Longhorn race has continued to hold its little own,—"little," that is to say, in view of what it was in the latter half of the eighteenth, and even in the first decade or even the second decade of the nineteenth century.

It is stated on authority in the Almanac of the *Live Stock Journal* for 1911, that "No Longhorn cattle were exported in 1910." Meanwhile, we are assured that the Longhorn Society is flourishing and increasing its membership, and that "the breed is gradually coming into favour again." It is to be genuinely hoped that the breed will continue to flourish, but the prosperity of two centuries ago cannot in the nature of things be reasonably expected to come back to them. It would not be consistent with the law of "survival of the fittest."

Welsh Cattle.—History tells us that in early times the inhabitants of Britain retreated to the west before the invaders from the Continent of Europe, and that they took their cattle with them. It is in Wales, therefore, that we should expect to find descendants of the aboriginal cattle of the island—the small Celtic Shorthorn ox, called by naturalists *Bos longifrons*. The Welsh cattle are descended from these native animals, but it is also evident that they were crossed with the large breed, whose first appearance in Britain, during the historic era, was in the Principality, as is shown by distinct references to white cows with red ears, these cattle being of higher value on account of their larger size. Coming to a more recent period, there used to be four or five varieties of Welsh cattle, though they perhaps did not possess the distinctive characters of breeds. They were the South Wales, Pembroke or Castle Martin; the North Wales or Anglesey; the Glamorgan; the old Castle Martin (a white variety, the South Wales and North Wales sorts having been black), and the Smoky-faced Montgomery. Of these several have become extinct, while others are in few hands. It will be sufficient for our purpose if we deal with the Welsh cattle as of two kinds—the South Wales or Pembroke, and the North Wales or Anglesey—both black in colour, and, though they have separate Herd Books, they are now in many respects similar. In 1834, Youatt said of the Pembrokes or Castle Martins, "Great Britain does not afford a more useful animal."

The South Wales black cattle are described in the following terms by Mr. Richard Hart Harvey, in an introductory article in the Herd Book in 1874:—"The black cattle to which this Herd Book especially refers are natives of the counties of Pembroke, Carmarthen and Cardigan, and are more generally known as Pembrokeshire Blacks, subdivided into Castle Martin and Dewsland breeds. From Cardigan they also extend along the North Wales coast up to Anglesey, and are then called the North Wales or Anglesey breed. In Glamorganshire they are found in the Seigniory of Gower. The black cattle may be described as a horned breed, generally of black colour, and frequently with white marks on the udders of the cows, also a few white hairs at the end of the tail. Sometimes a few white hairs are mixed up with the coat, but this is not always hereditary and only comes out occasionally A brown-black, approaching chocolate, is considered a good colour. Occasionally there are some cows striped red and black, also some quite white, with black ears, muzzle and feet, but these are becoming very rare. . . . The horns should be of a rich yellow; they are frequently tipped with black, and do not come out yellow to the very end like the Herefords. . . . A bull's horn should be low and well spread, the cow's narrower and the pitch more upright."

The first volume of the South Wales Herd Book was published in 1874 under the title of the "Welsh Black Cattle Herd Book." The second volume appeared in 1878, and the third in 1883. In the autumn of 1884 the South Wales Black Cattle Society was founded under the presidency of the Earl of Cawdor, and the fourth volume of the Herd Book was published in 1888.

In the year 1883 the North Wales Black Cattle Society was established, and a number of volumes of the North Wales Herd Book have been published. In one of these Mr. J. Maitland gives the following description of an ideal North Wales bull:—"The colour ought to be black, the head not too large, but handsome and neatly set on, the muzzle fine, nostrils wide, the horns low and well spread, moderately strong, of rich yellow colour, with black points; the eyes should be mild, large and expressive; the throat clean, the neck a fair length, rising from the head to the shoulder-top, and surmounted by moderate crest, which adds to the masculine appearance, a point so desirable in a bull. The neck should pass neatly and evenly into the body with full neck vein, but should show no undue prominence on the shoulder-top; an upright shoulder in cattle is generally accompanied by a light waist. The crops should be full and level, with no falling off behind, the ribs well sprung, springing out barrel-like and neatly joined to the crops and loins; the loins broad and strong, the hook bones not too wide, narrower than in the average Shorthorn; the quarters long, even and rounded, with no hollow from the hooks to the tail; the tail should come neatly out of the body and not be higher at the root than the line of the back; a high tail-head and rump are general characteristics of the breed, but form defects that are being gradually removed by the more scientific breeders throughout the Principality; on both sides of the tail the quarters should turn away in a rounded manner, swelling out downwards and passing into thick, deep thighs; the twist should be full, and the hind-legs set well apart and not detached from the body until the level of the flank is reached; the flanks full and soft; the bottom line should be as even as the top and side lines; the bones of the legs fine, flat and clean; the skin ought to be fairly thick, soft and pliable over the ribs, yielding to the least pressure and springing back towards the fingers. Many of the foregoing remarks apply to the Welsh cow, which in general character, however, differs considerably from the bull; her head ought to be much finer; the horns narrower, their pitch more upright; the neck thinner and cleaner, with no crest; the shoulder-top sharper, the bone altogether finer, the skin not quite so thick; the udder large; milk vessels large and well defined."

CHAPTER VIII

Breeds of Cattle—(*continued*)

ABERDEEN-ANGUS—GALLOWAYS—HIGHLANDERS—AYRSHIRES—ORKNEYS AND SHETLANDS

Aberdeen-Angus.—Few breeds have made such a rapid advance in public estimation as the Polled Aberdeen-Angus. These cattle have existed in portions of Aberdeenshire and Forfarshire from time immemorial. In the Buchan district of Aberdeenshire they were known as "humlies," and in the Angus district of Forfarshire as "doddies," both words indicating that they were hornless. The origin of this characteristic is unknown. Under domestication, horns in cattle may be regarded as to some extent useless appendages, and there is reason for supposing that early in the history of civilisation polled animals began to appear in countries lying widely apart; and whether this peculiarity be due to "spontaneous variation" or to "a proper organic change," as scientists suggest, it was considered desirable to perpetuate it, and this has been successfully accomplished. The following facts are cited as evidence of the antiquity of polled cattle:—Professor Boyd Dawkins mentions that he has seen in the museum at Florence a polled skull which had been obtained from the Pliocene strata of the Val d'Arno. Herodotus describes the domestic cattle of the Scythians as having been hornless; several of the breeds of Russia are without horns; there has long been a hornless variety in Paraguay, in South America; I saw, in 1890, a fine herd of polled dairy cows near to the city of Mexico; in Austria, on the estate of Prince Leichtenstein, a herd of polled cattle has existed for many years. There are also polled cattle in Norway and in

Iceland, and more than one of the herds of wild park cattle in Britain were hornless. Polled cattle have thus been found in many parts of the world. The peculiarity is hereditary, and it has been proved that horns can be obliterated by the use of polled sires for breeding.

The annals of Angus and Aberdeenshire show that polled cattle were an esteemed variety for a very long period in both these localities. The turning point in Northern Scottish history was in 1746, when, with the battle of Culloden, the fierce and protracted internecine conflict which had prevented industrial development came to an end. The people then settled down to peaceful pursuits, and agricultural development proceeded apace. The general improvement of the live stock of the farm received special attention.

So far as the systematic improvement of this breed of cattle is concerned, the work would appear to have been first commenced in Forfarshire. Mr. Hugh Watson, of Keillor, in that county, has been called "the first great improver." He was born at Bannatyne of Newtyle in 1789, and became tenant of the farm of Keillor in 1808. It has been stated that Mr. Hugh Watson's father had the breed as early as 1735. From boyhood Hugh Watson had loved the Angus doddies, and immediately on commencing farming on his own account he began to put into operation his ideas regarding the best method of improving them. He received from his father six of his best and blackest cows, together with a bull, as the nucleus of an Angus Polled herd. Soon afterwards he went to the Trinity Muir Market, Brechin, and there selected ten of the best heifers and the best bull he could procure, all the animals showing the finest characteristics of the breed. On this foundation Mr. Watson raised a herd of great excellence. He was a man of enterprise and public spirit. He bred only from the best animals, and went cautiously into the practice of in-and-in-breeding. An intelligent system of management was pursued, and the herd was widely exhibited in

Scotland, England, Ireland and France, upwards of 500 prizes having been won. In 1829, Mr. Watson first exhibited at the Highland Society's show at Perth, and in that year several of his animals also attracted attention at the Smithfield Club Show in London, after which the results of the "block test" added much to the rising fame of the breed. Tarnty Jock, Grey-breasted Jock, and Old Jock were the names of some of the famous Keillor bulls. Of the females a celebrity was "The Prima Cow," registered in the Herd Book as Old Grannie 1. She was kept by Mr. Watson for the purpose of testing, first, the length of time during which such a cow could be profitably kept, and, secondly, the length of life. She died of old age in the middle of her 36th year, having been calved in the beginning of 1824, and died on July 1st, 1859. She produced twenty-five calves, the last having been born when she was in her 29th year, and she ceased yielding milk after she had suckled and weaned her 24th calf.

In Aberdeenshire, Mr. William McCombie of Tillyfour brought the breed to great perfection, and extended its reputation throughout the world.

For many years past a grand herd has been maintained at Ballindalloch Castle, Ballindalloch, and Mr. McCombie described the herd there as the oldest in the North. The late Sir George Macpherson Grant, Bart., began to improve the herd immediately on coming to reside on the property in 1861. In that year he purchased the valuable cow Erica 843 at the Earl of Southesk's sale at Kinnaird Castle. The Erica tribe, descended from her, and full of the choicest Keillor blood, is one of the most esteemed of the breed, and has produced numerous prize-winners. The Jilts, also of Keillor blood, but obtained from Tillyfour, are another famous race, the noted bulls Juryman, Judge, and Justice being of this line. The herd still maintains a foremost place at the leading shows and sales, and its home has been described as the "Warlaby of the Polled breed."

The Americans soon discovered the merits of the polled cattle of the North of Scotland. The absence of horns was a recommendation with the view to shipment of animals to that country; but it was the fact that the breed took such a prominent place at fat stock shows and at the London Christmas market which led the agriculturists of the United States to give them a trial. The result was most satisfactory, and there were numerous exportations, the breed being now largely spread over the States. Ireland has also had a liking for the breed ever since Mr. Hugh Watson used to take over his prize teams to the great Irish shows, and there are now many herds there. Mr. Clement Stephenson, Sandyford Villa, Newcastle-on-Tyne, established a very fine herd, and there are now a large number of breeders in England, an English Aberdeen-Angus Cattle Association watching over their interests. The first volume of the Polled Herd Book was published by Mr. Edward Ravenscroft in 1862. The second volume was published in 1872 under the joint editorship of Mr. Alexander Ramsay, LL.D., and Mr. H. D. Adamson. The Polled Cattle Society acquired the copyright in 1879.

Characteristics of the Polled Cattle Breed.—The characteristics of a bull of the Polled Cattle breed are fully enumerated in the following "standard of excellence" issued by the Polled Cattle Society:—"Colour, black; white is objectionable, except in the underline behind the navel, and there only to a moderate extent. Head: Forehead broad, face slightly prominent and tapering towards the nose; muzzle fine; nostrils wide and open; distance from eye to nostril of moderate length; eye mild, full and expressive; ear of good medium size, well set, and well covered with hair; poll well defined and without any appearance of horns or scurs; jaws clean. Throat clean, without any development of loose flesh underneath; neck of medium length, muscular, with moderate crest (which increases with age) spreading out to meet the shoulders, with full neck vein. Shoulders well laid in, covered in the blades and on the top, which should be in a line with the back and moderately broad; chest wide and deep; bosom (or brisket) standing well out between the legs and moderately covered with flesh and fat; ribs well sprung from the backbone, arched and deep, neatly joined to the crops and loins. Back broad and straight from crops to hooks; loins strong; hook bones moderate in width, not prominent, and well covered; rumps long, full, level, and rounded neatly into hind-quarters; hind-quarters deep and full; thighs thick and muscular, and in proportion with hind-quarters; twist full; tail fine, coming neatly out of the body in a line with the back, and hanging at right angles to it; underline as nearly as possible straight; flank full and soft. Legs short, straight, and squarely placed; hind-legs slightly inclined forward below the hocks; fore-arm muscular; bones fine and clean. Flesh even, without bumps or patchiness; skin of moderate thickness and mellow touch, abundantly covered with thick and soft hair. General appearance: Gay, well bred, and masculine." The cow differs in appearance from the above description chiefly in that her forehead is moderately broad and slightly indented; the ear is large, slightly rising; the neck is of medium length, spreading out to meet the shoulders, with full neck vein; the udder should not be fleshy, coming well forward in line with the body and well up behind; teats squarely placed, and the general appearance gay, well-bred and feminine.

Its Special Properties.—As to the special properties of the breed, its historians (in the work on Polled Cattle before referred to) say:—"It is claimed that the Northern Polls surpass all other races in the production of beef. . . . In a strictly butcher's point of view the breed has very seldom to yield to any other race of cattle. The superiority over most other breeds for the butcher's purpose lies mainly in the excellent quality of beef, and in the high percentage of dead meat to live weight. As a rule, the beef of the Northern Polls is very well mixed, and contains a greater proportion of compact, finely grained flesh, and less soft, coarse fat, than most of the other kinds of beef. Inside, the carcase is usually well lined with fat of the finest quality, whilst in the density and quality of the carcase itself the breed may fairly enough claim the premier position among all our leading breeds of cattle. Some place the Devon breed alongside, if not even before it, in this respect; but, with that exception, we do not think that any other breed in the British Isles will on an average yield so high a percentage of dead meat to live weight. In butchers' phraseology it 'dies well' and 'cuts up' admirably. In all the leading fat stock markets in the country the breed is held in high estimation, and as a rule commands the very highest prices—in fact, generally a higher price in comparison to its size and live weight than any of the other leading breeds. This is especially the case at the Great Christmas Market in London, where the plump compact Polls from the North never fail to find a ready sale at the highest quotations."

To the above it may be added that the breed crosses admirably with the Shorthorn, and it also matures early, a quality in which great improvement has taken place within recent years. The breed has frequently taken the championship at the shows of the Smithfield Club. The average live weights of these show fat cattle have been:—steers under two years old, 1,400 lb.; steers under three years old, 1,835 lb.; steers over three years (before the abolition of that class), 2,170 lb.; heifers under three years old, 1,705 lb. The average daily gain of live weight was: steers under two years old, 1·91 lb.; steers under three years old, 1·67 lb.; heifers under three years old, 1·55 lb.

For some years the milking properties of the breed were neglected, the chief care having been to develop the beef-producing qualities, the calves being suckled by their dams. In recent years, however, rather more attention has been directed to this quality, because it is found that a cow that milks well is the best dam. Where care is taken the breed milks pretty well, and the milk is rich in cream. In early times the breed had considerable reputation for the large proportion of cream contained in the milk. At Cortachy Castle the late Earl of Airlie bestowed attention on the milking qualities, and had cows that gave 22½ quarts of milk daily after calving, and others that produced 18 quarts daily after having calved three months. At the London Dairy Show in 1892 an Aberdeen-Angus cow (without known pedigree) gave 60·3 lb. of milk on an average per day, the milk containing 4·99 butter fat and 8·75 casein.

Galloway Cattle.—This ancient and famous breed of Scottish cattle possesses a most interesting history, though its origin, like that of most of our domesticated animals, is somewhat obscure. The Rev. John Gillespie, LL.D., writing in 1878, expressed the opinion that there can be very little doubt that the Galloway and the West Highland breeds of cattle have sprung from the same parent stock at a very remote date. "There is," he adds, "a close resemblance even at the present day between a well-bred Polled Galloway and a West Highlander, *minus* the horns." "It is easy to understand how any difference which now exists between the two types of animals may have been produced by the different circumstances in which they have long been placed, and the different treatment to which they have been subjected." The old forest breeds probably entered into the composition of both; and the Galloways have been described as "Highlanders without the horns." It is impossible to say at what date the polled characteristic made its appearance, but it was evidently at a very early period, and as it was associated with animals of a very superior class, this feature was carefully cultivated.

The Galloways are described by George Culley in his "Observations on Live Stock," published in 1794, as an established Polled breed. He states that in Galloway (a large district in the south-west of Scotland) they were mostly bred upon the moors or hills and grazed upon the lands nearer the sea, until rising four or five years old, when the drover took them up in great numbers to the fairs in Norfolk and Suffolk, previous to the turnip feeding season, whence the greater part were again removed in the winter and spring (when fat) to supply the amazing consumption of the capital, where they were readily sold and at high prices. Culley had also been informed upon good authority that the polled cows were very good milkers in proportion to their size, and the milk was of a rich quality, yielding much more butter from a given quantity of milk than the Shorthorns.

Soon after the union of the crowns of England and Scotland in 1603, there was a gradual advance in the agriculture of Great Britain, and an important trade in cattle grew up between the ancient province or kingdom of Galloway (which then included the modern counties of Wigtown and Kirkcudbright, with a portion of the shires of Ayr and Dumfries) and the south of England, particularly Norfolk and Suffolk. This traffic increased greatly after the introduction of field turnip husbandry in Norfolk and Suffolk about 1730, and upwards of 20,000 head of cattle were annually exported from Galloway, 16,000 to 18,000 of that number being sold at Smithfield. The cattle were sent off in droves of from 200 to 300, and the journey to Norfolk occupied about three weeks. It is easy to understand that the absence of horns was a great advantage under such circumstances, and breeders were consequently encouraged by this preference to adhere to the polled stock. Norfolk and Suffolk could not produce a sufficient number of cattle to consume the turnips grown in these counties, and the Galloways were prime favourites for the purpose. As time went on, however, other districts were able to contribute more largely to the supply. There also came a change in the Galloway country itself, and a large portion of it was devoted to dairying. The "dairy wave" swept over the counties of Ayr, Renfrew, Lanark, Kirkcudbright, Wigtown, and Dumfries, and so the "Border Blackskins" encountered a period of trial. Breeders became discouraged, and their ranks were sadly attenuated. However, a few stuck courageously to their favourites, and resuscitation came in due course.

The revival of the breed took place about 1830, and at that date the best specimens were to be found around Kirkcudbright and the eastern district of Wigtownshire. Several of the landlords gave an impetus to the work by purchasing bulls from the old breeders for the use of the tenants on their estates. A very fine herd was established by the Duke of Buccleuch at Drumlanrig, and many magnificent animals were bred in it, the bull Black Prince 546 being a distinguished prize-winner and the sire of excellent stock. Mr. George Graham, of Riggfoot, designated "the Black Booth of Cumberland and the Border counties," was also a most successful breeder, his bull Cumberland Willie 162, by Galloway Lad 320, making a decidedly beneficial impression on the breed.

Characteristics of the Galloways.—For a graphic sketch of the breed we cannot do better than quote from the report prepared by the Council of the Galloway Cattle Society for the United States Consul in 1887 :—

"The improvement effected during the nineteenth century has been great, and it has been brought about by systematic and skilful mating of the best specimens of both sexes ; also by attention to diet and general management. The Galloways as a breed cannot lay claim to any superiority as milkers. Their milk is rich in quality, but the quantity they give is not large. However, the milking faculty runs in some strains, and individuals of them are excellent dairy cows. It is mainly as a beef-producing breed that Galloways have made a name for themselves. The quality of their beef is similar to that of the Aberdeen-Angus and West Highland. The beef of these three breeds ranks as 'prime Scots' in the Smithfield and other leading British fat markets, realising there the highest current rates. Its superiority arises from the fact that it is well marbled, the fat being well intermingled with the lean. In respect of proportion of dead to live weight Galloways kill usually well, matured animals of the breed being estimated by experienced butchers to dress upwards of 60 per cent. of their live weight.

"Galloways arrive at maturity when from two to three years of age, according to the way they are kept when young. A well-fed Galloway may be estimated to weigh, when two years and nine months old, 1,600 lb. live weight and 1,000 lb. dead weight. Many weigh more, but others reared under adverse circumstances are less. No cattle in Britain are hardier than the Galloways, except the West Highlanders, and the difference between these two breeds in this respect is very slight. In all improvements of the breed, the retention of this ancient characteristic of them has been successfully kept in view. While their skin is mellow to the touch it is moderately thick. Moreover, the profusion of long, soft hair with a thick mossy undercoat, which has always been characteristic of this breed, conduces to and is symptomatic of their exceptional hardiness.

"The Galloways are kept on the low-lying farms, where mixed farming, grain growing, and cattle breeding and feeding are practised, and also on the intermediate hill grazings, between the high mountains and the lower valleys. Many herds are located in hill-lying districts, where the climate is so severe and cold that the growth of cereals is not attempted. A large number of the young Galloways are wintered in the open air, 'the sky and the hills and the glen,' as has been said, being their only winter shelter. This system is pursued, not from scarcity of house accommodation, but of deliberate choice, it being found by experience that from their hardy nature, and being inured to exposure, they are not only able to stand the severities of the climate, but that they thrive better and make more progress during the succeeding summer and autumn when wintered in the open air than under cover. It is a valued characteristic of the Galloways that they thrive well when kept upon poor and scanty fare, and, indeed, they have long proved themselves able to stand adverse circumstances, whether these arise from soil or climate, or both. They are remarkably impressive as a breed, which is no doubt due to the length of time—at least nearly two centuries—they have been bred from animals of the same type, and possessed of the same characteristics. Alike in respect of colour, absence of horns, and general outline and symmetry, their offspring, from cows of other breeds, so very closely resemble the black Galloway Polls that it is not easy to distinguish a pure from a cross-bred animal. When the Galloway bull is put to horned cows of any breed, from 95 to 100 per cent. of the produce are found to be black and hornless, and in stamping their offspring with their qualities otherwise the prepotency of the Galloways is very marked. Galloways have long been in great favour for crossing with other breeds. Bulls of this breed have been very extensively put to both Shorthorns and Ayrshire cows, and in England especially it has been a favourite and highly successful mode of crossing for beef purposes to use the Shorthorn bull on the Galloway cow. By either mode symmetrical cattle of large frames are produced. They are hardy, and their meat is free from patchiness, well mixed and superior. These Galloway crosses mature early, and reach very heavy weights."

The " blue greys " of the Western Border counties have attained a high reputation. They result from a cross between the Galloway and the Shorthorn—frequently the Galloway cow and a white Shorthorn bull. A steer of the Galloway-Shorthorn cross won the champion prize at the Smithfield Club Show in 1892. His record was as follows: age in days, 1,250; weight, 2,276 lb.; average daily gain since date of birth, 1·82 lb.; weight of dressed carcase, 1,599 lb.; percentage of carcase to live weight, 70·25.

Pure-bred Galloways exhibited at the Smithfield Club Fat Stock Shows have given the following averages of live weight: steers under two years, 1,160 lb.; steers under three years, 1,665 lb.; steers over three years, 1,990 lb.; and heifers under three years, 1,455 lb. The average daily gain in live weight has been—steers under two years old, 1·58 lb.; steers under three years old, 1·52 lb.; heifers under three years old, 1·32 lb. The breed has done remarkably well in the carcase classes at the fat stock shows.

The Galloways were registered in the first four volumes of the "Polled Herd Book," but the Galloway Cattle Society was formed and acquired the Galloway section, which has since been published as the "Galloway Herd Book."

Highland Cattle.—The Highland, West Highland, or Kyloe breed, appears to be directly descended from the aboriginal cattle of the British Islands, the small Celtic short-horned ox known as the *Bos longifrons*. These picturesque cattle have been bred through many centuries in the districts in which they are now found, and they have been kept very uniform in character. In the Western Islands of Scotland it is not improbable that importations were made from Ireland; experiments with the Longhorn were also tried in some cases, but these may not have exercised much influence, and the general belief is that the breed as it now exists is practically unmixed, differing only in type and size to such an extent as would result from varieties of soil, climate and treatment.

In his work on "Domesticated Animals," Professor Low remarks that the Highland cattle, though varying in size and aspect with the nature and altitude of the country, present, with few exceptions, such characters in common as to justify their being referred to a common origin. "They are small in size; have horns in the male and female, turning more or less upwards at the points; have short muscular limbs, and are largely covered with hair. Their muzzle is usually black. On the neck there is a ridge of coarser hair, forming a mane. Their colour is various, often black, sometimes brown, or a mixture of brown and black, and often mouse dun. They are hardy beyond all races of the cattle reared in the British Isles. Their size bears a constant relation to the supplies of natural food. In the Northern and Central Highlands it does not often exceed that of the calves of a few months old of the larger breeds. Towards Argyleshire, on the south-west, including several of the Hebrides, where the production of the grasses and other herbaceous plants is much more abundant, the size of the animals becomes in a corresponding degree enlarged. In like manner, towards the eastern coast, where the mountains pass into the lower country, the cattle gradually assume a character approaching that of the larger breeds."

An interesting history of the breed, contributed to the first volume of the "Highland Herd Book," gives the opinion that there are only two distinct classes—the West Highland, and the Highlander or mainland Highlander. The former of these classes, sometimes designated by the term Kyloe, is, it is said, to be found in its greatest purity in the Western Isles of Scotland, to which it no doubt was at first confined. The normal colour of the Kyloes was black, and in the recollection of some who are still alive no other colour was known in the leading folds of the West. The pure Kyloe seems also to have been smaller and shaggier than the Highlander, but whether this was a distinctive feature of this class of the breed, or whether it arose from the cattle being kept in a purer state and more exposed to the elements than the mainland cattle, it is not easy to say. It is only within comparatively recent years that the colours which are now so much in favour with breeders became common among the West Highland cattle, and the first animals of colour seem to have been introduced from Perthshire. The Highlanders are common to the mainland of the North of Scotland, and also to the county of Argyle, and they seem generally to have been of larger size than the West Highlanders, and not uniformly of a black colour. It is not improbable that their greater size may be attributed to the superior pasture of many of the cattle-raising districts of the mainland and to greater care in breeding.

The breed has passed through vicissitudes, and for some time it seemed to be rather neglected. A number of the farmers who used to support it engaged in dairying and changed the breed kept. Then, when sheep and deer occupied such large tracts of the Highlands, the cattle were displaced. The breed, however, again came into favour, and has rapidly progressed.

Characteristics of Highland Cattle.—The Highland cattle have always been greatly admired for their handsome appearance and symmetrical form, as well as for the quality of their beef. Thus Culley, writing in 1794, alluded to the "pure, unmixed, valuable breed of Kyloes," which were met with in the more northern and western Highlands and all the Isles, but particularly in the Isle of Skye and the tract of country called Kintail. They were described as a hardy, industrious and excellent breed, calculated in every respect to thrive in a cold, exposed, mountainous country, and better adapted to the cold regions where they were bred than any other kind that Culley was acquainted with. They were driven to the South in great numbers every autumn, many into the western district of Yorkshire; but the largest part were sent into Norfolk, Suffolk, Essex, and other parts of the South of England, where they were fattened, and either slaughtered at their home markets or sent to Smithfield. The demand for Kyloes from England was of vast importance to those nobility and gentry who had estates in the North of Scotland, as most of their rents were paid in live cattle. Mr. John Price of Ryall, the celebrated breeder of Herefords, said that "among cattle, the Highland Scot approached more nearly than any other animal to the standard of form which he considered the true one"; and this decided him in adopting it as his model. He was, he remarked, desirous of possessing a breed of cattle on a somewhat larger scale than the Scotch Kyloes, yet having the same symmetrical, leggy forms, with similar coat and texture of flesh. Mr. Charge stated that he heard Bakewell remark that from the West Highland heifer he thought the best breed of cattle might be produced. Mr. Thomas Bates, the famous Shorthorn breeder, began his operations as a breeder of stock by crossing Highland heifers with Messrs. Colling's Shorthorn bulls. This was by way of an experiment.

Points of Highland Cattle.—The first volume of the "Highland Herd Book" (published by the Society at

28, Union Street, Inverness) contains a full and graphic description of the points of the breed, which is here summarised :—The Highlander has the grandest and most picturesque head of any breed of cattle. As a rule, it is most proportionate to the body of the animal, and is broad between the eyes, while short from the eyes to the point of the muzzle. The forelock between the eyes should be wide, long and bushy, and any nakedness or bareness there is certain to detract from the appearance of the animal. The eyes should be bright and full, and denoting, when excited, high courage. When viewed sideways there should be a proportionate breadth of the jaw-bones readily observable, when compared with the width of the head in front, whilst the muzzle should, when looked at from a similar point, be short, though very broad in front and with the nostrils fully distended, and indicating breeding in every way.

In the bulls, the horns should be strong and should come level out of the head, slightly inclining forwards and also slightly rising towards the points. Two opinions are prevalent as to the horns of the cow. As a rule, they come squarer out from the head than in the male, rise sooner, and are somewhat longer, though they preserve their substance and a rich reddish appearance to the very tips. The lack of the appearance of substance, of "sappiness" about the horns of the male would be very much against the animal in the show-yard. The other taste as regards the horns of the cows is when they come more level from the head with a peculiar back-set curve and a very wide sweep. The neck should be clear and without a dewlap below. It should form a straight line from the head to the shoulder in the cow, but in the bulls should have the distinct crest common to all male animals of the bovine species. The crest should come gracefully down to the roots of the horns, and being well coated with wavy hair, the masculine appearance of the animal is fully completed. The shoulder should be thick. and should fill out greatly as it descends from the point to the lower extremity of the forearm. From behind the shoulder, the back should be fully developed and beautifully rounded. Any slight sinking or hollow is objectionable. It should also be as straight as possible, and the ribs should spring boldly out and be both well rounded and deep.

When measured across the hips the breadth should be very great, and the quarters should be well developed from the hips backwards. The thighs should also be well developed, and should show great fullness. Viewed generally, the quarters should be square between the hips and the tail, and from between the tail right down to between the hind feet. The legs, both before and behind, should be short and strong, the bones strong, broad and straight, the hoofs well set in and large, and the legs well feathered with hair. The animal should be set wide between the fore-legs, and it should move with dignity and style: this being considered one of the most reliable evidences of careful and true breeding. The hair, of which there should be a great profusion, should be long and gracefully waved. The usual colours are black, dark brown, brindled, red, yellow, and dun.

Mr. James Cameron mentions, however, that breeders have catholic tastes as to colour.

In a letter to the writer some years ago the Earl of Southesk said: "People erroneously suppose that the Highland cattle are wild and savage animals, judging them by the appearance of their formidable horns. Wild they may be when allowed to run loose on the hills from calfhood, but when treated like other breeds and handled early, they are mostly quiet and even tame, and, as a rule, they are not savage, either towards one another or towards man. We have long been in the practice of grazing seventy or eighty oxen or heifers in the deer park—animals bought at Falkirk, Doune, or other trysts in October, and sold in the following year—and, speaking from the experience of at least thirty years, there has not been a single case among all these mixed lots of serious injury received by one of the cattle from the horns of another. All of my cows are quiet, and many of them will come to me at call; and the bulls are as quiet and harmless as the cows. In gentleness of temper towards man, I place the Highlanders quite on a level with the Herefords, when they have been handled and kindly treated from the first, though among themselves they seem more pugnacious than the placid 'White-faces.' A common mistake is the notion that this breed is diminutive in size. Doubtless there are very small animals bred in certain poor and inclement districts, or originally thence derived; but Highlanders of the best sort, such as prevail in the noted herds in Argyle, Perth, Inverness, and elsewhere, are of very considerable size and weight, though their length of hair, depth of rib, and shortness of leg, and to some extent their general symmetry and levelness, tend to lessen their apparent size to the careless observer. Undoubtedly they are of stronger constitution than most other breeds, illness and other troubles in calving being extremely rare. Barrenness is uncommon, and the cows go on steadily breeding to comparative old age. In the matter of keep their hardiness is well known; they will thrive on every kind of rough pasturage, where cattle of another breed would starve; no beasts that I can imagine could more exactly fill the place of the now (alas!) nearly extinct American bison."

Highland cattle are admirably adapted for the districts in which they are bred, their hardiness being of great value. They mature slowly when young, but the beef is of the choicest quality, and the land on which they are maintained does not favour quickly maturing breeds. When three or four years old the steers are much appreciated throughout the country as park cattle, and they are always a centre of admiration at the fat stock shows.

On an average of four years the cattle exhibited at the shows of the Smithfield Club gave the following live weights: Steers under three years old, 1,455 lb.; steers over three years old, 1,645 lb.; and heifers under three years old, 1,290 lb. As regards the average daily gain in live weight, steers under three years old gained 1·33 lb., and over three years old, 1·12 lb.; heifers under three years old, 1·17 lb.

The Highland Cattle Society was established in 1884, with Mr. Duncan Shaw, W.S., Inverness, as secretary.

Ayrshires.—Our account of the Ayrshire breed is chiefly based on a communication from Mr. James Buchanan, who remarks: "This heavy-milking and hardy breed of dairy cattle is well suited to the soil and climate of Scotland, where it has been long established and is highly valued. Small in size, short in the legs, and with fine clean bones, Ayrshires thrive and give a fair share of milk where large and less hardy cows would scarcely live. In the south and west of Scotland, where large cheese-dairies are kept, it is a rare thing to find any other breed of cows used, and the knowledge of this fact enables us to appreciate the justice of Mr. Scott Burns's remark, in one of his books on the dairy, etc., where he says: 'For dairy purposes, in cheese districts, the Ayrshires are justly celebrated; indeed, they seem to possess the power of converting the elements of food more completely than any other breed into cheese and butter.'

"Little is known as to how this breed was first brought into or bred in Scotland, but it is generally believed that the cows from which both they and Shorthorns are descended were the country cows of the district lying between the Wear and the Tees; and it is probable that some of these cows—which were famous for being good milkers more than a hundred years ago—were brought by Scotch dealers, or drovers, when returning to their own country, after disposing of their 'drives' of black cattle in England. The mothers of the milky herd being thus introduced into Scotland, there is good reason to believe that bulls of the West Highland breed were used for crossing; for West Highland cows are to the present day good milkers, and we often see a brindled bull or cow of the Ayrshire breed; but, above all, in the size and shape of the horns of a true Ayrshire there is clear evidence of West Highland blood. Another—not very pleasant—trait of character might also be mentioned, which

Photograph by G. H. Parsons, Alsager

Ayrshire Cow, Dewdrop I

sti
spi
goi
shi
to
pre

anc
An
the
anc
gra
cow
bee
sta
anc
kin
larg
of
ma
whe

Ayr
are
belo
187
is s
roar
side
not
of
pret
is d
to
Hig
cow
purc

still further confirms this supposition: both breeds are of spiteful and pugnacious dispositions, and always ready to gore or rip up each other when a fair chance offers. Ayrshires, although bred together, will do this, and it is safest to screw wooden or iron knobs on their sharp horns, which prevent their injuring each other.

"Large numbers of Ayrshire cows are annually bought, and sent to England, Ireland, and the United States of America, and the breed is rapidly rising in favour in all these countries, for, although they are profitable on poor and inferior pastures, they are much more profitable where grass is rich and plentiful. The returns from individual cows and from whole dairies of the breed have frequently been published in the agricultural papers, and from these statistics it is easy to understand why many tenant farmers and dairymen are anxious to obtain cows of so profitable a kind. The first cost being much less than what is paid for large cows, and the fact that a considerably larger number of the small cattle can be kept on a given acreage, induce many men to give the northern breed a trial, especially where milk is the chief desideratum."

Ayrshire Points.—"The favourite colour of the Ayrshire is a light brown, or brown and white; some few are found black and white (a notable bull of this colour, belonging to the Duke of Buccleuch, won many prizes about 1875 or 1876), and now and then even a pure white one is seen; but, so far as I have seen or heard, they are never roan-coloured. At one period an Ayrshire was hardly considered pure unless it had a black nose, but a white nose is not looked upon as any drawback to a good cow at the time of writing. When a cow or bull is slightly brindled it is pretty sure to have a black nose, or if the prevailing colour is dark brown, the nose and some other points are likely to be black; this is merely an indication that the West Highland blood is reappearing. Some people think if a cow shows a 'notch' in each of the ears it is a sign of a pure Ayrshire, but this is a mistake; it belongs, nevertheless, to some families, and is regularly transmitted, but it is no particular advantage, and an Ayrshire cow is just as well without the notch. Nor do I attach any importance to the 'escutcheon,' never having observed that a cow was better or worse for having a large one.

"The udder is the chief point from which we can infer the milking capabilities of a cow of any sort, and especially of an Ayrshire. Take the following description of what good judges esteem the best shape and appearance: 'It should, in form, be long from front to back, stretching well forward on the belly, broad behind, filling up well the space between the legs, but should not be too deep vertically—that is, hang too far down—space being obtained in it rather through length and breadth.' I may add to this description that some cows, even with large well-shaped 'bags,' are not nearly so good as they look, on account of their bags being fleshy; and it is sometimes hard to tell, from their appearance, whether they have been milked or not. A cow having a far smaller udder, but which can be emptied, or 'milked,' as it is called, is of more value, and will probably keep on milking fairly well for a much longer time than the former will do; it is always satisfactory to see the large veins on the belly full and prominent, with a good large cavity at the upper end of each. When well fed, a good Ayrshire cow will give milk up to within two or three weeks of calving, but she ought never to be allowed to do so, as it injures her considerably for the following season; milking once a day should be begun about ten weeks before the cow is due to calve, and she ought to be quite dry at least eight weeks before calving. There is often considerable difficulty in doing this, but the animal should be kept on straw and water until the milk leaves, if found necessary.

"As young Ayrshire heifers and cows have generally very small teats, inexperienced or heedless milkers should not be employed to milk them; after they have had one or two calves, their teats get larger, and they are as easily milked as cows of any other breed. As these cows are of lively and active dispositions it is very seldom indeed that they require any help when calving, unless they have been allowed to get too fat ; this sometimes happens when they have run on to midsummer before calving, and when they have had very good pasture. The best way is to turn a cow, when she is about to calve, into a roomy loose box or yard, and leave her alone ; it is very seldom that interference with her on these occasions does anything but mischief. When any unusual symptoms are observed she may be looked to occasionally, and assisted if really necessary."

To the foregoing we may add the description of the breed as given by the "Ayrshire Herd Book Society" :—Head short, forehead wide, nose fine between the muzzle and eyes, muzzle large, eyes full and lively, horns wide set on, inclining upwards. Neck moderately long and straight from the head to the top of the shoulder, free from loose skin on the under side, fine at its junction with the head, and enlarging symmetrically towards the shoulders. Fore-quarters—shoulders sloping, withers fine, chest sufficiently broad and deep to ensure constitution ; brisket and whole fore-quarters light, the cow gradually increasing in depth and width backwards. Back short and straight, spine well defined, especially at the shoulders ; ribs short and arched ; the body deep at the flanks. Hind-quarters long, broad, and straight ; hook bones wide apart and not overlaid with fat ; thighs deep and broad ; tail long, slender, and set on level with the back ; udder capacious and not fleshy, hinder part broad and firmly attached to the body, the sole nearly level, and extending well forward ; milk veins about udder and abdomen well developed ; the teats from 2 to 2½ inches in length, equal in thickness, the thickness being in proportion to the length, hanging perpendicularly ; their distance apart at the sides should be equal to about one-third of the length of the vessel, and across to about one-half of the breadth. Legs short in proportion to the size, the bones fine, the joints firm. Skin soft and elastic and covered with soft, close, woolly hair. Colour red, of any shade, brown or white, or a mixture of these, each colour being distinctly defined. Brindle or black and white is not in favour. Average live weight in full milk about 10½ cwt.

Mr. Buchanan made some suggestions as to the best times and ages at which Ayrshires should be purchased in Scotland by farmers who wish to try the breed in England and Ireland. "Those who wish to keep up a supply of milk in winter as well as in summer, and who have small farms, must no doubt buy cows near calving, or already calved; but there are serious risks in conveying them a long distance by rail. If the cows are calved they are very liable to catch colds at draughty stations; they cannot be regularly milked on the journey, and consequently we often hear of them taking milk fever after arriving at their destination. If, on the other hand, the cows purchased are very near calving, there are obvious risks of their calving in trucks, in which case I have found they do not recover from it during the whole season. Perhaps the best way for those to do who cannot keep heifers for a few months is to employ a cattle agent in a district where the breed is kept to go to the houses of farmers who have cows to sell, and to buy them when they are only beginning to 'spring,' and these may be conveyed with comparative safety by rail. To the English or Irish farmer, however, who has a good outlet for cattle through the winter, my advice is to buy at some of the Scotch fairs in October or November; he will get good heifers rising three years old, warranted in calf, at the current prices; these will thrive on grass fields through the winter, and they do not require anything extra until snow or frost comes, when a little chaff daily will keep them well enough until they can get a sufficient supply of rough grass again."

Ayrshires as Milk-producers.—A few well-authenticated cases of the quantities of milk given, or weight of butter produced, by some good specimens of this breed were recorded by Mr. Buchanan:—

"Mr. Burns tells us, in the book previously quoted from, that the Duke of Athole bought an Ayrshire cow from Mr. Wallace, of Kirklandholm, which produced 1,305 gallons of milk from 11th April, 1860, to 11th April, 1861, or about 17 quarts daily for forty-four weeks. He estimates the value of the new milk at 9d. per gallon, and that would give £48 18s. 9d. in a year.

"In June, 1868, I set aside the milk of a number of my best cows, in order to try how much butter they would each yield in seven days, with the following results :—The best cow produced 14 lb. of butter, and the worst very nearly 12 lb. in the time named; these cows were all pure Ayrshires, bred from stock which I had imported from Scotland. The pasture they had was first year's clover seeds, and they had no other food whatever; the quantity of milk required for each pound of butter was nearly 12 quarts. The experiment was made on the farm of Sackville, near Tralee, Ireland, and was conducted with great care and exactness.

"In County Durham there are many farmers who keep Ayrshire cows. In July, 1876, one of those farmers showed me his dairy-book, from which it appeared that in 1875 the gross returns from his thirty-six cows were over £35 each cow, and he assured me that he thought it a very bad year indeed when they produced less than that figure each. This gentleman had carried on his dairy for nearly thirty years in that neighbourhood, and had always, up to that date, bought cows, as he required them, in Scotland." Mr. Buchanan added that this seemed the best plan for English farmers to follow.

Ayrshires cross well with other breeds, and some excellent store cattle result from mating the Shorthorn or Aberdeen-Angus bull with Ayrshire cows.

Under the microscope the milk of the Ayrshire is found to be well stocked with nitrogenous matter or casein, and the cream globules are numerous, varying a good deal in size. This defect tells against the Ayrshire as a butter cow, for the cream does not rise well when the globules are unequal in size, nor is all the butter got out of it except by skilful churning. The milk is exceptionally well adapted for cheese-making.

The late W. P. Allsebrook of Wollaton wrote as to his experience with Ayrshire cows in the Midlands:—" They are specially valuable where the pasture land is not of a first-class quality, for their mouths seem to be harder than those of Shorthorns, and they do well on dry, wiry pastures that would starve cattle of more aristocratic blood. On second or third-rate land heavy costly cattle require much extra care and artificial food, or they will be sure to lose money; but Ayrshires, on such land, thrive and do well. One of the objections urged against Ayrshires is that they will not feed—they are bad grazers. Doubtless some are, but some of all breeds are bad ones for that purpose. I have had many that would get fat as readily as cattle of other breeds; and if such are selected as appear likely to feed there will be little disappointment in that direction. Still, if we get a little cow that eats but little and did not cost much, that will yield some four or five gallons of milk per day for months together, year after year, we may well forgive her if she is not easy to feed afterwards. If breeders of these very useful animals would pay more attention to the points indicated it would doubtless be an advantage, and if dams that are good milkers and also flesh carriers are selected, the objection would cease to be valid. Milk from Ayrshire cows is of a good quality, though not so rich as that from Channel Island cows. I have found, from repeated tests, that where Ayrshire cows were fairly matched against graded Shorthorns, ordinary Derbyshire cows, or good Irish cows, the Ayrshires had the best of it, their milk yielding about two per cent. more cream than the others.

"More Ayrshires can be kept on the same quantity of food. Three Ayrshires usually eat about as much as two ordinary Derbyshire cows, and three of the former will give more milk than three of the latter."

As already mentioned, the great points of an Ayrshire cow are the udder and teats. The udder must reach well forward, and be firmly attached up to the body, not coming out behind or hanging loosely down; the quarters alike in size, and the teats set on widely and equally apart, neat, and not very large, square at top like a cork, not hanging together like a bunch of parsnips under a loose flabby bag. For breeding, milking, and ultimate fattening combined the first place must be assigned to the Shorthorns, but for milk alone that place may probably be assigned to the Ayrshires. They are naturally hardy and vigorous in constitution; and their superiority over many other breeds is most apparent under adverse conditions, viz. hilly land with scant pasturage, and a climate subject to sudden and extreme changes of temperature. The cheerful look, the earnestness of manner, and the marked physical activity of the Ayrshires stamp them at once as being valuable and trustworthy cattle; and these qualities, combined with those previously mentioned, are a strong recommendation to farmers in districts to which nature has not been kind, as well as in those which are favourably situated.

Dairying districts, as a rule, are those in which the climate is more or less variable, where the atmosphere is cool and showers of rain are frequent, thus favouring the growth of pasture-grasses; where the winters are not unfrequently severe and the springs and autumns treacherous; where the general conditions of weather and soil are adapted to the growth of green rather than grain crops. To such conditions, particularly in more extreme cases, Ayrshires appear to be specially well adapted, so far as physical fitness is concerned; while, as regards their milking properties, there is hardly room for two opinions. On wet, clayey, or heavy soils of any kind, on which heavy breeds of cattle do much harm in a "dropping season," the lighter Ayrshires are an advantage, because they do not tread up the ground so much, and so destroy less of the grass. The Ayrshires possess, of course, a few undesirable qualities, but the only ones worth mentioning are their somewhat deficient aptitude to fatten, unless they are well selected for the purpose, and the shortness of their teats (this, however, is now being remedied). They are of a lively and active disposition.

An average of the milking trials at the London Dairy Show gives the results from fourteen Ayrshires. The daily milk yield was 45·4 lb., which contained 4·26 per cent. of fat, and 9·26 of solids other than fat, the total solids averaging 13·55 per cent. Mr. Primrose M'Connell, B.Sc., in the *Live Stock Journal Almanac*, stated the yield of herds of ordinary cows of the breed to be from 620 to 650 gallons of milk per annum.

The countries to which Ayrshires have been exported include the United States of America, Canada, Norway, Sweden, Finland, Denmark, Russia, Australia, Japan, and many others. In recent years a large number have gone to Sweden and Norway. As already indicated, the Ayrshire Cattle Society publishes a Herd Book, the first volume having been issued in 1878.

Orkney and Shetland Cattle.—The small cattle of the Orkney and Shetland Islands are supposed to be descended from the Norwegian race, being similar to those found in Iceland. The scanty herbage partly accounts for their diminutive size. The Shetland variety are very hardy, and the beef is of fine quality, while the milk yield is good in comparison to their size. They have rough, shaggy coats of various colours—light, dark and piebald. In symmetry they are irregular, though the best are very shapely. They cross well with Shorthorns. The Orkney cattle have been intercrossed with the Shetlands, and possess similar characteristics.

CHAPTER IX

Breeds of Cattle (*continued*)

CHANNEL ISLAND BREEDS: JERSEYS AND GUERNSEYS—IRISH BREEDS: KERRIES AND DEXTERS

Channel Island Cattle.—The Jersey and Guernsey breeds were for a long time known as "Alderneys," and are still occasionally referred to by that name, while they are also spoken of frequently as "Channel Islanders." The former of these terms was merely adventitious and not sufficiently descriptive, while nowadays it is actually misleading. Happening to be the shipping point for all the islands of the group, viz. Jersey, Guernsey, Alderney and Sark, and only so because it is nearer than the others to the coast of England, Alderney gave its name a long time ago to all cattle coming that way, whether from the other islands or from the mainland of France. The term "Channel Islands cattle" is more correct as well as more descriptive, but with the extension of Herd Books and breed societies the breeds are now generally referred to by their proper titles, Jerseys and Guernseys.

The source from which the Channel Islands cattle originally sprang is not known with anything like certainty; presumptive evidence, however, points to Normandy and to Brittany, on account of their nearness to the islands. But as these island cattle are now totally different in type from those of the adjacent mainland, it is probable that if they ever came from there at all they must have come many hundreds of years ago. The great difference in colours, in fact, removes to a very distant point the probability that they have a common origin. An island home for cattle is, of course, highly favourable for the formation of a type differing from the original stock, providing the natural influences of soil and climate are sufficiently marked to bring about the change; and in this case we may infer that fidelity to type was not maintained by repeated importations from the mainland, for the inhabitants of the islands have long been jealous, and have prided themselves on their jealousy, of the purity of the breed of their beautiful cattle; and indeed a most excellent jealousy it is! The radical differences which exist between these island cattle and their neighbours on the mainland, supposing the remote origin of both is identical, are so marked that it must have taken a long period to bring them about; and, besides this, the type of the former is so "fixed" that we have no room to doubt its great antiquity.

Be their origin what it may, however, these Channel Islands cattle are, and long have been, famous for the quantity and richness of their milk, and for their surpassing excellence as "butter-cows." The Brittanies are smaller in size, but with this exception Channel Islanders are less fleshy, physically more refined, lighter boned, and generally smaller than the cattle of the adjoining districts of France. These differences are accounted for by difference of soil, of climate, and of treatment. The mainland cattle generally are stronger, robuster, and hardier than those of the islands, because they live in a less genial climate, have less affectionate care bestowed upon them, and roam at large on the pastures; and the Brittanies are smaller and hardier on account of a poorer soil and a severer climate. The climate of Jersey is remarkably genial, and its soil is fertile; on the north and west the island is fringed by a high rocky shore, which secures to the southern-sloping land a grateful shelter against the cold and boisterous winds of winter. The breezes of the Atlantic that sweep over it, and the strong tides that wash its rocky beach, are greatly tempered by the warm and softening influence of that Gulf Stream to which the west coast of Ireland owes its adventitious mildness and fertility. The grass is green and nutritious, and the japonica blooms throughout the winter; so that the winters and summers of Jersey are not in violent contrast, and all its seasons are mild and uniform. So far may be reckoned the influence of climate on the type of cattle.

The agriculture of Jersey is gardening rather than farming, so thrifty and industrious are the people. The farms are usually very small—say twenty acres or less on an average; the cultivated crops are to a great extent raised by spade-husbandry and hand cultivation, and the abundant seaweed provides a cheap and valuable manure; the fields are very small, and their productive capacity is raised to a high degree. When deep ploughing is needed for the growth of root crops, the farmers join their teams and help each other, turn and turn about, because on one of these small farms the horses kept are not alone sufficient for the purpose; and high farming on a small scale is carried out to a degree scarcely to be found anywhere else out of China and Japan. The pastures on which the cattle graze in summer are orchards or small crofts, and from their birth none of the animals are allowed to roam at will, even in those small enclosures, but are always tended by children or tethered.

This method of treatment, and the great care bestowed upon them at all times and seasons, have made the Channel Islands cows very docile and gentle, though it may be they are less hardy and vigorous than they otherwise would have been. The comparative lack of exercise has, however, done more than affect the character and physique of the breed,—it has influenced it also with regard to the exceptional richness of the milk. Where there is little or no exercise there is no hard breathing, and consequently only a moderate degree of oxidation or combustion of carbon in the animal economy; and, as the hydrocarbons of the food the cow eats are converted into butter, the less exercise the animal takes the richer the milk will be in the fats of which the butter is composed. On the other hand, physical exercise tends to the formation of muscle rather than of milk—

that is, the food of the animal is in part diverted from the production of milk, and especially of rich milk. Such being the case, it naturally follows that animals treated and bred in the way the Jerseys have been for generations will acquire as one of their marked features the capacity to produce milk very rich in quality; and this feature is transmitted from parent to offspring, just as surely as any other quality that has been acquired by breeding in a given direction. As regards the health of the animals, it should be mentioned that on the islands they are especially free from tuberculosis, a fact which goes to prove that if cattle are exposed to the rays of the sun and kept out in the open as much as possible, they will to a large degree escape this malady.

Bred on islands limited in size, whose inhabitants for generations past have been most particular not to admit cattle from other countries, and in this way have constantly aimed at maintaining the purity of their own stock, the blood of the Channel Islands cattle has become more nearly thorough in its concentration, prepotency and refinement than that of most other breeds of the bovine race. In Jersey and Guernsey stringent local laws against importation of cattle were enforced long before the commencement of the nineteenth century. But though to the purity of the breed of these cattle such uncommon value was attached more than a century ago, they have in modern times been very greatly improved by careful selection in breeding, and the Channel Islanders of to-day are very superior to those of ninety years ago.

Jerseys.—Some at least of the foregoing remarks apply to both of these two breeds of butter cows, the Jerseys and the Guernseys. We shall now proceed to deal with their characteristics and distribution separately. Under the fostering influence of a genial climate, a fertile soil, kind and generous treatment, and a jealous watchfulness as to purity of blood, the Jersey cow has ripened into what she is: a small, gentle, and exceedingly winning animal, famous

Jersey Cow, Cute II

al
Th
qu
te
of
tha
it
be
glo
mo
of
aso
cre
and
mi
mil
are
the
in

Jers
part
in r
fixed
as a
John
Eng
of t
Man
Roy
the
" Mr
ficati
exhil
gath

alike for meekness and for milk, for butter and for beauty! The uncommon richness of the milk she gives, and the quantity and quality of the butter it will yield, are characteristics acquired by careful breeding through a long period of time. Butter made from her milk has a higher colour than that from the milk of, perhaps, any other breed, and it has also the merit of being more easily worked and of being firmer and more wax-like in texture. The cream globules are larger in size, and this accounts for the cream moving so freely upwards through the milk; the envelope of casein—if such it be—seems thinner, and to this may be ascribed the ease with which the butter comes out of the cream in churning; while the unusual firmness, richness, and flavour of the butter are due to qualities not yet determined. The cream globules of milk differ in size in the milk of different breeds. The globules in Ayrshire milk are intermediate between those of Dutch and Jersey, and the following figures illustrate the differences between those in Jersey and in Ayrshire milk:—

Jersey, average size, $\frac{1}{5233}$ of an inch.
Ayrshire, " $\frac{1}{7080}$ "

The Royal Agricultural and Horticultural Society of Jersey, which was established in 1833, has taken an active part in improving the Jersey breed. Shows were begun in 1834, and prizes were awarded for pedigree, and upon a fixed scale of points. In 1866 a Herd Book was founded as a result of the efforts of Mr. Chas. P. Le Cornu. Mr. John Thornton, who was instrumental in forming the English Jersey Cattle Society, has written the fullest history of the breed, under the title "Jersey Cattle and their Management," originally contributed to the *Journal* of the Royal Agricultural Society of England (1881). As regards the "Island Herd Book," commenced in 1866, he says:—"Mr. Cornu foresaw the necessity of some further classification of the animals in a show where upwards of 200 were exhibited. His principle was to sift, as it were, the large gatherings into three classes; by highly commending the best for their quality, symmetry, and their constitution, and their butyraceous or milk-flowing properties, commending the second best, and rejecting the remainder, or third class, and by examining and registering the approved offspring, he hoped in time to root out the bad animals, so that with six or seven registered crosses animals might be bred more to a certainty."

Description of a Jersey Cow or Heifer.—The following is the description of the Jersey cow or heifer as drawn up by the Royal Jersey Agricultural Society in 1875:—Head small, fine and tapering. Cheek small, throat clean. Muzzle dark and encircled by a light colour, with nostrils high and open. Horns small, not thick at the base, crumpled, yellow, tipped with black. Ears small and thin, and of a deep orange colour within. Eye full and placid. Neck straight, fine and lightly placed on the shoulders. Withers fine, shoulders flat and sloping, chest broad and deep. Barrel hooped, broad and deep, being well ribbed up. Back straight from the withers to the setting on of the tail; broad across the loins. Hips wide apart and fine in the bone; rump long, broad and level. Tail fine, reaching the hocks and hanging at right angles with the back. Hide of a yellow colour, thin and mellow, covered with fine soft hair. Legs short, straight and fine, with small hoofs. Arms full and swelling above the knees. Hind-quarters, from the hock to point of rump, long, wide apart, and well filled up. Hind-legs squarely placed when viewed from behind, and not to cross or sweep in walking. Udder large, not fleshy, running well forward in line with the belly and well up behind. Teats moderately large, yellow, of equal size, wide apart and squarely placed. Milk veins about the udder and abdomen prominent.

Guernseys.—Although the Guernsey is descended from the same original foundation as the Jersey, the former breed now differs from the latter in size, appearance, and colour. It is larger than the Jersey, not so beautiful or elegant, and the colour varies from light red to lemon and orange fawn, with white markings. A great quantity of milk is yielded, and its quality for butter-making is high. The differences between the two breeds are attributed to selection in breeding, and to the sustained cultivation of peculiar features to suit varying tastes and purposes. It has also been suggested that the long and extensive use of oxen for labour in the island of Guernsey probably tended to the increase of size and strength by selection with a view to the breeding of powerful oxen. The result, by whatever means attained, has been the production of a very valuable breed, which has steadily increased in favour.

Characteristics.—Mr. James James, a very successful breeder of Guernseys, has given the following comprehensive account of the characteristics of these cattle, in a paper contributed to a United States Consular Report :—" This breed has long been famed for its cream and butter producing qualities, and it is also eminently adapted for the shambles when, from age or other causes, these valuable properties fail to be profitable. The animals are exquisitely delicate in form, in colour varying from light red to lemon and orange fawn, almost all having a considerable admixture of white. In individual cases there are black patches, encircled with light-coloured hair. The most approved points of a Guernsey may be considered to be : Head small but long ; eye bright, lively, but placid ; horns small and well turned upwards, being fine, yellow and waxy at the base ; ears small and thin, with fine, thin hair, and a deep golden colour inside ; nostrils open ; neck long and slender, tapering towards the head ; shoulders thin ; fore-quarters light ; limbs delicate ; back straight, and broad behind ; tail fine and thin, set on at right angles with the back ; hide thin and mellow to touch ; carcase deep and well let down ; hind-quarters full and large ; udder capacious, broad and square, well in line with belly and stretching well forwards, not fleshy, silky, with fine down or hair ; milk veins very large and prominent ; teats large and strutting outwards, and well apart; the general figure compact, wedge-shaped; skin tinged with a deep orange-yellow throughout, especially marked inside the pastern joint. The opinion of the Guernsey farmer is much divided as to what may be considered the most approved points of the male animal. Some prefer the bull which possesses many of the points as approved in the female; others, those of the more masculine type."

In greater detail on some points is the scale adopted by the English Guernsey Cattle Society, which we quote as follows:—Head fine and long, muzzle expanded, eyes large, quiet and gentle expression. Horns yellow at base, curved, not coarse. Nose free from black markings. Throat clean; neck thin, and rather long, not heavy at shoulders. Back level to setting-on of tail, broad and level across loins and hips. Rump long. Withers thin; thighs long and thin. Barrel long, well hooped and deep at flank. Tail fine, reaching hocks, good switch. Legs short, arms full, fine below knee and hocks. Hide mellow and flexible to the touch, well and closely covered with fine hair. Yellow inside the ears, at the end of tail, and on skin generally. Fore udder large and extending forward, and not fleshy; udder full in form and well up behind with flat sole. Teats rather large, wide apart and squarely placed. Milk veins prominent, long and tortuous. Escutcheon wide on thighs, high and broad, with high ovals.

The Milk-Producing Quality of Guernseys.—The deep rich colour of the milk of the Guernsey imparts that golden hue which is so much appreciated, and, as Mr. G. Titus Barham remarks, it is this quality which makes the Guernsey cow so valuable to introduce into a herd for the purpose of improving the colour of the butter. The milk of a few Guernseys will very perceptibly tinge the milk of a dairy of Shorthorns. The Guernsey milk is also noted for its high percentage of butter fat, which the late Sir John B. Lennard gave as 4·80 per cent. and up to 5·50 per cent. In the United States cows have given from

15 lb. to 22½ lb. of butter in seven days. Newly calved cows have given milk which yielded 1 lb. of butter from 16 lb. to 18 lb. of milk, and, after milking some months, 1 lb. of butter from 10 lb. to 12 lb. of milk. A cow belonging to Colonel Macleay, of Glasshayes, had her first calf in 1886, and it was eighteen months before she again calved. During that time she gave 5,053 quarts or 1,263 gallons of milk. Calving again in August, 1888, she gave in sixteen months 3,595 quarts or 898 gallons. She calved the third time in August, 1889, and up to the end of May, 1890, gave 3,644 quarts; her average for the first six months being 14·5 quarts a day, and for ten months 12·2 quarts. She was officially tested for butter five months after calving in the months of November, 1888, and gave 14 lb. 1½ oz. per week. A cow sold to go to America gave 22½ lb. of butter in seven days from 19 quarts of milk a day.

At an important dairy test, extending over six months, at the Pan-American Exhibition at Buffalo, United States, in 1901, the Guernsey breed greatly distinguished itself, winning two of the four prizes—one for the herd showing the greatest net profit, butter fat alone considered, and the other for the herd showing the greatest net profit, butter alone considered, as determined by the churn. Five cows of each of ten breeds competed. The Guernseys gave 1,248·1 lb. of fat and 1,429 lb. of churned butter. The cow that stood at the head of the list for butter profit out of 50 competitors was the Guernsey Mary Marshall, which gave a butter profit of 59·40 dollars, a Red Polled cow being next with 52·10 dollars. The percentage of fat given by the five Guernsey cows was 4·60, and percentage of total solids 13·9. The profit on estimated butter was 230·11 dollars, and on the churned butter 220·37 dollars.

The Guernsey cow yields a good carcass of beef, but there is a prejudice against meat with yellow fat. In the island of Guernsey, however, "foreign or white beef" brings an inferior price.

The English Guernsey Cattle Society was formed in

1884, and publishes a "Herd Book" for the breed. There are also Herd Books published on the island.

The Irish Breeds: Kerries and Dexters.—The late Mr. R. O. Pringle, author of the "Live Stock of the Farm," and formerly editor of the *Farmers' Gazette* (Dublin), contributed the following notes on the Irish breeds of Kerries and Dexters:—

"Irish cattle have from time immemorial been noted for their milking properties. The old-fashioned cow, now extinct through crossing, gave a large quantity of rich milk. Those cows were not Kerries; they were short-legged cattle, long in the body, and many of them were hornless, or, as they were called in Ireland, 'moylé' cattle. Others had widespread, elevated, and projecting horns. They were of all colours, but chiefly black, brindled, or red, and some were mottled along the ridge of the back. These characteristics, although indicating some distinction as to kind, did not affect the value of the cows for the dairy. No attention was paid to selection in breeding; but, notwithstanding the neglect with which they were treated, their milking properties remained intact.

"The Kerry breed of cattle is undoubtedly an aboriginal breed, and is now the only native breed existing in Ireland; for, although the common or native cattle of Connaught are larger than the ordinary Kerry, and differ to some extent in shape, still it is evident they are from the same original stock as the Kerry. There is much in the Kerry which indicates a relationship between it and the small Breton breed, and, considering that Brittany and Kerry are the nearest points of France and Ireland, it is not improbable that at some remote period cattle may have been conveyed from one country to the other."

Difference between Kerries and Dexters.—"The Kerry cow is a neat, light-made animal, with fine and rather long limbs, fine small head, lively eye, fine white horn, which in many cases, after projecting forward, is turned or 'cocked' backward. The rump is narrow, and the

Photograph by G. H. Parsons, Alsager

Kerry Cow, Fenella

thi
but
sho
wit

or t
thic
whi
stra
vari
resu
cow
yielo
and
desc
Dex
for s
are v
of gr
"
did r
main
have
witho
The
been
men
the s
sidera
in it
have
a 'fa
stock.
Si
have
becon
herds

thigh light. The fashionable colour is pure black throughout, but some are black and white, and others red. The skin should have a mellow touch, and ought to be well coated with hair.

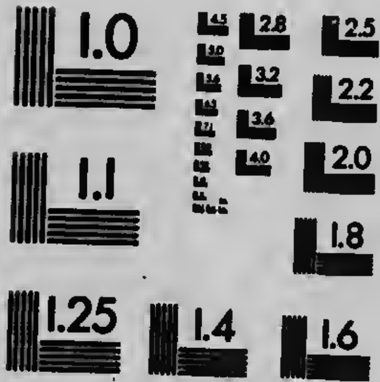
"The 'Dexter' variety is distinguished from the pure or true Kerry in having a round plump body, soft and rather thick legs; the head is heavier, and wanting in that fineness which marks the true Kerry, and the horns are longer, straighter, and coarser. The real origin of the Dexter variety is not well understood, but it is supposed to be the result of special selection. Youatt described the Kerry cow as 'truly the poor man's cow, living everywhere, hardy, yielding for her size abundance of milk of a good quality, and fattening rapidly when required.' This is a correct description of the breed, both the true Kerry and the Dexter. In Ireland the Kerry is much esteemed as suitable for small villa farms, as the cows, although naturally active, are very gentle, and do well when tethered on confined bits of grass. They also thrive when kept constantly house-fed.

"With a few exceptions, the breeders of Kerry cattle did not until recently devote much attention to the proper maintenance of the breed, and the fact that Kerry cattle have survived the neglect with which they have been treated without material deterioration is strongly in their favour. The Knight of Kerry has a herd of Kerry cattle which has been bred with great care for a long period, and other gentlemen in that part of Ireland have also devoted attention to the subject; but the reputation of the breed has been considerably enhanced by the interest which has been taken in it by gentlemen residing in other parts of Ireland, who have taken up the breeding of Kerry cattle not merely as a 'fancy,' but from the intrinsic merits of the breed as dairy stock."

Since the foregoing was written the Kerry and the Dexter have made great advances in popular favour, and have become widely distributed, there being now many fine herds of these little breeds in England. One of the first

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



considerable herds established was that of Mr. Martin John Sutton, and he also showed choice specimens of the breeds at the leading agricultural exhibitions. Numerous other herds were established, one of the best being that of His Majesty the King at Sandringham. Classes have been provided at the shows of the Royal Agricultural Society of England, the Smithfield Club, and several of the other leading agricultural societies, and many supporters of the breed have been secured.

A Herd Book started by the *Farmers' Gazette*, Dublin, was subsequently acquired and published by the Royal Dublin Society.

The English Kerry and Dexter Society was formed, and also published a Herd Book.

Points of the Kerry.—"As regards the Kerry, the description given in the Herd Book of this Society is as follows:—The cow should be long, level, and deep; colour, black; head, long and fine; horns, fine at base, mottled or white tipped with black, upright and cocked; eye, soft and prominent; bone, fine; her coat, in summer like satin, in winter long and thick; the udder should be soft and large, but not fleshy, protruding well under the belly, the teats being placed square and well apart, the milk veins prominent and large; the tail should be well put on, and have at the end long, fine black hair. The Kerry cow should not weigh over 900 lb. live weight when in breeding condition. A small amount of white on the udder and under line not to disqualify. The bull should be whole black without a white hair; should have a long head; wide between the eyes; of masculine character; throat, clean; horns, medium length, mottled or white with black tips, turning backwards; withers, fine; back, straight from withers to setting-on of tail, which should be long, fine, tipped with black hairs. The Kerry bull should not weigh over 1,000 lb. live weight when in breeding condition."

Points of the Dexter.—The Dexter is described in the same Herd Book as essentially a milk-producing and a beef-making breed, and both these points should, in judging, be taken into consideration. As regards colour, the bulls should be whole black or whole red (the two colours being of equal merit); a little white on organs of generation not to disqualify an animal which answers all other essentials of the standard description. In colour the cows should be whole black or whole red (the two colours in this case being also of equal merit); they should be black with white on udder or red with white on bag. The extension of the white on the udder slightly along the inside of the flank or under side of the belly, or a little white on end of tail, should not be held to disqualify an animal which in all other essentials answers the standard description. The other points are described as follows :—Head and neck—head, short and broad, with great width between the eyes, and tapering gracefully towards the muzzle, which should be large, with wide distended nostrils; eyes, bright, prominent, and of a kind and placid expression; neck, short, deep, and thick, and well set on to the shoulders, which, when viewed in front, should be wide, showing thickness through the heart, the breast coming well forward. Horns—these should be short and moderately thick, springing well from the head, with an inward and slightly upward curve. Body—shoulders of medium thickness, full and well filled in behind; hips, wide; quarters, thick and deep, and well sprung; udder, well forward and broad behind, with well-placed teats of moderate size; legs, short (especially from knee to fetlock), strong, and well placed under the body, which should be as close to the ground as possible; the tail should be well set on and level with the back. The skin should be soft and mellow and handle well, not too thin; hair, fine, plentiful, and silky. Dexter bulls should not exceed 900 lb. live weight when in breeding condition.

Kerries and Dexters as Milk-Producers.—A herd of Kerries was started by Mr. Pierce Mahony, at Kilmorna, Listowel, his aim being to have cows of about 6 cwt. live weight that would give on poor pasture 500 gallons of milk in the year, without extra feeding. In 1886, several of his cows produced an average of 504 gallons each of milk, which yielded 12 per cent. of cream, one giving 9⅜ lb. of butter per week on grass alone. The cream percentage was raised to 15·4, while a cow which on his poor land returned 12 per cent. of cream, when she was put on really good land gave 24 per cent. Mr. Robertson's experience of an ordinary Kerry was that she would yield on an average 12 quarts of milk per day, and 10 to 11 quarts produced 1 lb. of butter. The weight of the animals when fat, he said, was from 30 to 36 stone of 8 lb.; they frequently ran up to 40 stone. The cow Babraham Belle, exhibited by Mr. Adeane at the Royal Show at Warwick in 1892, weighed 889 lb.; she gave during the morning and evening milkings 51½ lb. of milk, or by measure 5 gallons, yielding an average of 4 per cent. of butter fat, the total solids being 13 per cent. A Dexter cow belonging to Mr. Martin J. Sutton gave, from April 1st, 1892, to April 3rd, 1893, as much as 4 tons 9 cwt. 3 qrs. 20 lb. of milk, averaging nearly 3 gallons per day; the live weight of this cow was only 6 cwt. 3 qrs. 6 lb. The average for Kerries over five years at the London Dairy Shows was 28 lb. daily milk yield; 4·15 per cent. fat; 9·05 solids other than fat; and 13·19 total solids.

An average of live weights of Kerries at the shows of the Smithfield Club for four years gives the following:— Steers under two years old, 860 lb.; steers under three years old, 980 lb.; and heifers under three years old, 935 lb.; the average daily gain being: for steers under two years, 1·17 lb.; steers under three years, 0·89 lb.; and heifers under three years, 0·85 lb. For Dexters the average weights were: For steers under two years, 800 lb.; steers under three years, 1,010 lb.; and heifers under three years, 950 lb.; the average daily gain being: for steers under two years, 1·09 lb.; steers under three years, 0·92 lb.; and heifers under three years, 0·86 lb. The beef of these breeds is of excellent quality, supplying the small joints now so much in demand.

Dexter Cow, Compton Daphne

D
re
d
k
of
B
w

no
su
th
of
his
ap
pr

cat
int
be
me
fou
isol
the
for
be
Abe

exc
mill
the
Ker

good
coln
the
the

As is remarked in a paper in the English Kerry and Dexter Cattle Society's Herd Book, the Kerry or Dexter readily crosses with other breeds, and in many cases produces animals of exceptional merit. An instance is the well-known Straffan-Dexter Shorthorns, the outcome of a series of experiments carried on for many years by the late Major Barton, of Straffan, co. Kildare, and which were attended with great success.

Other Breeds.—That the British Isles should possess now—as, indeed, they have possessed for many centuries—such a number and variety of domesticated live-stock of the farm as cannot be found in any other country, is one of the most remarkable and interesting facts in natural history. This fact, indeed, suggests many considerations appertaining to what I may venture to term the versatile productiveness of our soils and climates.

It is desirable to confine our notice, in this volume, to cattle only. And, indeed, they form alone a sufficiently interesting study, well worth ten times the space that can be allotted them. This will at once be seen in the statement that we have now some two dozen breeds, including four or five varieties which themselves are now sufficiently isolated and differentiated from the parent stocks to merit the name and title of distinct breeds that are dependable for breeding true to type. As of these last indicated may be mentioned the Red Shorthorns of Lincolnshire and the Aberdeenshire Shorthorns.

Of these numerous breeds, each of which is more or less excellent in its sphere, there are five which may be called milking breeds, pre-eminently so. These are the Jerseys, the Guernseys, the Ayrshires, the Kerries and the Dexter Kerries.

Yet a dozen may be called general purpose breeds, really good for both milk and beef—viz. the Shorthorns, the Lincolnshire Red Shorthorns, the Aberdeenshire Shorthorns, the Red Polls of Norfolk and Suffolk, the South Devons, the South Hammers, the Herefords, the Longhorns, the

Pembrokes (Castle Martin and Dewsland varieties), the Angleseys, the Orkneys and the Shetlanders.

The remaining breeds are essentially beef cattle, and more or less deficient at the milking pail. They are the West Highlanders, the Polled Angus, the Galloways, the North Devons, the Sussex, the Glamorgans, and the Gloucesters.

But these do not exhaust the number of our insular and indigenous breeds of cattle. On May 24th, 1895, was sold a herd of twenty cows and heifers and five bulls, owned by Mr. R. S. Lofft, of Troston, Bury St. Edmunds. They were described in the *Times* of May 20th as "white polled cattle." They were supposed to be a tamed variety of the Wild White Cattle of this country.

In 1879 several herds of these wild white cattle were in existence which have since disappeared. The Chartley Park herd went to the south so recently as 1904, and the Lyme Park herd, in Cheshire, some twenty years earlier. A letter from a previous owner of Lyme Park to the present writer runs as follows:—

"LYME PARK, DISLEY, CHESHIRE.
"*October 2nd*, 1890.

"DEAR SIR,—The breed of Wild Cattle here became extinct about six years ago, and as far as I know there is no blood remaining among the cattle about this district.
"Yours faithfully,
"WILLIAM J. LEIGH."

It is believed that only three herds are now in existence in their ancient haunts—those of Chillingham, Cadzow and Vaynol. These represent the original wild cattle from which our many tame breeds have been evolved and developed by taming and domestication.

CHAPTER X

FEEDING AND TREATMENT OF DAIRY CATTLE

THAT the feeding and treatment of cattle is a most important question few will be slow to admit, and yet in practice it is too generally neglected. If all dairy-farmers could be made to realise the simple fact—so simple that it is commonly lost sight of—that whatever milk or beef is produced must be produced wholly from the food that the animals eat, a great change in the treatment of cattle would spread over the face of the country. Not a morsel of beef, not a drop of milk, is produced without food; not a movement of a limb can be made and not a breath be drawn that is not compensated for in food. If the cows travel two miles or one mile to pasture, or if they are hurried, or abused, or frightened—all is paid for by the food. If they are chased by dogs, or by flies, or by men, they are chased at the cost of food, and the milk is poorer in butter—nervous excitement uses it up. There is not one degree of heat in the body of the cow that is not produced from the food she eats. If cows are exposed in winter to a temperature of several degrees below freezing point, if they are "deformed by dripping rains or withered by a frost," food enough must be burnt in the stomach to make up for the loss of heat through the skin. This is Nature's law of equivalents: "Something must be paid for everything, for it is impossible to produce anything from nothing."

With regard to dairy cows, it must be borne in mind that they have first of all to live before they can produce any milk at all from the food they eat; and that about two-thirds of their food goes to keep them in fair condition before any milk can be made from it. This has been tested and proved over and over again. Some dairy-farmers seem to think that they can with impunity keep their cows on "short commons" during the winter, and that they will pick up in the spring and milk as well as ever; but this is crass stupidity. A poverty-stricken cow must first of all supply the needs of her system and get back into decent condition before she can possibly give rich milk and plenty of it; and many cows for months in the summer do not fully recover from a winter's starving; some never get over it at all. All *profit* that comes from either a dairy cow, or one that is being fattened, is derived from the food over and above that which is necessary to sustain the offices of life; and in a fattening animal that weighs no more at the end of the season than at its beginning the food consumed has, except for the excreta, been wholly wasted; that is to say, the farmer derives no profit from it. So with a dairy cow: if she gives no more than 200 gallons of milk in the season, she is kept at a loss.

A dairy cow is simply an organism for the production of milk, just as a steam-boiler is a machine for the production of steam; and food is fuel to the cow exactly as coal is fuel to the boiler. If the cow is pinched of food she will not yield a profitable quantity of milk; this explains the proverb: "You had better be over-rented than over-stocked." So with the boiler, if it receives only coal enough to make the water warm, there will be no steam. There is, of course, as already pointed out, a great difference in cows, as there is in boilers, as to the return they make for the fuel consumed; some cows and some boilers seem to burn a great deal of fuel to waste; and it is from the fuel, not from the cow or the boiler, that we derive our profit. It is, therefore, a mistake to bestow good and abundant food on cattle whose physical imperfections prevent their turning it to the best account. It is advisable to test carefully the milk-producing capacity of a suspected cow; this may easily be done by weighing the food she eats and the milk she yields during a given period, and comparing them with similar records of a cow that is a satisfactory milker. Such tests and comparisons as these are very instructive; and whoever makes them carefully and repeatedly is pretty sure to carry out the lessons they teach, which course will soon result in the evolution of a first-class herd of dairy cows,—a consummation that is within the reach of every dairy-farmer. It is scarcely necessary to say that calves from cows that are poor milkers should never be kept to replenish the herd with; they should go to the shambles, not to the milk-pail.

Effects of Food.—The effect of food on animal nutrition, more particularly with regard to the production of cheese and butter, and taking into account the influence of breed in the animal consuming it, has been carefully investigated by an American expert, and he gives as follows a summary of his conclusions:—

1. That the production of butter is largely dependent on the breed.

2. That there is a structural limit to the production of butter in each cow.

3. That when the cow is fed to this limit, increased food cannot increase the product.

4. That the superior cow has this structural limit at a greater distance from ordinary feed, and is more ready to respond to stimuli than the inferior cow.

5. That, consequently, the superior cow is seldom fed to her limit, while the inferior cow may be easily fed beyond her limit; and as a practical conclusion, increased feed with a superior lot of cows will increase the butter product; but if fed to an inferior lot of cows, only waste can be the result.

6. That the character of the food has some influence on the character of the butter; but even here breed influences more than food.

7. That there is no constant relation between the butter product and the cheese product.

8. That the casein retains a constant percentage, and that this percentage does not appear to respond to increased food.

9. That the casein appears to remain constant without regard to the season.

10. That increase in the quantity of milk is followed by an increase in the total amount of casein.

11. That insufficient food acts directly to check the proportion of butter, and has a tendency to decrease the casein of the milk and substitute albumen.

12. That the best practice of feeding is to regulate the character of the food by the character of the animals fed—feeding superior cows nearer to the limit of their production than inferior cows; feeding, if for butter, more concentrated and nutritious foods than for cheese; feeding for cheese product succulent material which will increase the quantity of the milk yield.

It will thus be seen that to secure a full measure of success the dairy-farmer must devote at least as much care to the breeding of his cows for milk production as he does to their feeding and treatment, and to the improvement of his land for the same end. Not one or even two of these points, but all three of them demand special attention.

One of the reasons why poor land produces milk which, as compared with that produced on good land, is deficient in fatty matters, and so is better adapted for cheese-making than for butter-making, lies in the fact that the grasses on it contain a larger proportion of flesh-forming ingredients—as albumen, fibrin, casein, gluten, etc.—and a smaller one of fat-forming ones—as starch, gum, sugar, etc.—than are found in the grasses of rich land.

Effects of Exercise and Weather.—Another reason is found in the additional respiration of oxygen which takes place in the animal system when cows are pastured on poor land, and have to go through *more exercise* in the search for food. The oxygen of the air, which is inhaled to an increased extent by animals who take an extra amount of exercise, has a direct tendency to consume the fat in the system of the animal: actual combustion of the fat takes place. Hence the increased heat of the animal's body, and hence also a diminished amount of fat among the tissues, and a diminished proportion of butter in the milk.

Again, the more exercise an animal takes the greater will be the waste or breaking up of the tissues; and, as this is the source from which the curd in milk is derived, milk produced on land whose herbage is scanty will contain a smaller proportion of cream than milk produced on land whose herbage is abundant. And so the milk of unduly exercised cows, in whatever manner that exercise may be brought about—whether on poor land in search of food, or in travelling a distance to and from the pastures, or in being chased by dogs, or flies, or men—will likewise have a normal proportion of casein in it and a small one of butter.

It is unnecessary to point out that the less exercise an animal takes the sooner it will fatten, for this simple fact is known to every farmer; and it is equally well known that the more exercise an animal—a horse, for example—is made to take, the more food is required to maintain the condition and bulk of that animal. And the ratio of the consumption of fat is equivalent to the violence and extent of the exercise.

It will now be perceived why it is that the milk produced on poor land has a normal proportion of curd and a small one of butter compared with milk from good land; it will be equally plain that the shorter the distance cows have to travel to and from their pastures, whether those pastures be rich or poor land, the richer in fats their milk will be; and it will be even still more evident that the faster they are made to traverse that distance the poorer their milk will be. Distance and speed bring about a greater inhalation of oxygen, and the more the oxygen that enters the system the greater will be the consumption of fat in it.

In the hot weather of summer, when cows are tormented by flies and by heat, the evening's milk will always be found poorer than the morning's in butter. This is explained on the same principle; and so is the fact that the milk of stall-fed cows is richer in fats than the milk of cows who roam at large on the pastures, presuming that the two sets of animals are fed on exactly the same kinds and quantities of food. Experiments have demonstrated the truth of this statement.

Conclusions as to Feeding.—The following conclusions may be regarded as sufficiently well established for all practical purposes: Firstly, an increase of the ration with respect to both nitrogenous and non-nitrogenous matter does, within limits, increase the yield of milk, and the richness of the milk in solids; and, also, the better the natural yield of the cow, the larger will be this increase. Secondly, changes in the proportion of carbohydrates only in the fodder produce no marked effect on the yield of milk. Thirdly, the proportion of fat in the ration bears no special relation to the proportion of fat in the milk, but an increase of fat in the fodder rather increases the production of milk as a whole. Fourthly, the most constant interdependence between the composition of fodder and the yield of milk was found to exist with reference to the proportion of albuminoids in the fodder. Within certain limits the production of milk rises and falls with the proportion of albuminoids in the ration. But for every animal there is found to be a limit beyond which any addition of albuminoids to her food produced no effect in the yield of milk. Fifthly, in general the composition of the dry substance of the milk is not sensibly altered by changes in the composition of the ration; but to this there are some striking exceptions.

The sum and substance of the whole question may be stated simply, in this way:—Moderately fed dairy cattle in milk will yield a better profit than those that are over-fed on the one hand or under-fed on the other. Each cow should be fed according to her capacity for milking, and no cow should be fed until she leaves no part of her food unfinished between meals. Out on the pasture she will eat what she needs and likes, and then take a rest.

Calving-Time.—On farms whose speciality is the production of cheese the practice still is, as it long has been, to have all the cows drop their calves in the early months of the year: the bulk of them in March and April, and some of the heifers in May. In the first or second weeks of May, or whenever else there is grass enough to go on with, the cows are turned finally out on the pastures, having for a week or two previously been pastured on "seeds" or other earliest grass during the day, to accustom them gradually to the change from dry to green food and from indoor to outdoor feeding; and they commonly depend wholly on the pastures from this period until the time when the eddish in the meadows is available. Later on they have early turnips, vetches, or cabbages carted out to them on the pastures, until the time comes when outdoor keep begins to fail, and the blasts of early winter give warning that it is no longer wise to keep them out of doors; they are then taken in o' nights, but for a little while longer still go out in the daytime, after which they are kept wholly indoors until spring comes round again. This is, in brief, the old and still general system of managing dairy cows on cheese-making dairy-farms.

For purely cheese-making purposes there is nothing important gained by having the cows calving before the middle of March, for they would then have passed partly through the flush period of milk before the time when the grasses in the pastures are most plentiful, luxuriant, and nutritious; indeed, the only advantage of having them calving very early—say in January and the first half of February—lies in the better chance there is then of those calves that are intended eventually for the herd being well reared in good time; but this does not counterbalance the disadvantage of having the cows past the flush of milk when the period of succulent grasses comes on.

It is a serious mistake, and one too commonly committed, to allow milch-cows to get into a low condition of system during the last three or four months of the gestation period, or, indeed, at any other period, for that matter; and this is too frequently done when they are "dry for calving." Many farmers milk their cows too far on into the winter, giving them too short a resting time before they calve again, and this is an almost inevitable cause of winter leanness of milch-cows; for as the time of parturition approaches, the cow has enough to do to supply the increased nourishment which the calf in the womb demands, without giving milk in addition.

Some cows, indeed, are such willing milkers that it is difficult to let them dry at all before calving, and it is even necessary in some cases to put a cow on "short commons" for a week or so to check the flow of milk. Generally speaking, however, cows show signs of drying up in milk some three or four months prior to the time at which they are due to calve, and it is as a rule advisable that they should give no milk whatever during the last month or two of gestation. The length of this period may be governed by the quality of the food which the cows receive; the better the food, the shorter the period of dryness, and vice versa. Some farmers think cows are less liable to "lose quarters" if they are not let dry at all; but the danger of this mishap is averted by drawing the teats now and then, when the cows are drying, to rid them of any milk that may accumulate. And, indeed, they should be let dry in a gradual manner, by milking once a day for a time, then once in two days, and so on till the milk is gone; this done, the "quarters" are safe enough as a rule.

If cows are lean and weak at calving-time, they are occupied during the best part of the ensuing summer in "getting their backs up again," during which has slipped away that which ought to be the flush period of milk; and it should ever be borne in mind that well-bred cows are particularly honest and grateful animals, always returning excellent interest on any little additional capital which is invested in them in the shape of nourishing food, especially at such times when they need it most: for instance, when their systems are, or ought to be, laying in a store of vigour for the next summer's work. Farmers too seldom think of this, and seldomer still do they put it in practice. The most profitable milking season—the one, that is to say, when there is the highest return on the lowest expenditure, and with the least labour—is when the grass in the pastures is most nutritious and tender, in the months of May, June and July; and the lacteal stage of the cows themselves should—where cheese is made—correspond with this, by their having but recently passed through parturition. If cows when turned out to grass are in good condition, and have recently calved, they will always give a good account of themselves, provided they are of a right sort for milk.

Many dairy-farmers make the grave mistake of thinking that when cows are dry for calving it is the time to economise food by keeping them on straw or weathered hay,—on anything, in fact, which they would never venture to give them if they were in milk. And yet this is the very time when a generous diet will lay the best foundation for subsequent usefulness. It is true that inferior kinds of forage may be most conveniently consumed at this period, but they should be improved by the addition of a few pounds of cake per day to each cow; and if straw is being used at this time, it should be chaffed and improved by adding to it some kind of meal, and its bulk may well be increased by brewers' grains; but in any case the *quality* of the ration should be made at least equal to that of good meadow hay: less than this is insufficient to allow in-calf cows to acquire before parturition that amount of bodily condition which is necessary to enable them to give a good flow of milk during the coming season. A handy system of improving inferior hay, without chaffing it, is to scatter a handful or two of maize-meal over it in the mangers before the cows; this done, not only will the hay be consumed with a relish, but the mangers will be kept clean without any trouble on the herdsman's part; the quantity of meal used will be regulated by the quality of the hay and the condition of the cows. It will pay well to treat even good hay in this manner, particularly when fed to cows in milk and when it is rather scarce, so as to spin it out to the best advantage; this is the best way to save hay in winter, when there is no other bulky food to be had.

Flesh-forming and Heat-producing Foods.—It is necessary in the artificial feeding of cattle to remember that the flesh-forming and the heat-producing elements should be made to bear a given relationship to each other, according to the season of the year. If a cow is not in milk she may not need any more albuminoids in cold than in warm weather; but she will need more heat-producing food. In summer she will require 3 lb. of heat-producing food for every 1 lb. of flesh-forming food she uses, and in winter 5 lb. or 6 lb.; and she will live well on food in such proportions if she is doing nothing more than merely living: 25 lb. of good hay per day would supply her with 2 lb. of flesh-forming and 10 lb. or 11 lb. of heat-producing elements, and on this she would do well enough, along with water *ad lib.* But when she is in milk she requires a much larger proportion of albuminoids, say 2 lb. to 5 lb.; to keep up the flow of milk she must receive those kinds of food in which albuminoids bear an increased proportion as compared with heat-producing materials. These kinds of food would be meal of various sorts and corn generally, bran, oil-cake, cotton-cake, and hay cut a little under-ripe. The table on page 169 shows, approximately, the proportions of these elements in various kinds of food, and a careful study of it will enable a farmer to give his cows such a ration as will admit of the least waste of food and of money.

For the production of milk, grass of good quality is the most nearly perfect food that cows can eat. If it is required to increase the quantity and the value of the milk for cheese-making purposes, artificial food rich in nitrogenous matters —albumen, casein, legumen, etc.—may be fed to the cattle; if to increase them for butter-making, non-nitrogenous food may be added, in which there is a large proportion of starch, gum, sugar, oil, etc. And in winter it is well to prepare the food, so that it may be easy of digestion

Foods	*Percentage of Albuminoids*	*Starch, Sugar, Gum, etc.*	*Fat*
Linseed-cake	28·3	41·3	10·0
Decorticated cotton-cake ..	41·0	57·0	10·0
Undecorticated " ..	24·0	46·9	8·0
Bean meal	25·5	45·5	2·0
Pea "	22·4	52·3	2·5
Rye "	11·0	69·2	2·0
Indian corn	10·0	68·0	7·0
Rice meal (best)	6·9	77·0	4·0
Palm-nut meal	14·0	76·0	4·0
Wheat bran..	14·0	50·0	3·8
Oats	12·0	60·9	6·0
Barley	9·5	66·6	2·5
Malt	9·0	76·0	3·0
Malt culms	26·0	60·0	4·0
Alsike clover in blossom ..	15·3	29·2	3·3
White " " ..	14·9	34·3	3·5
Red " " ..	13·4	29·9	3·2
Lucerne	14·4	22·5	2·5
Maize, cut green	3·0	39·0	1·1
Common meadow hay ..	8·2	41·3	2·0
Pea straw	6·5	35·2	2·0
Oat straw	2·5	38·2	2·0
Barley straw	3·0	32·7	1·4
Wheat straw	2·0	30·2	1·5
Potatoes	2·0	21·0	0·3
Carrots	1·5	7·0	0·2
Turnips	1·1	5·1	0·1
Mangels	2·0	8·0	0·2

and assimilation, taking grass as a standard of perfection in this respect. This can only be done by gently steaming the food, or by moistening it with water or pulped turnips, and allowing it to lie together in a heap until the fibre is softened by incipient fermentation. In cold weather, tepid water given to cows will increase the flow of milk.

Arable Dairy-farming.—We naturally, or rather from force of habit, associate dairy-farming chiefly with grass land. The districts specially known as devoted to dairying in the British Islands are the grass-land districts, in those sections of the country where the humidity of the air is well suited to the growth of permanent pastures; and our arable districts, on the other hand, are chiefly those in which, owing to the dryness of the soil and climate, the area of grass land is small, and where dairy-farming is carried out on a very small scale. In only isolated cases has dairy-farming been extensively followed on an arable basis, with but a small amount of permanent grass; and, in these islands, we have consequently come to regard dairy-farming as being inseparable from grass land.

This idea, however, though based on the practice of many generations, is not necessarily the only one that may be entertained with respect to dairy-farming. Permanent grass land, as the leading feature of the farm, is not by any means essential to successful milk-production in the great bulk of cases, and in dry climates it is certainly unfavourable to profitable dairying. While it is true that some kinds of land in given districts are more profitable in grass than under the plough, it is none the less so that other kinds will not pay either the landowner or the farmer if they are kept in permanent pasture. It follows, therefore, that in some districts, and almost everywhere on light and naturally dry land, dairy-farming will yield better returns in conjunction with arable cultivation than it will if wholly depending on permanent grass land.

On this arable system, where the farmer is free to crop as he likes, dairy-farming may be carried on with a very small area of permanent pasture, or, for the matter of that, with none at all; but if pasture were always dispensed with it would, of course, be necessary to keep the cows and young stock constantly in sheds or yards, and feed them there, cutting and carrying to them all the green food in spring, summer and autumn, as well as the dry food in winter. And it is true that on this method a larger number of cattle can be maintained than on any other, because the land, being constantly under cultivation for the several crops, produces a maximum supply of food, and also because the waste of food is reduced to a minimum. It must be borne in mind, however, that the labour bill, the outlay in manures and feeding-stuffs, and, the wear and tear of horses and implements, will all be much greater on this plan than on any other; and as all farming is, or ought to be, carried on to the profit of the farmer, it will be necessary to ascertain which system will admit of the most satisfactory results.

The Soiling System.—The practice of "soiling" dairy cows, throughout the spring, summer and autumn, with one kind or another of green food, has come greatly into favour, especially with those who send off their milk to some town or city. Some have even carried the system to the length of keeping the cows in the sheds all the year round, cutting and carting to them all the green food they eat; and there can be no doubt that this is a money-making system, provided it is intelligently and thoroughly carried out. But, where this is the practice, two-thirds or more of the land is necessarily under arable cultivation. On this system it is possible to carry on dairy-farming in a profitable manner on land which, being of a light and dry character, and situated in a dry climate, is commonly considered most suitable for sheep, roots and cereals. Such land will commonly grow good rotation crops of clover, rye-grass, *Trifolium incarnatum*, vetches, etc., all of which are well adapted to soiling; while it will produce, in the shape of straw and other forage, plenty of food for winter consumption.

The "soiling" system, indeed, is, according to degree, synonymous with arable dairying, and may with advantage be conducted on a basis of permanent pasture land as the chief thing in summer.

There can be no doubt that on light land in a dry climate dairying can only be profitably carried on in conjunction with arable cultivation and the growth of green crops for soiling. Left in permanent grass, such land is of very little value. It can only be made to pay by keeping it constantly under the plough, taking many green crops, and now and then a white one, and manuring each of them lightly, instead of one of them heavily and the next not at all; for light land does not retain manure from one year to another as heavy land does. It is, however, doubtful whether such a system of dairy-farming would be suitable to cheese-making on English methods. It used to be thought by English dairy-farmers that when cows were eating, in the early spring, young clovers and grasses on newly seeded land, it was very difficult to make sound cheese from the milk; and on some kinds of land, particularly marls, this difficulty does exist. In the dairying districts of France the soiling system is much more extensively practised than it is in England, and both cheese and butter of excellent quality are made; but the French make principally soft cheese, much of which is for early consumption; and the English hard cheese differs so widely from the French soft, that a system of farming suitable for the one would in all probability not be suitable for the other. Much too, depends on climate, but still more depends in all cases on the care with which, and the system on which, the cheese and butter are made, and on this point I shall have more to say later on.

Where the soiling system is carried out thoroughly it is necessary to have a regular succession of green crops, commencing with the early spring and continued until winter sets in. It is important to remember that dairy cows when in full milk should have an adequate supply of succulent food; and on land which is well adapted to the growth of various kinds of green crops a special effort should be made, and a regular system laid down, to provide these crops for consumption from April to November inclusive, along with a small proportion of dry food. It is a good system to give the cows throughout the summer one feed a day of green and dry food chaffed up together. The dry food may consist of straw or hay, whichever happens to be the more plentiful, and the mixture may with great advantage be improved by the addition of a moderate quantity of bean, pea, palm-nut, rice, or maize meal, bran of wheat, malt culms, linseed or cotton cake; for these kinds of food will supply the albuminoids in which, as a perfect ration for cows in milk, the addition of straw or hay may have made the mixture more or less deficient. Lucerne and various other clovers are excellent soiling crops, and, when cut whilst they are in blossom, contain a proper proportion of the different food-elements required by cows in milk; but most other soiling crops, such as rye-grass, green rye, vetches, green maize, and the like, are more or less deficient in albuminoids, and these elements should be supplied by one or other of the concentrated kinds of food mentioned above.

Rye.—For earliest green food in spring, rye is found to answer very well. Sown in September, on corn or potato land, it is usually ready to cut for soiling early in April. As soon as the corn or potatoes are harvested, the land should be well cultivated, cleaned and manured, and the seed drilled in at the rate of two bushels per acre; or, if the land is clean, they may be broadcasted. One of the best manurings for rye is soot, at the rate of 100 to 200 bushels per acre; but if soot cannot be readily obtained, 10 or 12 tons per acre of good farmyard manure, ploughed under when the land has been well cultivated and cleaned, will be found to produce a good and early crop. It must be borne in mind that the rye will be ready for cutting a fortnight earlier if the land is well prepared and manured than it will if these matters have been imperfectly performed or neglected altogether; and the secret of early cutting rests in having the land in high condition. The period during which rye is available for soiling is short, as it becomes too tough before May has far advanced; but it may commonly be used until the succeeding crop is ready to take its place, and, as soon as it is cleared off, the land may be ploughed up at once and planted with turnips, cabbages, or some other green crop, for autumn consumption.

Vetches.—To come into use immediately after the rye is finished, winter vetches, sown at several times in September and October, with a little wheat or winter oats to keep them standing, will provide a large amount of food in May, June, and July. Spring vetches should be sown at intervals from the beginning of March to the middle of May; and if there are two sowings in the autumn and four or six in the spring, the successive crops will bridge over the summer, from May to October, especially if they are assisted in May and June with clover or rye-grass; they will last, in fact, until turnips and cabbages are available. As spring-sown vetches are in the best state for use when seeds are beginning to form in the pods, the first spring sowing may be so regulated that the crop will be ready for use when the winter vetches are cleared off. There need, however, be no great amount of anxiety on this point, for clovers and rye-grasses are available in May and early June. To secure a good thick-set crop of vetches, 4 bushels of seed per acre should be sown broadcast, but if drilled, 3 or 3½ will be enough; and drilling is the best system, on account of the facilities it affords for hoeing the land so as to keep down the weeds until the crop is fairly established. A good crop of vetches will completely smother all the small annual weeds, and most of the others too; but with a poor crop the land is certain to become so foul that it is better to plough it up early and put in some other kind of crop. Along with spring vetches it is a good plan to sow a little rape-seed, say 1 lb. per acre, in order to keep the vetches standing better than they would alone. Though rape is an excellent green food for sheep, it is not much used for dairy stock.

Rye-grass and Red Clover.—Rye-grass and red clover, either together or separately, are commonly sown on a crop of corn in spring, and they come into use the following spring. They are exceedingly useful for a time for soiling purposes, say from the beginning of May until the middle of June, after which it is necessary to cut the remainder for winter forage, because if overgrown they are far less valuable than they are up to the blossoming period of the clover. Some farmers advocate sowing rye-grass early in July on land from which a crop of *Trifolium incarnatum* has recently been consumed; it is only necessary to surface-cultivate the land, providing it is clean, when it is fit for the rye-grass seed. When sown alone, 1½ bushels per acre is recommended; when with clover, 1 bushel; of clover seed, 14 lb. per acre along with the rye-grass will be enough; if alone, 20 lb. To grow either rye-grass or clover successfully the land must be in good condition; or, failing that, the crop must be well manured just before sowing, or at some convenient period afterwards. A good dressing of well-made farmyard manure, well incorporated with the soil, will ensure a good crop; as an alternative, the crop may be dressed in early spring with 2 cwt. of guano per acre, or a mixture of nitrate of soda, superphosphate of lime, and gypsum—say 1 cwt. of the first, 1½ cwt. of the second, and 2 cwt. of the third. These artificial manures are best sown in damp weather.

Maize.—Maize is an excellent green crop for soiling; it has long been extensively grown for that purpose in America, and it is, in fact, the favourite green crop in most of the great dairying districts of that country. It is also grown widely in France and other Continental countries for soiling dairy cows. It is a plant whose growth is rapid, and it answers well when sown for successive crops; it is, however, deficient in albuminoids, and, though a most valuable crop in itself, it is greatly improved by cotton cake, pea- or bean-meal being fed along with it. Simple of cultivation, a large cropper, of rapid growth, and rich in sugar and other heat-producing elements, maize ought to become fairly popular in Britain for soiling purposes or for winter forage. It is suited to a variety of soils, and when the land is in good condition, and the weather hot enough, will grow an astonishingly large bulk of food per acre. It is especially adapted to the production of milk, increasing the quantity and improving the quality; while, being tender, sweet, and succulent, it is much relished by cattle, so long as it is not overgrown. When the land has been well prepared by cultivation, maize may be planted after the manner of potatoes, the land well manured, and the seed scattered pretty thickly in drills 2 feet apart; this admits of the horse-hoe being used freely for a time. There need be no hesitation about sowing a good quantity of it, say an acre for each six or eight cows, to come into use in successive half-acre lots, for if there is more than enough for soiling purposes, it is a simple matter to cut and stack the overplus, after the manner of oats, and it will be found to make excellent winter forage.

Turnips.—Turnips are more costly and troublesome to grow than the preceding crops, and are not so well adapted to the production of milk, not alone because they will not produce so much of it, but also because they are apt to give it an unpleasant flavour; yet are they useful because they come in when most of the other green crops are done. Owing to the attacks of numerous enemies, of which the "fly" is the most destructive, turnips are not a crop on which certain dependence can be placed, and this uncertainty detracts greatly from their value. It is estimated that one-sixth of the turnips sown in these islands are annually destroyed in this manner. One chance of checking such wholesale destruction lies in having the soil well pulverised and mellowed by winter frosts, and in manuring it well in the spring, so that the crop may make rapid progress out of the reach of its enemies; and yet this forcing of the crop in its early stages diminishes its subsequent keeping properties, and it is liable to early decay. The turnip-fly is said to be driven off if the land has been manured with dung that has been produced in stables where disinfecting powders are constantly used; or by a spraying, repeated now and again while the danger lasts, of paraffin oil diluted with water over the young plants.

In some districts it is the custom, when the land is clean, to plough under 10 or 12 tons per acre of farmyard manure in the autumn, and to give it a further dressing of

3 cwt. of superphosphate or 6 cwt. of basic slag, in the following spring at sowing time; but as farmyard manure may generally be applied with greater advantage to meadow-land and to the growth of soiling crops, it is on the whole better to keep it for those purposes, and to grow the turnips with 3 cwt. each of superphosphate and dissolved bones. The thinning out and repeated hoeings which turnips require make them an expensive crop to grow, and when to this is added the uncertainty of the crop, it is no matter for surprise that they are much less widely cultivated than they were some thirty years ago.

Swedes.—Turnips and swedes alike are grown to the greatest advantage in a cool, moist climate, and on friable loams. Swedes are very useful for pulping purposes in the early winter months, because they keep sound longer than turnips; while mangels, which grow best on a strong, deep soil, and in a warmer climate than turnips or swedes, are most useful in the early months of the year, because they keep sound longer than either of the other roots, and also because they improve in quality by keeping until February or March. The cultivation, manuring, and general treatment are much the same with all of them.

Cabbage.—Of all crops cultivated for late autumn consumption, cabbage is without doubt the most valuable in all respects. Under generous treatment it will produce heavier crops than any other kind of green food, while its adaptability to the production of milk is of a very high order. It does not impart, as turnips do, an unpleasant flavour to milk, its feeding properties are much superior to theirs, and withal it is a healthy and most valuable article of food for dairy stock. The seed is usually sown in the autumn on well-prepared beds, the plants are moved later on into other beds, and in the spring are finally transplanted out in the fields. The soils best suited to them are deep rich, friable loams; but if the land is well manured and properly prepared, they will grow successfully in almost any soil. It is best, generally speaking, to ridge the land as if for potatoes, and after putting in 12 or 15 tons of well-rotted farmyard dung per acre, along with 2 cwt. of nitrate of soda, or 3 cwt. of Peruvian guano, the ridges should be re-split, and the cabbage plants "pricked in" about 2 feet apart. A handy horse-hoe should afterwards be used once or twice between the rows, and the soil "earthed up" again with a ridge-plough.

Prickly Comfrey.—Prickly comfrey (*Symphytum asperrimum*) some years ago attracted considerable notice as a forage plant; but though many farmers tried it on a limited scale, it does not appear to be regarded as one of the acknowledged crops of the farm. Provided only that animals would eat it freely, it might and would, after a time, come into cultivation, but we hear the objection urged against it that they will not; this objection, if sustained, is of course fatal to its popularity. We had it on two or three plots in the botanical gardens of the Royal Agricultural College at Cirencester, and it has been used as food for horses; yet not only are the horses averse to it, but it is not by any means a heavy cropper; still the land there is light, dry, and generally inferior, and under more favourable conditions the plant would, no doubt, do much better. It is said to be a native of the Caucasus, and, according to Loudon, was first introduced into England in 1779. Dr. Voelcker says of it:—"In its fresh state, comfrey contains still more water than white mustard; but, notwithstanding this large proportion of water, the amount of flesh-forming substances is considerable. The juice of this plant contains much gum and mucilage, and but little sugar."

Lucerne.—Lucerne (*Medicago sativa*) is already, and most worthily, popular in some parts of Britain, and its popularity probably will increase. In the Western States of America, particularly in California, and also in the South American States, it is held in very high estimation, and under the name of *alfalfa* it is very extensively cultivated both for soiling purposes and for winter forage. A practical

Californian dairy-farmer writes of it in the following terms :—" We speak our own experience, which has been considerable, and the experience of every dairyman in the northern half of the State, when we say that alfalfa is the best butter and cheese making plant we have ever fed cows upon, either in the summer or winter, either as grazing or hay. Indeed, it is the general testimony of dairymen who pasture cows on the native grasses and on alfalfa, that when pasturing on alfalfa the milk and butter are at least 20 per cent. greater, and much richer and finer, than when pasturing on native grasses." Lucerne, being one of the many kinds of clover, requires the same sort of general treatment as the others; like them, it does best in a deep soil into which its roots penetrate deeply, and though it prefers a soil that is not very dry, it likes a warm climate. Under favourable conditions it is said to produce 30 to 40 tons of green food, or 5 to 6 tons of hay, per acre per annum, in three or four cuttings.

The Right Use of Straw.—The remaining crops grown on a dairy-farm where soiling is practised will be wheat, oats, or barley, as the case may be; a portion of the land will be in permanent pasture for the use of young stock, and the remainder in meadow. While meadow hay is next to indispensable in winter-time, all the straw of the cereal crops will be turned to good account by being chaffed and mixed with pulped roots or brewers' grains, and brought up to a high standard of quality by the addition of various kinds of purchased feeding-stuffs, the selection of which will be partly governed by the state of the markets. In many cases, however, especially where the farmer has no conveniences for chaffing his straw, and where the straw is very good in quality, well harvested, and not overgrown, it is expedient to feed the straw to the cattle without chaffing it; and where it is given this way, it is found to be enhanced in value by setting the " battens " or sheaves on end out in the rickyard a few days before it is eaten, and either pouring water over it or allowing the rain, if any, to soak it; the soaking softens the fibre of the straw, prepares it for the stomach, makes it easier of digestion as well as of mastication, and the cattle relish it better, eat it up cleaner, and there is less waste. This may appear too simple an expedient to be valuable; but try it, we can recommend it. If there is any good in "steaming" such food, it is just the same good, done in a different way, which the straw derives from the soaking with water out in the rick-yard. Further, soaking is much cheaper.

The same principle is involved, done in yet again a different way, and along with certain other improvements, in the system of preparing straw-chaff described as follows by Mr. Samuel Jonas, in the *Journal* of the Royal Agricultural Society:—

"The straw, when delivered from the threshing-machine, is carried by rollers to the height of 9 feet; it then comes down an inclined plane. Three men get in the straw, and hand it to the chaff-cutter; it is then cut, and carried into the chaff-barn and well trodden down, mixing about a bushel of salt to every ton, and also a certain quantity of green-stuff. Tares or rye, cut green into chaff, are scattered by hand as the chaff is brought in. This causes it to heat, and adding the amount of green-stuff required to give it a proper heat is the secret of the successful operation of storing chaff.

"Respecting the quantity of green-chaff to be mixed with the straw-chaff to cause a proper fermentation: I use about 1 cwt. to the ton of straw-chaff, and 1 bushel of salt (56 lb.) to the ton of chaff. But some judgment is required as to the state of the green-stuff. If it is green rye on the ear a full hundredweight is required; if very green tares, a rather less quantity will do, as the degree of fermentation depends upon the quantity of sap contained in it. This is done in spring and summer—the chaff is not used till October and the winter months. I can thus thresh and dress the corn crops, and cut the straw into chaff, in one process, the expense of cutting and storing the same being about 1s. per acre; the principal additional expense is for about 4 cwt. of coal per day, and we thrash and cut from 8 to 10 acres of straw per day."

This simple, inexpensive, and in all respects excellent method of dealing with straw for feeding purposes recommends itself to farmers throughout the length and breadth of the land as one of sterling practical value, and it is to be hoped the system will obtain a widespread popularity. The straw formerly wasted in these islands, in one way or another, would have kept thousands of dairy cattle through the winter; and there was a still larger quantity which, though not absolutely wasted, was wastefully used. Vast quantities of straw which, prepared on Mr. Jonas's simple plan, would make valuable food, were formerly trodden down into manure as expeditiously as possible, as if that were the first object for which straw is cultivated, and the best use to which it can be put.

Composition of Meadow Hay, Straw Chaff, and Wheat-Straw Chaff.—The analyses on page 182, by Dr. Voelcker, show the composition of ordinary meadow hay, of Mr. Jonas's fermented straw-chaff, and of ordinary wheat-straw chaff, respectively. Tabulated side by side, the reader can see at a glance the great improvement produced by the fermenting process, and also the difference which yet remains between the fermented chaff and meadow hay.

In respect of these analyses, Dr. Voelcker remarks:—(1) The prepared wheat-chaff is one-fourth richer than the unprepared in materials which produce the substance of the lean fibre of meat or of muscle; (2) the percentage of sugar, gum, etc., amounts to nearly two and a half times the quantity which occurs in good unprepared wheat-chaff; (3) the treatment rendered soluble 50·85 per cent. of the vegetable fibre of the fermented chaff, whilst the soluble portion of vegetable fibre does not amount to more than 26·38 per cent.; (4) the fermentation has the effect of rendering the hard and dry substance, which constitutes the bulk of straw, more soluble and digestible than it is in its natural

	Compositions of		
	Ordinary Meadow Hay	*Fermented and Prepared Straw-chaff*	*Wheat-straw Chaff*
Moisture	14·61	7·76	13·33
Oil and fatty matters	2·56	1·60	1·74
*Albuminous compounds (flesh-forming matters)	8·44	4·19	2·93
Sngar, gum, and other soluble organic compounds	41·07	10·16	4·26
Digestible fibre ..	—	35·74	19·40
Indigestible woody fibre (cellulose)	27·16	34·54	54·13
Mineral matter (ash) ..	6·16	6·01	4·21
	100·00	100·00	100·00
* Containing nitrogen ..	1·35	·67	·47

condition; (5) the prepared straw-chaff has all the agreeable smell which characterises good green meadow hay, and a hot infusion with water produces a liquid which can hardly be distinguished from hay-tea; and (6) about 2 cwt. of decorticated cotton-cake ground into meal and added to 1 ton of fermented straw-chaff constitutes a mixture which agrees closely in composition with good meadow hay.

No definite rules can be imposed as to the quantity of food which dairy cows should receive—this depends entirely on the capacity of each cow individually; but it must be borne in mind that it is a wasteful policy to overfeed them. They should receive just what they will eat up cleanly; more or less than this will be detrimental not only to the comfort of the animals, but also to the quantity and quality of milk they give. The feeding of stock both requires and rewards careful and intelligent attention. Overfeeding is not only a waste of food, but is injurious to the cattle. Indiscriminate and lavish feeding is sheer and wanton waste. During the time a cow is in calf and in milk, and especially toward the end of the period of gestation, she will require an increased proportion of albuminoids or nitrogenous food, and a smaller one of carbonaceous, than if she is neither in milk nor in calf—that is to say, if she is merely growing or fattening.

The question of feeding cattle on sound principles is one that needs to be studied more than it has been by practical farmers, and we are glad to see that in many parts of tho country this is coming to be the case.

Mr. Primrose MacConnell, well known as a practical dairy farmer and as a lucid writer on the practice and science of farming generally, writes as follows:—

"For cheapness combined with efficiency, rations something like the following will be found suitable for medium-sized cows:—

"Hay, 14 lb.; oat straw (chopped), 7 lb.; mangolds (pulped), 45 lb.; cotton cake, 2 lb.

"With hay and roots alone, however, a bushel of mangolds (45 lb.) and 30 lb. of hay would be required to keep a cow going.

"The whole thing resolves itself into the question of giving the animal enough of good food (i.e. not musty or mouldy), without needing to make it 'rich' with concentrated cakes and meals, or at least using these very sparingly. If anyone who reads this has been in the habit of feeding heavily, and tries a reduced ration, he will be surprised at the result; the saving of expense will far more than compensate for the slight decline in the milk yield. It is likely that a small allowance of cake or meal will be beneficial, say 2 lb. or 3 lb. per head daily, especially if the fodder is a little inferior from weathering or mustiness; but all experience now goes to show that a greater quantity is fed at a loss, or that there is no proportionate gain in the milk yield.

"In the matter of preparing the food, experiment after experiment has shown that this may easily be overdone. Probably chaffing the straw to mix with pulped roots, plus a little meal, is the full extent of benefit to be derived. Cooking the food—a practice the writer followed for half a a lifetime—is all a mistake; putting some hot water over a mixture of feed to steam it a little to take the chill off in cold weather may be beneficial, but the writer has fed everything cold for several years now, with satisfactory results. We shall probably in another generation or two find out the best way to feed a milk cow."

First Aid in Illness of Cattle.—Dairy-farmers, as a rule, live on isolated farms, far away from a veterinary doctor, and therefore everyone of them should keep in stock, ready for use without delay, a well-selected stock of animal medicines, lotions, and pick-me-up powders, suitable to the probable requirements of his cattle. This precautionary measure is so obviously an act of simple prudence as not to need an argument in support. During a period of nigh upon fifty years the present writer has not neglected the "stitch in time" which is so commonly useful. The veterinary preparations of Day and Sons, Crewe, are, or ought to be, well known to all dairy-farmers, particularly their White Oils and Black Oils, the former for strains and swellings, and the latter for sores and wounds; and even more especially for Red Drinks and Black Drinks, either of which may save a life if administered intelligently and promptly. Take a case of parturient apoplexy, commonly known as "milk fever," to which further reference is made a little later on. Well, fatal effects may be averted by at once giving the cow a Red Drink and two wineglassfuls of chloral opiate. Parturient paralysis, a kindred malady, may be relieved by a Red Drink, followed by repeated doses of etheric ammonia, and by rubbing the spine vigorously with White Oils or Oil of the Night. These insidious attacks may be averted by pre-parturition doses of Red Drink once a week for a month, and by plain food that is laxative and easily digestible. And, to give another instance, I may add that I know not anything else so effective as Myrrhal Compound for bad cases of foul in the feet, a malady of which there is now and again something approaching an epidemic.

"Milk Fever" (parturient apoplexy) is a malady to be dreaded, though it is not transmissible. It is a disease of the blood, not yet fundamentally understood. Its victims are chiefly high-bred cattle, or deep milkers in high condition, and four or five years old. The malady may generally be checkmated and prevented by giving a Red Drink in gruel made of oatmeal and sweetened with black treacle a month before the cow is due to calve, and repeating the dose each week, or giving a half dose each three days, until parturition occurs. During this probationary period the cow should be fed on plain, laxative, easily digested food, of which almost any sort of grass freshly cut is the best of all. When parturition is consummated cover the cow's body at once with a rug which has been dried thoroughly and warmed in readiness, and give her to drink about a gallon of lukewarm water or thin oatmeal gruel, in order to stave off a possible chill. The calf's navel may advisedly be dressed with antiseptic preparation to prevent inflammation.

Every live stock farmer can obtain, at one penny per volume, the following bound leaflets, issued by the Board of Agriculture, 4 Whitehall Place, London, S.W. :—Section 2, "Farm Animals and Dairying." 3. "Diseases and Insect Pests of Farm Animals." 6. "Manures and Feeding Stuffs." These leaflets contain reliable information on various subjects on which enlightenment should be most welcome and useful to stock breeders.

With these and a stock of simple remedies, any intelligent dairy farmer may help his cattle out of many attacks which, neglected, may readily become fatal. To a great extent, except in surgical cases, a man may readily become his own veterinarian, and a good one at that, by the means suggested above.

Contagious Abortion in Cattle.—Short of death-producing maladies, contagious abortion is probably the most annoying ailment which, in certain localities especially, dairy-farmers have to contend with. There are cases of abortion to which cows are liable now and again; one or two wholly sporadic cases, on any farm, at any time of the year, but chiefly in winter. These are sufficiently unpleasant because of the loss of the calf, and of the cow's services as a milk producer. But they are trivial in comparison with an epidemic of the contagious variety of abortion.

It was only in 1893 that contagious abortion came under the ken of the Board of Agriculture, since which time the careful attention of veterinary officers, acting under instructions from the Board, has been constantly given to this serious malady. Results of treatment testify to efficiency of methods employed, and these are tabulated in Leaflet No. 108, issued free of cost and post free to applicants by the Secretary of the Board of Agriculture and Fisheries, 4 Whitehall Place, London, S.W.

Physical disturbance causing such abortion is defined as "an infectious catarrh of the womb, transmitted from one animal to another by the transference of a specific microbe."

Treatment consists of the following:—

1. All aborted cows should be strictly isolated, and all fœtuses and placental membranes should be burnt or buried.

2. No aborted cows should be bred from, but should be fattened and sold.

3. The sheds should be lime-washed every three months, adding to each bucketful of lime-wash 1 pint of common carbolic acid.

4. At the same time the under surface of the roofs, and all parts of the interior of the sheds which cannot be conveniently lime-washed, should be sprayed with a disinfectant.

5. All cows in the herd should have their hind parts—viz. anus, vulva, under surface of tail, thighs, and udder—sprayed with a solution of Izal in water, in the proportion of Izal 1 part, water 80 parts, or 1 ounce of Izal to every 4 pints of water. The necessary quantity of Izal is measured off and well mixed with the proper amount of tepid

water. This solution is then to be sprayed on the parts mentioned above with a garden syringe, using a fine rose. One syringeful will be sufficient for each cow, and during the spraying the tail of each animal should be slightly raised. This should be done three times a week.

6. The floors and drains of the sheds should be washed down with solution of Izal (Izal 1 part, water 200 parts) three times a week, alternately with the spraying of the cows.

CHAPTER XI

MILKING, CALVING AND CALF-REARING

MODERN exigencies have very much upset many old-fashioned methods; and milking has shared in the change which seems to have passed over all things: the hours—five in the morning and five in the evening—which used to be pretty uniform throughout the country, are now varied in different places to meet the needs of the milk trade. A given train has to be met, and the station is two or three miles away; the milker therefore often sits down to his cow in the morning while the cold stars are still seen in the sky. Punching his hat well into her flank—a hat well covered with hairs, much battered and shiny with grease from the skin of the cow, a hat which is kept for this one use, and lasts through many years—he tugs away lustily with hands and arms and shoulders, first on the fore teats and then on the hind, the hands working alternately because it is easier so, and that to a surprising degree.

Out of doors the milker is exposed to all sorts of weather. Storms of wind and rain contrive to be at their worst when the milking is half done. Very soon the soil is soaked with rain, in a day or two it is mud, and it sucks at one's boots. The three-legged stool, whose rude surface is roughly polished by use, sinks deeper and deeper into the mire. The gates, and the trees, and the old rails in the fence are dripping with wet, and the air is a vapour-bath. The rain runs in streams from the back of the cow and pours down the arms and thighs of the milker, while the wind blows big drops into the nape of his neck. But in fine weather, when the cows are contented, outdoor milking is not the least pleasant of the farmer's duties.

After a good many years' experience with both ways, we are strongly in favour of having the cows brought into the sheds and tied for milking, rather than of milking them out of doors in a corner of the field, and especially so if the corner is not railed off from the rest. On some inconvenient farms, however, the pastures are so far away from the buildings that it would be a mistake to bring the cows to the sheds to be milked, for the more exercise of this kind dairy cows are compelled to take, the less milk they will give. In cases of this sort it is a necessary evil to milk in the open. It is necessary because it is an unwise practice to bring the cows home from a distance, and is an evil because the milkers themselves lose a great deal of time in going to and from the milking field. The cows, especially in hot weather, are often more restless out of doors than in, and it is consequently not only more troublesome, but more annoying to milk them so. Wherever the pastures are within easy reach of the buildings, it will be found more satisfactory in all respects to milk the cows in their stalls.

The Necessity for Cleanliness in Milking.—In winter more particularly, but also at any other period if the cows are kept indoors and fed there, it is well before the milking commences for some person to go round with a brush or a coarse cloth in his hand and rub off from the cows' udders any loose dirt and dust, in order to keep the milk clean. In some cases it may be found necessary to wash the udders and teats; and it is no less desirable that those who are to do the milking should first wash their hands, and should never have long finger-nails, or the cows will have sore teats. One advantage in favour of milking out of doors is found in connection with this point, viz. that in case of being hurt by long finger-nails the cow will just simply walk off; whereas in the stalls the milker may suddenly find himself in the gutter, with the pail anywhere and the milk all over the place.

Really good and careful milkers are scarce and valuable. More frequently than people imagine, especially in the hot weather, milk has been injured by milkers' unclean hands and by cows' unclean udders; and we have seen milkers, with the false idea of milking easier, dip their dirty fingers into the milk in the pail, and then go on milking, the drops of dirty milk oozing out between the fingers and returning to the pail from which they were taken. Where this is done, the cheese and butter will suffer in condition more than those who do it are in the habit of thinking. Milk is a peculiar product, and exceedingly susceptible of injury from dirt of any kind and from impure odours; and if it is not taken proper care of it soon goes sour in hot weather, its natural tendency to decay being promoted by ever-present bacteria.

Some people say that each cow should, if possible, be always milked by the same person, as all cows will not let down their milk to other people. Now this, in our opinion, is the very way to train cows not to let down their milk to others, for when the person who has been in the habit of milking them happens to be away, the result is that some of them are milked with difficulty by anyone else. A better plan is to accustom every cow from the first to be milked by anyone to whose turn she happens to fall.

How to Milk.—Milking should always be done quietly, regularly, and thoroughly, though at the same time quickly. It should be done quietly, without any scolding or beating of the cow—some cows, though, are very provoking—and with as little talking and noise as possible, for many cows will hold their milk if they are scolded. It should be done regularly, because cows give their milk more freely; and they soon learn regularity themselves, if they are treated with regularity and system. It should be done thoroughly, getting out every drop when "aftering," because a cow will soon fail in her flow of milk if she is not milked clean each time; and it should be done quickly, for cows appreciate despatch, provided you do not hurt them, and because a good milker is almost invariably a quick milker. Violent nervous excitement not only lessens the quantity but lowers the quality of the milk. Cows are essentially creatures of habit; they soon learn to come towards the sheds at milking-time, grazing homewards, and sooner still they learn their own places in the sheds; they soon also acquire the habit of letting down their milk at regular times, and it is therefore quite desirable always to milk them in the same order in the sheds, beginning so that each successive cow can be sat down to without disturbing the previous one—that is to say, begin with the cow whose left or near side is next to the wall at the end of the shed, and they will all very quickly learn to expect being milked in order as they stand. This milking in order is one of the advantages of shed milking, for if the cows are milked out of doors, standing loosely about, it commonly follows that all the easy ones are milked first, but not in order, each milker aiming to get hold of the easiest cow he can find; but in sheds the cows must be taken in order as they stand, and so each milker gets his share of the "hard" ones.

Some farmers tie together the hind-legs of each cow, in order to prevent her kicking the pail over while she is being milked. With certain cows this is absolutely necessary, and we are inclined to think it is a good system to adopt, for now and then a most respectable sort of a cow, when anything hurts her, and sometimes when it does not—a cow whose general conduct is above reproach—will lift up her foot suddenly and overturn the pail in the twinkling of an eye; not that she intends at the time to be vicious, but it is a way cows have. It is a most unpleasant and startling thing for a man to have a pail of milk knocked over when he is milking, and this is oftenest done by cows whose characters are good, and with whom he is not so much on his guard as he is with those whose morals are shaky; hence we think it is not a bad practice to tie all cows' legs at milking-time, as the milkmaids do in Ireland.

When to Milk.—Whether cows ought or ought not to be milked oftener than twice a day is essentially a matter in which circumstances alter cases; but the following propositions may be accepted as being approximately correct:—

1. As a general rule, milking three times a day influences the secretion of milk, so far as its quantity is concerned, more favourably than twice milking. 2. In certain circumstances, in the case of cows that are large milk-givers and are highly fed, and are yet in the early period of lactation, milking three times a day may be obviously necessary for their comfort, especially with a view to the prevention of diseases of the udder. 3. The shorter the time that has elapsed since the last milking, the richer and fatter is the milk; so that in milking thrice a day a milk richer in quality is obtained than on the twice-a-day system. On the other hand, the following points require to be taken into consideration:—1. Milking three times a day necessitates a greater demand on the strength of the cows. Only where this is compensated by a corresponding amount of nourishment can milking three times a day be of lasting advantage. The better the cows are fed, the more likely is thrice-a-day milking to be more profitable than twice-a-day milking. 2. The better milk-giver a cow is, and the less she is advanced in lactation, the greater is the advantage of the thrice-a-day over the twice-a-day system. 3. On the thrice-a-day system the greater amount of labour required in it must be taken into consideration, a factor in the calculation which becomes of no little importance when the pasture grounds of the cows are at any considerable distance from the dairy.

Cracked Teats.—At some periods of the year, oftenest in the autumn, cows' teats are apt to crack and become sore. A little fresh lard, applied at milking-time and well worked into the skin of the teat during the operation of milking, will generally cure the sores with three or four dressings, and it certainly makes the milking much less painful to the cow, whether it cures the sores or not; but where the lard fails to cure, a little carbolic ointment should be used. A cow will now and again have a teat badly cut, or scratched, or torn by accident, and sometimes a sore will come which reopens every time she is milked, and which for a time defies all attempts made to heal it. These injuries cause acute pain to a cow when she is being milked by hand; and to avoid causing this pain, as well as to give the sore a fair chance of healing, it is a good thing for a dairy-farmer to keep always in his possession, locked up in a place where it can at any time be found, a silver "siphon," or "milk-tube." The sore teat should be milked with this whilst the sore remains; the tube should be carefully smeared with fresh lard before using, in order that it may be easily inserted into the teat, and it should be carefully cleaned each time after using, in order to prevent clogging with coagulated milk laden with micro-organisms.

Milking Pails.—Everyone who has been accustomed to milking is well aware what a difference there is between a properly and an improperly constructed milking-pail, so far as the milker's comfort is concerned. Deep, narrow cans are not only difficult to hold between one's legs, but they are generally awkward and uncomfortable. Milking-pails should always be narrower in the bottom than at the top. Some people still prefer wooden pails to milk in, but they are objectionable chiefly on account of the greater difficulty of keeping them sweet and clean. A pair of "ears" attached to a pail and resting on the milker's thighs are very useful in sustaining the vessel between the knees. In one design the seat and pail are combined; the cow cannot kick over or put her foot into the pail; the milk is kept free from hairs and dirt by the strainer inside the funnel; and the impure atmosphere of the cow-shed comes as little as possible in contact with the milk.

Milking Machines.—It is estimated that 200,000 persons are required to milk the cows in England alone, so it is easy to understand what an enormous amount of time and labour are expended in milking cows by hand, and it is hardly too much to say that milking is the great bugbear of dairy-farms. It is far from being easy work; it comes round at least twice a day with monotonous regularity, and it *must be done*, whatever else is left undone. Dairy-farmers feel the strain, and servants dislike the task of milking. A great number of attempts have been made to produce a thoroughly satisfactory milking-machine. There are several different machines in this country, and more in America, for which patents have been taken out, and it is to be hoped that one will before long be produced which shall embody the necessary qualifications of simplicity, effectiveness, rapidity in working, and harmlessness to the cows' teats; such a machine would be a great boon to dairy-farmers. The Royal Agricultural Society of England, alive to the importance of this matter, offered a special prize of £50 for an efficient and satisfactory milking-machine at the Bristol Show in July, 1878; but as no machines were entered for competition, it is plain that no inventor had then produced one which he deemed likely to be successful. Slow and gradual progress is being made towards perfecting the practical success so far attained. The "Murchland" milker, a Scottish machine, is well spoken of, and there are others—the "Lawrence Kennedy" machine, for instance—which do good work. It is, however, generally believed that an ideal milking machine still remains to some extent an unsolved mechanical problem. A great difficulty lies in the diversity in the size and position of cows' teats, and in the application of the motive power.

Most, if not all, of the so-called "cow-milkers" are on one common principle: that is, tubes of one pattern or another are inserted into the cows' teats, and as these tubes have holes near the upper end, the milk simply runs out by the force of its own gravity. The contrivance is effective enough so far as milking the cow goes, but the objection to passing tubes into a cow's teats every time she is milked is a serious one. The internal mechanism, if we may so term it, of a cow's teat is of a most delicate description, and is easily deranged by the introduction of foreign substances. Tubes inserted into cows' teats are also, unless inserted with great care, apt to produce inflammation. We have known at all events one cow, a valuable heifer, killed in this way;

Photograph by Sport and General Illustrations Co.

A Milking Machine in Operation

ar
ag
or
mi
he
to
ve
ev
co
all

bef
exc
diff
the
in t
not
ceas
S
cons
the
udde
off i
ing i
the
calle
diste
plug
wood
over,
the r
must
cow l
shoul
neck,
right
time

and if the tubes do no other harm, a complaint is lodged against them to the effect that they permanently distend or otherwise derange the opening into the teat, so that the milk runs out of its own accord and is lost. We have heard both favourable and unfavourable opinions given as to the utility of such a milker; and though we should not venture to recommend its indiscriminate use, we consider every farmer should possess one, if only to milk very "hard" cows a few times with it. The teats of such cows would be all the better for being distended a little.

It is recommended to milk a few drops from each teat before using the cow-milker, then insert the tubes (not exceeding an inch), when the milk will flow freely. No difficulty will be experienced whatever if the operator, in the first instance, take the precaution of seeing the hole in the teat whilst inserting the tube. The apparatus should not be allowed to remain in the teats after the milk has ceased to flow, or air will find its way into the udder.

Some cows are extremely "hard" to milk, and are consequently seldom milked "clean"; this is sure to cause the flow of milk to diminish, for if any milk is left in, the udder becomes more or less inflamed, and the milk falls off in quantity. The hardness in milking is caused by the hole in the end of the teat—the diaphragm, it may be called—being too small; it may be distended by the insertion of a small plug or cone of ivory, bone, or hard wood, well oiled, when the milking is over, and leaving it in the teat until the next milking-time, after which it must be re-inserted each time until the cow becomes easy to milk. The cone should be made with a head at the lower end, then a neck, after which it is sloped to a dull point. If made the right size, no harm will come of its use, and in a short time the orifice in the teat will become permanently

Teat Cone

liberated, and the cow will no longer be difficult to milk.

Rearing of Calves.— It may be laid down as a first proposition that a dairy-farmer should raise at least as many heifer-calves as are required to fill up the vacancies which occur year by year in his herd of dairy cows, and it is all the better if he has a few more than he wants for that purpose. Some people contend that three-year-old in-calf heifers can be bought for less money than they can be raised for, counting in the risks; this, however, depends entirely on the land a man has for young cattle, so as not to interfere with milking pastures. On all mixed farms it is commonly a simple enough matter to summer and winter young cattle so cheaply that it is better to raise them than to buy others for the dairy herd, and many farmers find it to their advantage to raise them for sale when "on note," or to fatten if barren. Judiciously carried out, rearing pays very well, and heifers raised on the farm are commonly found more suited to it in after-life as milkers than others that are raised elsewhere and purchased; besides which, it is more than probable that rearing will generally pay well in the British Islands, provided always that the stock is of good quality, for the demand for milk in our towns and cities is sure to go on increasing, and there will always be a brisk demand for store stock of good quality for grazing purposes. A careful breeder can but seldom buy dairy stock that will suit him as well as those of his own rearing; those he buys may, perhaps, be as well bred as his own are in every respect, but if they are only as well and no better bred, they will but seldom do as well at the milk-pail as those that have been reared on the farm.

There should always be one or two loose boxes available into which cows may be taken if anything is wrong at calving-time; but, generally speaking, they need not be taken away from their stalls at this period. There is a good deal of philanthropy wasted on this point by some people, for a cow will be more composed and tranquil in her own stall than in a loose box which is strange to her. It is a mistake to hurry cows over their calving. Give them time, supplement the efforts of nature, but do not supersede them altogether; and immediately they have calved give each cow about two quarts of *chilled water;* it takes away the sickly feeling better than hot water does, and it does the cow no harm whatever. Afterwards it is a good thing to give them linseed and flour gruel for a few days; this strengthens the cow and promotes the flow of milk. We have tried this system for years, always with satisfactory results.

It does not follow that a cow need be in very good condition herself in order to produce a strong and healthy calf; rather the contrary. A cow will often be rather lean at calving-time if she has been indifferently fed, and yet produce a surprisingly good calf. The calf is the explanation, in part, of her leanness; if she had been better fed she would probably not only have produced a still better calf, but would have been in a more satisfactory condition herself. On the other hand, it is not uncommon for a cow in very high condition either to produce a small and delicate calf, or to go barren altogether.

Many farmers like to have a given number of their best cows calving rather early, so that they may have their number of rearing calves in forward condition before cheese-making gets into full swing. There is, however, no real but only a fanciful reason why calves that are dropped in April should not be as well reared as those that are dropped in February. But the reason commonly assigned is this: as soon as cheese-making has fairly begun, the calves are begrudged the milk which is freely enough given to them before it commences. And yet milk applied to cheese-making is not by any means so essentially the most profitable use to which it can be devoted that the later calves should be unduly deprived of it on that account. This is a point on which a little reflection will dispel much of the prejudice that exists; and it must be borne in mind that calves will thrive faster in May than in March on a given allowance of milk, simply because the weather conditions are then more favourable. It is, however, an advantage to have the calves so far advanced that when grass-day arrives they are fit to be turned out on the pastures in good form, and this they hardly can be unless they are dropped pretty early.

Perhaps the most potent argument in favour of giving calves as good a start as may be in life lies in the fact that at no subsequent period do they grow so rapidly on a given quantity and quality of food. Moreover, if they are well started they never, as a rule, except from accidental causes, suffer a check in their progress to maturity. In any case, no matter when they are born, it is "a penny wise and pound foolish" policy not to rear them fairly well—always keeping short of pampering them. Except when rearing pedigree stock, or in case of late calving, it is seldom a good plan to allow the calves to suck at all from their mothers, because it makes them both unsettled when separated; and, once acquired, a calf seldom forgets the habit of sucking, but in after-life will commonly begin to suck other cows of the herd; or even to suck herself, which is most objectionable. And yet there are complaints sometimes of young calves dying from an excess of coagulated milk forming in a mass in the stomach when they are fed from the pail—a misfortune which is said never to occur when they obtain their sustenance in the manner which Nature so beautifully teaches. The complaint is certainly not without foundation in fact, for calves are apt to drink too greedily from a pail, in which case a due proportion of the saliva of the mouth is not mixed with the milk. One of the digestive ferments is thus deficient in quantity in the stomach; hence the formation of masses of casein, which are simply evidences of imperfect digestion. This may be to a great extent, if not wholly, obviated by allowing the calves, during the first week or two, to have only a small quantity of food at any one time—a regimen which Nature dictates to the instinct of the cow—but they should have that little often.

At the same time we think it is well in some cases, especially when the udder is "hogged," to allow a "twinter" or a heifer to suckle her first calf for a week or two, even at the risk of making her unsettled when the calf is taken away, for she comes to milk freely in a shorter time, and there is less risk of spoiling her temper. Yet we should not advise this to be followed as a regular practice with stirks and heifers. It must, however, be always remembered that a calf will as a rule do better when sucking from its mother than when it is brought up by hand; and it will in the former case seldom take any harm at all, even in bad weather, while in the latter it needs to be most carefully sheltered.

Calf Feeding Pail

For the feeding-pail of which we give an illustration, it is claimed that, by causing the calf to suck the milk through the indiarubber tube which forms part of it, Nature's process is closely copied, and the calf cannot gulp down its food, as it often does when drinking from an ordinary pail; the saliva of the mouth mixes freely with the milk, and an improved digestion is the result; it obviates the necessity of teaching the calf to drink by putting one's finger in its mouth; and as the pail stands on a broad base and cannot easily be knocked over, one person can tend a number of calves whilst they are being fed, and but little of the food is wasted. We have used these feeding-pails, and, although they require more cleaning than ordinary pails, we consider them a useful invention.

The Feeding of Calves.—Young calves that are intended to become dairy cows should always be allowed a fairly sufficient quantity of new milk for the first three or four weeks; after this period skim-milk may be fed to them, but it must be improved by boiled linseed, with ground wheat or oatmeal added. These two last-named additions to the skim milk should be boiled or lightly roasted, and not given raw—not so much that they may possibly do harm in the raw state as that they are more effective and are more easily digested by having been cooked; and the food, when it is given to the calf, may be at a temperature of 95° to 98°, which is the temperature of milk in a cow's udder. If the prepared food is higher or lower than this, it is so far a deviation from Nature's rule in this respect, and some deviations do harm.

While the quantity of food a calf requires will naturally increase a little day by day, over-feeding should always be carefully avoided, for a calf will always thrive better when its appetite is stimulated by under- rather than satiated by over-feeding, and in the first two or three days it should be decidedly under- rather than over-fed. It is difficult to lay down any rule as to the quantity to be given, for a strong and vigorous calf will naturally require more than a weak and delicate one; this is a point on which judgment must at all times be exercised. For the first two or three days two to three quarts of cow's milk per day will be enough, and this may be increased to four or five quarts by the end of the first week, to six or seven in the second week, and to eight or nine by the end of the first month. These quantities refer to new milk or to its equivalent, and to a full-sized and healthy calf. The food should always be good in quality and reasonable in quantity. When skim-milk is used, linseed meal should be employed to make amends for the cream which has been removed, and a little oat, pea, or flour-meal to restore the lost casein. By the time they are two or three weeks old young calves will begin to nibble a little sweet green hay, if it is given them in racks or nets, and it is a good plan to teach them to eat it early. This is best done by suspending a netful of hay so that it dangles in front of them; rubbing their noses, they soon begin to nibble.

Many people are in the habit of giving "hay-tea," as it is called, to young calves along with the milk, with the view of getting them used to a hay diet before they are able to eat the hay for themselves. The tea is made by putting some hay in a kettle that is half filled with water, and letting it simmer over a slow fire for an hour or two; the liquid is then poured off and set aside for use. There is, no doubt, a good deal of merit in this system, for the calves get all the nutriment the hay contains without any of the indigestible fibre. It is well, however, as soon as the weather is warm enough, to get the young calves out of doors for a few hours each day, so that they may nibble the fresh and tender grass.

Condimental Foods.—For some years we have used condimental food in the rearing of calves—just a "pinch" in the "beastings," and increasing it as the time goes on to a good teaspoonful—and we have found it an excellent thing in keeping the calves healthy, and an effectual preventive of "scour"—a malady from which young calves, when reared away from their mothers, are constantly liable to suffer. The condiment gives a tone to the stomach, and when used in moderation is a very useful tonic. There are various kinds of condimental food on the market, some of which have obtained considerable reputation, but the chief objection against them all is that they are sold at a far higher price than a fair profit would seem to justify. Much credit has been claimed—and we believe justly so—for the stimulating effect which a properly prepared "cattle-food" has on the digestive organs, and it is no doubt true that a sparing use of it will prevent many illnesses in young stock; but the price at which it is usually sold is higher than any farmer is justified in paying, especially when he can compound for himself, at a reasonable cost, a food which will be found equal to any that are sold, and superior to most.

The late Mr. Pringle, in his "Live Stock of the Farm," gives the formula appearing on page 202, which represents a safe mixture.

A ton of condimental food compounded of the materials specified in this list, in the quantities and at the prices named, costs only £12 16s. 7d., which is about one-fourth of what is charged for certain much-advertised articles.

		Cwt.	qr.	lb.
Locust beans, finely ground, at £6 per ton ..	..	6	0	0
Indian corn " " £7 " ..	..	9	0	0
Linseed-cake " " £10 " ..	..	3	0	0
Powdered turmeric.. .. 8d. per lb. ..	..	0	0	40
Sulphur .. .. .. 2d. " ..	..	0	0	40
Saltpetre .. .. .. 5d. " ..	..	0	0	20
Liquorice .. .. .. 1s. " ..	..	0	0	27
Ginger (ground) .. .. 6d. " ..	..	0	0	3
Aniseed .. .. .. 9d. " ..	..	0	0	4
Coriander .. .. .. 9d. " ..	..	0	0	10
Gentian .. .. .. 8d. " ..	..	0	0	10
Cream of tartar .. .. 1s. 8d. " ..	..	0	0	2
Carbonate of soda .. .. 4d. " ..	..	0	0	6
Levigated antimony .. 6d. " ..	..	0	0	6
Common salt .. .. ½d. " ..	..	0	0	30
Peruvian bark .. .. 4s. " ..	..	0	0	4
Fenugreek .. .. .. 8d. " ..	..	0	0	22
		20	0	0

Nothing is simpler than for four or five farmers to unite in the purchase of the materials for a ton of the food, mix them, and divide the food *pro rata*. The food, we may add, will be found useful to various kinds of animals, and 1 cwt. will go a long way in the rearing of calves. But care must be observed not to use too much of it in rearing store calves, or they will after a time be found to have been over-forced, and when turned out to grass will be apt to fall away in condition, and come to a standstill so far as progress is concerned. With calves that are being fattened for the butcher the case is different; the object with them is to feed them as quickly as possible consistently with safety, and they may receive as much milk as they will take, along with an increased quantity of condimental food. With fattening calves we have not to consider the effect of their feeding on their constitutions in after-life, for they have no after-life, and all we want is to fatten them quickly and successfully.

It is a common practice to bleed fat calves some hours before they are killed, and to keep them without food for a day or so; these "dodges" are supposed to improve the veal somehow or other—a great mistake. It is better to kill the calf without previously interfering with any of its natural functions. The veal will be better and healthier in all respects if the calf has not been put through any change of treatment, and there is a gain on the side of humanity.

Calf-houses.—The calf-houses should not only be kept as clean as possible while the calves are in them, but they should be thoroughly cleaned out when the calves are turned out to grass; the floors scrubbed and swilled, and the walls lime-washed. Whilst the calves are in them they should be well ventilated, but not cold, and a daily supply of litter—the old litter being removed once or twice a week—should be placed on sparred floors, which will admit of the urine passing freely away. On a sparred floor the litter keeps clean and dry for a much longer period than on an ordinary floor, and the cost of it is soon saved in litter alone. Such a floor is cheaply and quickly made of young larch-trees, split down the middle, and nailed across on sawn spars, on unsplit larch-trees, or on any odd pieces of planking that will rest on the paved floor beneath. The intervals between the lower spars may be about one foot, and between the upper ones about an inch. When put down in squares not too large—say 4 feet squares—these sparred floors are easily taken out to be cleaned, and as easily replaced. If well cleaned, dried, and stored away when the calves have done with them, they will last several seasons; and they not only keep the calves clean, dry, and warm, but also economise litter, and on dairy-farms straw can be put to a better purpose than that of mere litter. These precautions properly attended to, young calves will seldom suffer much from any kind of ill-health, and they will certainly grow the faster on a given quantity of food.

The surest way to prevent scouring in calves is to feed them regularly, and to keep them clean, dry and warm, but not too warm. Neglect of these matters is a fruitful cause of "scour," and of other ailments to which young calves are liable, while attention to them will prevent much trouble, loss and disappointment. Since adopting these measures, now many years ago, and by giving the calves from the first a little condiment or spiced food in their milk, we are in a position to recommend such precautions.

"Black-leg."—There is much difference of practice as to the after-treatment of calves—say, from the time they are turned out to grass until they are twelve or fifteen months old. In their first winter, especially in certain localities, calves are extremely liable to the fatal disease of "hyant," "speed," "quarter-evil," or "black-leg," as it is variously termed. This scourge is said to be the effect of an excess of fibrin in the blood or of some kind of blood-poisoning. Be that as it may, however, the causes to which it is more obviously due are changes of food and of temperature, and it generally seizes on the best and the worst calves in the lot, passing over the medium ones. It is a very uncertain malady, being much more active in some years than others, and in autumn and spring rather than in mid-winter, but it is not infectious. We have tried many highly recommended nostrums, with a view to preventing it—curing it is out of the question. Some of these would seem to succeed one year and would utterly fail the next, and we have frequently, in spite of the nostrum, lost half our calves in the course of a single winter. For a number of years, however, we lost only one calf from this cause, and the immunity was owing to an improved system of treatment. The calves were taught, when they were six or eight weeks old, to eat *linseed-cake*, broken into small pieces and put into their "suckling." When the latter was cut off, which was commonly done soon after they were turned out to grass, the cake was continued to them throughout the summer and winter and until the following "grass-day," along with a pinch of common salt to each calf once or twice a week. They ran loose all the winter on a sheltered portion of the land, having a building or shed into which they could go when they chose to eat the hay which was placed at their disposal inside. Instead of hay, they sometimes have had chaffed oat-straw and hay, improved by some kind or other of meal—rice, maize, oat, pea, or bean meal—and they have had the linseed-cake in addition; this last is a *sine qua non*. The one calf we lost from "black-leg" since commencing this system owed its death to decorticated cotton-cake, which we thought we might safely substitute for the linseed-cake.

When a calf is seized with "black-leg" it will go away from its companions, and will stand in a dejected manner under a fence or in some out-of-the-way place, quite alone, and it prefers not to move away. It does not seem to be in much pain, but it will go lame if made to stir about, and sometimes will carry the leg clear of the ground. The location of the disease is easily ascertained by passing the hand over the infected quarter; a rustling, crackling noise is heard under the skin, as if there were an accumulation of air or gas in the subcuticle, which in reality there is. After a time the poor animal sinks into a kind of stupor, from which there is no release but death.

Linseed-cake, given daily throughout the summer, autumn, and winter, starting *before* the calves are weaned from liquid food, has been found to be efficacious in preventing "black-leg." When the calves are turned out to grass they may receive as much cake as they care to eat (but that will not be much, say ½ lb. each per day), along with a little common salt, say a tablespoonful among half a dozen, once or twice a week. As the autumn comes on they require and will enjoy a little more cake, say 1 lb. per day, and this may be gradually increased during the winter until they are getting 2 lb. per day per calf; but on no account must cotton-cake be given instead. If the calves are on sheltered land, with an open shed as a protection against storms, and are receiving good hay in addition to the linseed-cake, they will commonly be big enough to be put to the bull during the ensuing autumn; and it is thought they become better milkers—they are thrown more into milk—by having their first calf when they are two instead of three years old. But it is necessary to rear them well if this system is carried out; half-rearing will not do. The chief advantages of this system lie in getting them into work a year earlier, and in saving part of a year's keep.

Wintering.—The system of wintering may be varied. Chaffed food of the kind the rest of the stock are receiving, may, for instance, be given in the place of hay; but we consider the linseed-cake should in all cases be given, whatever may be the other kinds of food they have, and not alone on account of securing the calves' safety against "black-leg," but also because it pays well in all other respects. In their second summer the "yearlings" should run on a good pasture, so that the rate of progress may be maintained; and in their second winter they should have a generous diet, and be kept indoors, for the same reason. If at fifteen months old any of them are found to be unfit to go to the bull, these ought to run on another year, and come into the herd as heifers instead of stirks,—that is, at three years old instead of two. Formerly all young stock ran on to three years old before the first calf, and it would have been thought strange to "bring them in" as stirks; but now it is the exception rather than the rule for them to run on to heifers before calving. The new order of things is in keeping, perhaps, with the spirit of the time.


Anti-Sucking Nose-Piece

Anti-sucking Devices.—One of the chief objections against rearing young calves by allowing them to suck from their mothers, lies in the fact that they frequently pick up the habit again in after-life, and suck their companions or themselves—generally their companions. Some years ago we had a cow who had acquired by some means or other, by accident or by instinct, the habit of sucking herself; she was very cunning over it, and for a time defeated all our efforts to cure her of the habit. We tried what is called a "cradle" round her neck, and smeared her teats and udder with various nauseous things; but all to no purpose. At length a neighbour lent us a nose-piece that would cure her, he said, simple though it seemed to be. The nose-piece was made out of a piece of oak board, 8 inches long, 5 inches wide, and about ½ inch thick, shaped as in the illustration. We sprang or bent the nostril until the piece fitted, as seen in the companion figure, and watched the result with interest. The cow tried again and again to get one of her teats into her mouth, but all to no purpose, for the nose-piece, hanging down, always came between the mouth and the teat. At length she gave it up in disgust, and went on with her grazing. The nose-piece formed no obstacle to her in eating, for it floated easily over the grass, and was really no detriment whatever. In making such a nose-piece, care must be taken not to have the two points of it too far asunder, or it will easily slip off the nose. The points should be about ½ inch apart, and should be nicely smoothed and rounded off so that they will not hurt the cow's nose.

Spiked Halter

Another device shown on this page is useful in preventing calves from sucking cows, or cows from sucking each other, but we have not found it effectual in preventing a cow from sucking herself. The nose-piece, on the other hand, it must be remembered, is not so effectual as the spiked halter in preventing one cow from sucking another. All dairy-farmers should have both these devices in readiness. There are various other kinds, but none of them that we have ever seen or tried is so certain in action as the two we have described and illustrated. The spikes in the halter are simply wrought-iron nails, with flattened heads, stuck through a stout piece of leather, and the heads protected underneath by another piece of leather. The figure sufficiently describes the form, size, and method of attaching the halter. These devices may also be used to prevent calves from sucking cows when both are out together on the pasture.

Meantime everything — calf-rearing and fattening, cheese-making and butter-making—is being more or less subordinated to what are regarded as exigencies of the milk trade. Should this go on much longer, a reaction must necessarily set in to restore a balance. But just what form that reaction will take, and how it will be used, are serious problems of the future.

CHAPTER XII

FORAGE PLANTS AND WEEDS

Definitions.—We shall consider the various forage plants under the heads of the natural orders to which they respectively belong, as we believe this method will be found advantageous to the reader acquainted with the outlines of classification, while it will in no way complicate the subject for the non-botanical reader. A *natural order* is simply an assemblage of plants grouped together on account of the many botanical characters they possess in common, and the general characters of the natural order pertain in most cases to all the plants included in it. The systemic name of a plant consists of two words; the first is the generic name, and refers to the sub-group, or *genus*, of the order to which the plant belongs; the second is the specific name, and indicates, when there are more plants than one in the genus, which particular plant or *species* is referred to. Thus, the primrose, *Primula vulgaris*, and the cowslip, *Primula veris*, are both species of the genus *Primula*, and *Primula* itself is one of a number of genera which constitute the order *Primulaceæ*. An order, then, is made up of genera, and a genus of species. Occasionally a species is divided into several varieties, and sometimes a genus only contains a single species.

Cruciferæ.—Passing under view a list of natural orders systematically arranged, the first to attract our attention as being of agricultural importance is the one named Cruciferæ. The fruit of this order may be either long, as in the mustard, cabbage, and gillyflower, or short, as in the common weed shepherd's purse. In either case a thin membrane will be exposed to view when the two valves of the fruit open, and it is to the margins of this membrane that the seeds on each side are attached. The arrangement of the leaves in plants of this order is *alternate*, first one on one side of the stem, then another at a different level on the other side. There are no *stipules* and no *bracts*. Stipules are small leaves at or near the base of the leaf-stalk, or *petiole*, as seen in the rose leaf; bracts are similar small leaves on the flower-stalk.

The plants of this order are distinguished by their pungent, stimulating, and sometimes acrid properties, but none of them is poisonous. They are anti-scorbutic, hence the desire of people, such as sailors, who have for long subsisted on salt meat, to obtain vegetables yielded by this order. The Cruciferæ contain notable quantities of sulphur and nitrogen, and these, in union with other elements present, form amongst other products a peculiar volatile acrid oil, to which the stimulating properties of the order are due. The disgusting odour which arises from decaying heaps of cabbages and turnips is due, in great part, to the formation of sulphuretted hydrogen and ammonia.

Among crucifers, the cabbage, *Brassica oleracea*, is used as a cattle food, especially in autumn and winter. Analysis No. 8 (*see* table at the end of this chapter, p. 252) refers to this plant. The inner and younger leaves contain much more water than the older outside leaves, and on the whole this vegetable may be considered more nutritious than the turnip. Thousand-headed kale (or cabbage) is a heavy cropping plant much valued by stock-feeders. The kohl-rabi is a variety of cabbage in which the stem is enlarged into a fleshy, turnip-like knob above ground. Savoys, Brussels sprouts, Scotch kale, and red cabbage are all modifications of the common cabbage; so are the cauliflower and broccoli, in both of which a large number of very imperfect flowers are crowded together to form the white heads so much relished at our tables.

The turnip, *Brassica rapa*, is a widely cultivated crucifer, and is a food much relished by cattle and sheep. The peculiar flavour of the root, which is especially noticeable in a "strong" turnip, is due to the presence of a pungent essential oil. As will be seen from the analysis (No. 1), the root is very watery, and contains but little nourishment, so that if an attempt were made to fatten an animal on turnips alone it would have to pass a large quantity of unnecessary water through its stomach. The Swedish turnip, or swede, is specifically distinct from the turnip, and is believed to have sprung from *Brassica campestris*; it is rather more nutritious, and contains less water than the common turnip (analysis No. 2). In external appearance the swede differs from the turnip by possessing a "collar" at the junction of leaves and root. The rape, *Brassica napus*, is valuable both as green fodder and for ploughing in as a green manure; its seeds (rape and colza) are crushed for oil, and the residue, consisting chiefly of the seed-coats, is made up into cake, and used as cattle food and as a fertiliser. An analysis (No. 52) of rape-cake is given.

White mustard, *Sinapis alba*, the leaves of which are used as a salad; black mustard, *Sinapis nigra*, the ground seeds of which form a condiment; and the troublesome weed called charlock, *Sinapis arvensis*, are closely allied to the foregoing plants of the genus *Brassica*. White mustard is eaten off as a green crop, or may be ploughed in as a green manure.

The radish, horse-radish, seakale, cress, water-cress, Jack-by-the-hedge, shepherd's purse, wallflower, and stock are all familiar crucifers.

Papilionaceous Corolla of the Pea

Leguminosæ. — The natural order Leguminosæ is the one to which the pulses (peas, beans, etc.) and the clovers belong. Its botanical characters are very definite, so that it is easy to determine whether or not a given plant belongs to this order. Thus, the corolla consists of five petals, which are of three different sizes; their arrangement will be understood by reference to the corolla of the pea, as represented in two of the accompanying figures. At the top is seen the largest petal, called the *standard;* below and enclosed by the standard are two side petals, both alike, termed the *wings;* these latter partly overlap the two smallest petals, which are joined together to form the *keel.* Every *British* leguminous plant has its corolla built up on this type.

Separate parts of the Corolla of the Pea

After fertilisation, the pistil develops into the fruit, which is termed a pod, or *legume.* In the third figure is shown the legume of the pea, with the flower-stalk and calyx still remaining. The pod of leguminous plants resembles that of crucifers in opening by a pair of valves, but the two differ in that the cruciferous pod has a thin partition down the middle, while the leguminous pod has not. The foliage leaves are furnished with stipules, and are alternate. The leaves, again, instead of being *simple,* are usually *compound;* that is, each leaf consists of several distinct pieces called *leaflets,* as is seen in the *ternate* leaf of the clover, and *pinnate* leaf of the pea or laburnum. Frequently the leaves or leaflets are modified into tendrils, which enable weak-climbing stems to obtain support from more substantial structures. In the ordinary pea, we have an example of a pinnate leaf with the upper leaflets transformed into tendrils; at the base of the leaf-stalks are two large

Fruit of the Pea

stipules which meet round the stem, and the peduncle bears a flower and a fruit.

The Leguminosæ yield more substances of general use than, perhaps, any other order. The farinaceous seeds are highly nutritious, and the herbage affords a superior fodder.

The clovers, or trefoils, belong to the genus *Trifolium*, which in the British Isles includes some eighteen or twenty species, and it derives its name from the fact that each leaf is divided into three leaflets. The part commonly called the blossom will be seen, on examination, to consist really of a large number of small papilionaceous flowers crowded together into one head on the receptacle. The fruit is a short, unjointed, nearly straight pod, containing from one to four seeds. Not more than six or seven species are under cultivation as forage plants.

The white, Dutch, or honeysuckle clover *Trifolium repens*, is at once distinguished from its allies by the large globose head of white, rarely pinkish, flowers; the lower flowers of the head are often to be seen brown and withered, while the upper ones are still in their prime. The longish pod contains four to six small seeds. The green leaflets have usually a horseshoe mark near the base, and the *creeping* stem sends down fibrous roots at the joints. The plant should find a place in all pastures, as it bears grazing well, and quickly springs up again. Too much of it, however, is said to have a scouring effect on cattle. Two analyses are given, one of white clover in blossom (No. 9), the other of hay made from white clover (No. 28).

The common red, purple, or broad-leaved clover, *Trifolium pratense*, takes rank as one of the most valuable clovers. Its hard, somewhat woody root supports a stem growing from 12 to 18 inches high, and the oval leaflets have a horseshoe mark in the middle. A good crop of it forms a rich and handsome picture. The pod contains one seed, purple in colour, and rather large for a clover seed. This plant is chiefly used for alternate husbandry. There are many varieties of it peculiar to different countries, the plant appearing to vary according to soil and climate. Two analyses of the green plant are given, and one of the hay (Nos. 10, 11, 29). A variety called true cow grass clover, or perennial red clover, *Trifolium pratense perenne*, is much in favour; it only differs from the common red clover in being, according to some growers, more lasting, and therefore preferable in seeds for several years' lay, and for permanent pasture.

The hybrid or alsike clover, *Trifolium hybridum*, is a smooth perennial plant which has *hollow* stems and fibrous roots. The flowers are partly white and partly pinkish, and are arranged in loose heads on long stalks, so that the plant has an appearance intermediate between that of white clover and common red clover. The pod is short, and contains a couple of dark little seeds. Alsike possesses the useful property of yielding abundant crops on "clover-sick" soils. Two analyses of the green plant and one of the hay are given (Nos. 12, 13, 30).

The crimson, scarlet, carnation, or Italian clover, *Trifolium incarnatum*, can be readily identified by its elongated, velvet-like, crimson head of flowers. As it is particularly addicted to limestone soils, it can be grown to greater advantage on such than on any other kind. Sown in autumn—simply scratched in on a wheat stubble—it is ready for cutting or eating down in the following May. It may be grown either alone or with Italian rye grass. As a green fodder it is eagerly eaten by cattle and sheep. When farmers speak of "trifolium," this is the plant they mean. (Analyses 14, 31.)

Other clovers occasionally grown are the zigzag trefoil, or meadow clover, *Trifolium medium*, with rather rigid leaflets, and heads of flowers of a rose-purple colour; and the lesser yellow trefoil, or yellow suckling clover, *Trifolium minus*, which much resembles the black medick, *Medicago lupulina*, differing from the latter, however, in that its leaflets are heart-shaped with the narrow parts joined to the leaf-stalk, and in having the florets less densely crowded on the receptacle. The hop clover, or hop trefoil, *Trifolium procumbens*, is seldom included in mixtures. Its flower-head is rather larger than that of *M. lupulina*, and its colour is a pale yellow. As the largest petal of each floret is bent back at its free extremity, the whole head has a hop-like appearance.

From a botanical point of view, only those plants which belong to the genus *Trifolium* are properly termed clovers, or trefoils. There are, however, many other useful leguminous plants which the farmer sometimes includes under the general name of clover. The chief of these we proceed to notice.

The genus *Medicago* resembles *Trifolium* in that each of its leaves consists of three leaflets. But the little flowers are arranged in short *racemes*, that is, a number of short-stalked florets is given off from each side of a common flower-stalk, the resulting structure appearing not unlike a small clover-head. Again, the unjointed pod of *Medicago* is spiral, while the pod of *Trifolium* is nearly straight. Two important plants, black medick and lucerne, belong to this genus.

Black medick, or nonsuch, *Medicago lupulina*, is a pretty little, yellow-flowered plant, which is more generally known to farmers by the common names of "hop" and "trefoil"—sometimes "yellow trefoil." As a wild British plant it is common in fields and waste places. The root is tapering and fibrous, the stem much branched. Black medick is so called from the black colour of the seed-vessel, or pod, which is coiled into a kidney-shaped spiral, and has a network on its outer surface. The pod contains only one seed. As the plant is an annual or biennial, it is not suited to permanent pasture, and is always best grown in connection with rye grass or sainfoin. Analyses of the hay and of the green plant are quoted (Nos. 15, 32).

Lucerne, or purple medick, *Medicago sativa*, is distinguished by its erect stem, bluish-purple flowers arranged in open racemes, and the pods twisted two or three times. It is rather later than most of the so-called clovers, as it does not flower till June or July; it is a plant of vigorous growth, and attains a height of 2 feet or more. If not eaten down, it may be cut several times during the season for green food, for which purpose it is highly valued. The analyses (Nos. 16, 17, 33) indicate that it may be used to better advantage as a green food than in the form of hay, the amount of indigestible fibre in the latter being one-third of the entire weight. This plant deserves more attention than it has received, for, in addition to the qualities already mentioned, it is of long duration, and, being very deep rooted, is eminently suited to withstand long droughts. It is extensively cultivated in India. Throughout the American continent lucerne is known by its Spanish name *alfalfa*.

Sainfoin, *Onobrychis sativa*, has pinnate leaves, each of which consists of an odd number of leaflets, there being a solitary leaflet at the end. There are no tendrils. The beautiful pink flowers are arranged in elegant racemes, and the solitary seeds are contained in flat, wrinkled, one-jointed pods. Sainfoin is a perennial, it has an upright stem about 2 feet high, and a rather woody root penetrating deeply into the ground. It grows on all good soils, and has the additional merit of producing excellent crops on dry limestone soils, a property it owes to its long roots. It is one of the best crops for folding with sheep. (Analyses 18 and 34.)

In connection with sainfoin, mention may be made of the burnet, *Sanguisorba officinalis* (*Poterium officinale*), which is a plant belonging to the rose family, differing, however, from most plants in that order by possessing no petals. Its height varies from 6 to 18 inches, and it was formerly recommended for growth with sainfoin and lucerne, but as it has proved to be a coarse and somewhat useless plant the practice is discontinued, and care should be taken that neither its seeds nor those of its ally, the salad burnet, *Poterium sanguisorba*, are introduced with clover seed.

The vetch, or tare, *Vicia sativa*, has pinnate leaves, which differ from those of sainfoin in consisting of an even number of leaflets, and in having the upper leaflets, transformed into tendrils. The plant is an annual, it has pale purple flowers which produce straight unjointed hairy pods containing four to ten seeds, the pods being not unlike those of the sweet pea, but rather smaller. It has a stout trailing or climbing stem. Vetches have long constituted a favourite crop, and an American writer states that " there is no green food of any variety so well relished by horses as vetches, and none which has such a purifying effect, lucerne being no exception." Analyses of the green plant and the hay are quoted on pp. 252 and 253 (Nos. 19 and 35). There are ten or twelve species of wild vetch, one of the most beautiful being *Vicia Cracca*, which bears fine racemes of blue flowers.

The kidney vetch, or ladies' fingers, *Anthyllis vulneraria*, has pinnate leaves with unequal leaflets, a terminal leaflet being present. It is readily recognised by its fluffy head of yellow flowers. Notwithstanding that it is much relished by sheep and cattle, and that it succeeds well on limestone soils, it is very rarely cultivated, the attempt made years ago to get it regularly grown as a farm crop having failed.

In the genus *Lotus* the yellow flowers are arranged in an *umbel*, that is, several short-stalked flowers all spring from one level, as in the cowslip. Each leaf consists of three leaflets, as in *Trifolium* and *Medicago*, and has large leaf-like stipules at the base of the leaf-stalk. The pod is nearly straight, and is many-seeded. The way in which the four or five pods spread out from a common head suggests the appearance of a bird's foot—hence the name. The two following species are perennials.

The common bird's-foot trefoil, *Lotus corniculatus*, is an elegant little plant, in which the yellow flowers are crimson before expanding. It may be seen in flower almost any time between May and September on grassy banks and in dry pastures. The smooth stem lies on the ground, and the height of the plant is from 6 to 12 inches. It is fairly nutritious, is well liked by cattle, and admirably suited for growing on elevated soils of too poor a character to suit the ordinary clovers. The root-nodules of leguminous plants, associated with the acquisition of nitrogen from the atmosphere by the agency of the bacteria they contain, may readily be seen on the roots of *L. corniculatus*.

The greater bird's foot trefoil, *Lotus major*, is very like the foregoing, differing from it chiefly in its larger and more numerous flowers of duller hue, and in its erect stem. It thrives best on somewhat peaty soils.

The melilot, *Melilotus officinalis*, is rarely grown as a forage crop; it is odoriferous when dry, and sweetens hay.

The lupins, belonging to the genus *Lupinus*, which is not British, include several varieties with differently coloured flowers. They are not much cultivated in England, save occasionally in the eastern counties. The yellow lupin is extensively grown on the Continent, where it is used both as a forage plant and as a green manure. (Analysis No. 20.)

The furze, whin, or gorse, *Ulex Europæus*, is a prickly shrub with deep yellow blossoms, and it grows where little else will. It can be raised from the seed on any waste land available, but transplanting may prove fatal. Furze is recommended on account of its yielding a nutritious green food for horses and cattle in the winter, forming at that season an agreeable change in diet from hay, and from such roots as turnips and carrots. On account of the prickles it is, of course, necessary to bruise furze before supplying it to cattle, and this may be done either in a furze-breaking machine or by hand with a mallet. (Analysis No. 21.)

Besides those leguminous plants which are used either as green fodder or hay, there are others which are grown chiefly for their valuable seeds. The pea, *Pisum sativum*, affords in its green unripe seeds a fresh vegetable for the table, while from the ripe seeds are obtained pea-meal and the split peas used in soups and as cattle-food; it is sometimes grown as a fodder crop, the pea-straw, of which the composition is shown in analysis No. 36, serving as a nutritious adjunct in chaff. The lentil, which is the seed of *Ervum lens*, is imported into Britain from Southern Europe and Egypt, and is used by millers in the composition of meals for cattle-food. "Revalenta," "Ervalenta," and other widely advertised preparations contain lentil meal, generally mixed with the flour of barley or some other grain; they are sold at many times their real value. A glance at the analyses (Nos. 53, 54, 55) of these leguminous seeds will show their high value as nutrients.

The seeds of the laburnum tree, an exotic ornamental leguminous plant in English gardens, are poisonous.

Umbelliferæ.—The natural order Umbelliferæ is characterised by producing its flowers in umbels, like the ribs of an umbrella, and by the leaves being usually much divided; the leaf-stalk at its base sheaths the stem, which is hollow. Harmless weeds belonging to the order are the hedge-parsley and cow-parsnip; more objectionable are such poisonous plants as the hemlock, fool's parsley, and water-dropwort. The hemlock, *Conium maculatum*, is at once known by its polished stem, covered with brownish-red spots, and by the unpleasant odour of mice emitted by the stem when bruised. It usually grows in hedges and waste places, attaining a height of from 2 to 4 feet. The fool's parsley, *Æthusa Cynapium*, is another denizen of waste places, and grows from 1 to 2 feet high. It is very poisonous, and it known by its three narrow bracts which grow towards one side at the base of each little umbel, and point downwards. The water-dropwort, *Œnanthe crocata*, contains a dangerous poison; it grows in marshes and on the banks of rivers and ditches, its height varying from 2 to 5 feet. Its flowers are white, as are those of the hemlock and fool's parsley. The well-known herb parsley, *Petroselinum sativum*, is sometimes sparingly introduced into pastures, as it is believed to produce a beneficial medicinal effect on sheep. It is a biennial, and produces umbels of light yellow flowers in July. Parsley is distinguished by its pleasant odour, and by the extreme tips of its leaf-segments being white. The most interesting umbellifers to the farmer, however, are undoubtedly the carrot and parsnip, both of which are cultivated for the sake of their succulent tap-roots, which yield an acceptable supply of juicy food in the winter. The wild carrot, *Daucus carota*, has a pungent odour and disagreeable taste, but it has been much improved by cultivation. Carrots, unlike parsnips, contain no starch; analyses of two varieties are given (Nos. 3, 4). The parsnip is a cultivated form of the wild parsnip, *Pastinaca sativa*; its root contains a good deal of starch and some sugar. The composition of the parsnip is shown in analysis No. 5. The cultivated carrot has a white blossom, the parsnip a yellow one.

Compositæ.—The Compositæ, although it is the largest natural order, including a greater number of plants than any other, is yet of far less service to man than such orders as *Gramineæ*, *Leguminosæ*, and *Cruciferæ*. It is distinguished by the extraordinary character of its inflorescence, which may easily be examined in the daisy, where the so-called "flower" will be seen to be made up of a large number of very small florets. The order includes many well-known plants, such as the lettuce, dandelion, tansy, sow-thistle, hawkweed, nipplewort, thistle, corn bluebottle, groundsel, chamomile, and everlastings. Two only require notice here, the milfoil and the chicory.

Milfoil, or yarrow, *Achillea millefolium*, is a plant which is to be met with in most pastures and on roadsides, especially on poor soils. It has very much divided leaves, and the flowers, though usually white, vary from that colour to pink and red; this sometimes occurs on one and the same plant. It possesses astringent properties, and is eaten in moderate quantity by sheep, rather perhaps as a condiment than for any direct nutritive value it may possess. Milfoil is usually recommended to be sown on light sandy soils, railway cuttings, and embankments, because of the creeping, fibrous character of its roots, which serve admirably to bind loose soils together. The plant is perennial, and grows to the height of about 1 foot.

Wild chicory, or succory, *Cichorium Intybus*, has blue flowers, the heads being given off from the stem in pairs. It is a deep-rooted perennial, flowering from June to August. Chicory is used on the Continent both as a forage plant and as a salad, but it has found little favour in Britain. Cattle are fond of the foliage, but it is said to give an unpleasant flavour to their milk. The root, dried and ground, forms the chicory which is frequently mixed with coffee.

Boraginaceæ.—The natural order Boraginaceæ requires a passing note, as it includes the prickly comfrey, *Symphytum asperrimum*. Common wild plants belonging to the order are the borage, forget-me-not, hound's tongue, lungwort, and gromwell. There are two native British species of comfrey, the common comfrey, *Symphytum officinale*, and the tuberous-rooted comfrey, *S. tuberosum*. The common comfrey grows by riversides, and its leaves were formerly boiled for food by the poorer people. The prickly comfrey, which attains a height of 5 feet, is rather larger than the common comfrey; it has much rougher leaves, and its flowers are more variable in colour—dull white, reddish, or blue. A native of the Caucasus, it was introduced into Britain at the beginning of the nineteenth century as an ornamental plant, and has only been grown as a forage plant within recent years. It is raised from the roots in this country, as the seeds do not appear to arrive at perfection. The plant is of such rapid growth that it may be cut for green fodder at least four times in the season. It has about the same feeding value as green mustard or mangel or turnip tops, and is recommended to dairy-farmers as a change of food for their cattle. Being a very deep-rooted plant, it is far less liable than plants of more superficial growth to be affected by drought, and it is therefore being cultivated in India. Another point in its favour is its enormous yield, which in the green state is said to be upwards of 80 tons per acre, or from two to three times the yield of lucerne. It comes in earlier than other crops, and lasts longer, and its cultivation requires but little care after the root-cuttings are once planted, as it is perennial. Cattle, sheep, and especially horses, although they prefer other food, soon acquire a taste for it in the green state; when dried it makes an excellent substitute for hay to mix with straw for chaff-cutting. Prickly comfrey is at present less cultivated than seemed probable twenty years ago, and not much was heard of it during the closing decade of the nineteenth century. Analysis No. 22 refers to a freshly gathered plant.

Plantagineæ.—Common plantain, rib-wort, or rib grass, *Plantago lanceolata*, belongs to the natural order Plantagineæ, and is not a true grass. It has narrow leaves tapering at both ends, and with prominent parallel veins. The flowers are small, have no stalks, and are closely arranged on an elongated axis. The fruit is a nutlet containing a seed, and the long clusters of these nutlets, forming the "bobtails" of which canaries and other birds are so fond, constitute familiar objects in summer in meadows and cultivated fields. The leaves are produced early in the season, and are then eaten by horses and cattle; but it is rather for the binding action which this plant, like the milfoil, exerts on loose soils than as a forage plant that it is introduced into seed mixtures. Owing to the low-lying and spreading habit of its leaves, moreover, the plant often takes up much more room than it is worth; this property manifests itself especially on lawns, where the rib grass is nothing but a nuisance. The greater plantain, *Plantago major*, has broader leaves than the rib grass, and its long spikes of nutlets are much sought after by birds.

Chenopodiaceæ.—The mangel wurzel, *Beta vulgaris*, belongs to the goose-foot order, Chenopodiaceæ, which includes the beet, spinach, good King Henry, and various common weeds to which the name of goose-foot, or fat-hen, is applied. The root of the mangel, of which an analysis (No. 6) is given, affords a supply of succulent food many months after the crop is lifted; it will be seen from its composition that it contains less water than the turnip. The garden beet, used in salads, and the sugar beet, which is cultivated, especially in France, for sugar manufacture, are simply other varieties of *Beta vulgaris*, the mangel itself being the field beet. The beetroot (analysis No. 7) and mangel owe their sweet taste to the large amount of sugar they contain.

Polygonaceæ.—The order Polygonaceæ, known by its membranous sheathing stipules and three-cornered fruits includes, in addition to the common weeds called docks and sorrels, the rhubarb plant, of which the leaf stalks are eaten at the table, and the buckwheat, *Polygonum Fagopyrum*, which is an annual of quick growth and easy cultivation. Buckwheat is grown for green fodder, and its starchy seeds (analysis No. 56), which resemble those of the cereals in composition, are used for feeding poultry and for making meal.

The flowers of *Chenopodiaceæ* and *Polygonaceæ* have no petals, and therefore easily escape notice.

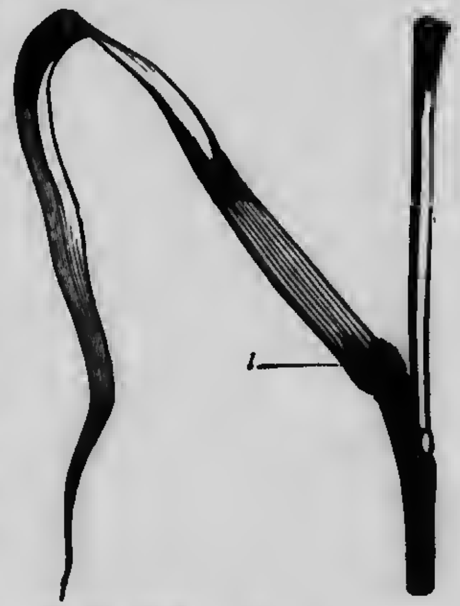
Gramineæ or Grasses.—The natural order Gramineæ is of much greater importance to man than any other group of plants. All our cereals—wheat, barley, oats, rye, maize, rice, millet, dari, and canary-seed—all true pasture grasses, the succulent sugar-cane, and the lofty bamboo alike belong to this order. Rice alone, as we need hardly say, furnishes more food to the human race than any other one species.

Before giving a brief account of the most important pasture grasses it will be desirable to say a few words on the structure of the grass plant and its flower, and to indicate the means of distinguishing between the true grasses and certain far less valuable plants which bear a close external resemblance to them.

All grasses have fibrous roots, which are frequently


Culms of Rye

given off from creeping underground stems. The parts above ground consist of ascending axes, or stems, called *culms*, and these produce the leaves and flowers. The leaves are always entire and usually strap-shaped, tapering, however, towards the upper end. If the base of the leaf be examined, it will be seen to form a sheath around the culm, the sheath being split down lengthwise in front. At the place where the leaf springs from the stem the latter will be seen to be swollen, and this swollen part is called a *joint*. By cutting across the stem it will be found to be hollow, except at the joint, where it is solid. Most of these details will be best understood by examining a living specimen ; nevertheless they are represented in our figure, which illustrates the culms of the rye plant. If the leaf be bent back from the culm, there will be seen at the top of the leaf-sheath, and between the leaf and the culm, a small membranous projection, which is apparently a continuation of the lining of the sheath. This structure is called a *ligule*, and attention is drawn to it because, as it varies in size and shape in different grasses, it will in some cases be found of use in discriminating between grasses which closely resemble each other. In our next figure, *l* is the ligule of the millet grass.



Millet, showing the ligule, *l*

It is, however, in the inflorescence that the most striking peculiarities of grasses are apparent, and they may be seen in the first of the figures on p. 226. An examination of a wheat-ear in flower will show it to consist of a number of distinct structures arranged in rows lengthwise on the upper part of the stem or axis. The entire ear is called a *spike*; let this spike be broken through at the middle, and let one of the structures already referred to be taken from the bottom of the upper part. This structure is a single *spikelet*, and it will be noticed that it is attached broadside to the axis, as is the case in most grasses—rye grass, however, forming an exception. This spikelet should be carefully taken to pieces, proceeding regularly from the outer and lowest parts inwards. Two dry, scaly leaves nearly opposite to each other are first removed; these are the *outer glumes*. Inside are three to five *florets* alternately arranged on opposite sides of the axis of the spikelet. Let one of these florets be taken from about the middle and dissected just as the spikelet has been. The outermost and lowest scaly leaf which appears to envelop the inner parts is called the *flowering glume*; opposite to this, but at a little higher level, is another scaly leaf called the *pale*; notice that the edges of the flowering glume overlap the pale to some extent. The flowering glume in many grasses bears a bristle, or *awn*, which springs from either its back or its summit. By laying apart the flowering glume and pale, the contents of the space between them are exposed to view. At the very bottom of the cavity and lying one against the flowering glume and the other against the pale, are two very small scales, or *lodicules*, representing perhaps the calyx and corolla of ordinary flowers. Next are seen the lower ends of the filaments of *three* stamens; and lastly, nestling snugly in the very middle of the cavity, is the ovary, surmounted by two short styles with feathery stigmas. This is shown in the above figure, which, it must be understood, is not a dissection of the entire spikelet, but represents below the outer glumes of the spikelet, and shows above the details of only *one* of the several florets which the outer glumes enclose. After fertilisation the little ovary develops into the *grain* of wheat, which is the true fruit of the plant, termed by botanists a *caryopsis*. Sometimes, as in the case of barley, the grain when ripe remains firmly enclosed by the scale-leaves; this is not the case in wheat. In some grasses, between the outer glumes and the base of the lowest floret, one or more scale-leaves, called *empty glumes*, considered to represent *barren florets*, are inserted. Such

Two outer Glumes of a Spikelet and the Parts of a Single Floret of Wheat.—*Oliver*.

Dissected Spikelet of Vernal Grass

empty glumes may also occur *above* the uppermost perfect floret. An example of the former case is afforded by sweet vernal grass, in which the entire spikelet consists of, first, two outer glumes, then two awned empty glumes representing two barren florets, and lastly a perfect floret with its flowering glume and pale, but with no *lodicules*, only *two* stamens, and the pistil surmounted by two feathery stigmas.

The foregoing descriptions of the spikelets of wheat and vernal grass will give the reader a general idea of the structure of the flowers of grasses. The actual dissection of spikelets of various grasses, by the aid of a penknife, a mounted needle, and a magnifying glass, is strongly recommended, when the minor characters which enable botanists to classify grasses will be brought into view.

The manner in which the anthers are attached to the filaments will also be seen from the figures. As the anthers can swing freely about their point of attachment they are said to be *versatile*. The anthers and feathery stigmas are usually to be seen protruding from the spikelets at the time of flowering. Most grasses have *three* stamens, but the rice plant has *six*, and sweet vernal grass, as we have remarked, only *two*. The flowering glume and pale are nearly always present, but in foxtail grass there is *no pale*. Lodicules, again, of which the number is usually two, are absent in sweet vernal, foxtail, and mat grass, while the feather grass has three.

The inflorescence of grasses may be described either as *spicate*, when the spikelets are arranged close against the axis in the form of a spike, as in fox-tail (Plate facing p. 228), or it is a *panicle*, in which case the spikelets spread out on little branches, as in the smooth meadow grass (Plate facing p. 232). There are various intermediate forms, as sweet vernal grass (Plate facing p. 228).

Rushes.—Two groups of plants exist which may be, and not unfrequently are, mistaken for grasses; these are the rushes and sedges. The rushes belong to the order

Juncaceæ, and grow in moist meadows and by the sides of streams and ponds; in them the stem is solid and tapers to a point, whilst the flowers are produced in heads on the side of the stem, and are quite different in their structure from those of grasses. The reader is, of course, familiar with a tulip flower; its protective envelope consists of three outer leaves and three inner leaves, all like petals, while inside are six stamens and the pistil. Imagine such a flower to be greatly reduced in size, so as to be not much larger than a pin's head, and at the same time suppose the six petal-like leaves of the protective envelope to become brown and membranous; a good idea will then be obtained of the kind of flower met with in rushes, and it will be evident that it is quite unlike a grass flower.

Sedges.—The sedges belong to the order Cyperaceæ, and are generally found accompanying rushes. They apparently have a close resemblance to grasses, but are easily distinguished from them by the characters contrasted in the following table :—

	Cyperaceæ	*Gramineæ*
Stem	Angular	Round.
	Solid	Usually hollow.
Leaf-sheath ..	Entire	Split.
Anther	Entire at the ends	Notched at the ends.
Ligule	Absent	Present.

The sedges, then, may be distinguished by their angular solid stems, entire leaf-sheaths, and the absence of ligules. Both rushes and sedges are worthless from a nutritive point of view; indeed, cattle seldom touch them, on account of their brittle character, which is due to the presence of an unusually large amount of silica. If these plants make their appearance in a meadow, a defective state of drainage is probably the cause.

The term "grasses," as used by the farmer, includes not only gramineous but also leguminous plants, so that clovers, vetches, sainfoin, lucerne, and even other green crops may be embraced by the term in an agricultural

Common Grasses

1. Marsh Bent
2. Sweet Scented Vernal
3. Meadow Fox-tail
4. Yellow Oat
5. Crested Dog's-tail
6. Rough Cock's-foot

se
a
th

gra
of
thi
mo
fro
wor
rec
and
bot
thos
in S
gras
com
there
the s
and t
altho
confu
stood
Ti
p. 232
to 3 f
Flowe
flower
althou
cultiva
introdu
Timoth
grass.
improv
but it
soils.
to beco

sense, when reference is made to the *artificial* grasses. In a botanical sense, the *true* grasses belong exclusively to the order *Gramineæ*.

True Grasses.—In the following account of the true grasses the object in view has been to give a brief notice of all those which are usually cultivated. In addition to this, the reader's attention has been directed to some of the more commonly occurring "weed grasses"—grasses that, from an agricultural point of view, must be looked upon as worthless, and which the cultivator, when he is able to recognise them, would find it advantageous to exterminate and replace by more valuable species. No attempt at a botanical classification of the grasses has been made, but those mentioned are given in the order in which they occur in Sir J. D. Hooker's "Flora of the British Islands." Some grasses are unfortunately burdened with a superfluity of common names, so that much confusion results. We therefore recommend the reader to familiarise himself with the systematic names, as these more usually have a definite and unvarying application, which is the same in all countries, although the existence of synonyms sometimes leads to confusion. Where not otherwise stated, it is to be understood that the undermentioned grasses are perennials.

Timothy grass, cat's-tail, or *Phleum pratense* (Plate facing p. 232). Root fibrous, slightly creeping. Stem 18 inches to 3 feet high in Britain, but frequently 4 feet in America. Flowers from June to August. The spikelets are one-flowered, and arranged in a spicate manner. This grass, although well known to the British grower, is extensively cultivated as a self crop, in the United States, where it was introduced from Britain, nearly a century ago, by Mr. Timothy Hanson, and for this reason it is called timothy grass. It thrives most luxuriantly on clay lands, peaty soils, improved moors, alluvial flats, and estuarine warp lands, but it is not suited either to very stiff clays or to chalk soils. If grown on light dry soils its roots have a tendency to become bulbous. As timothy is a late species, yielding comparatively little aftermath, it is better adapted for grazing or pasture land than for the meadow. If intended for hay, however, it may be grazed till late in spring without prejudice to the crop. Analyses (Nos. 23, 37) are quoted of the grass and the hay, in both of which forms it is eagerly eaten by all kinds of stock.

Meadow fox-tail grass, *Alopecurus pratensis* (Plate facing p. 228). Root fibrous; height of stem, 1 to 3 feet. Flowers from April to June, ripening its seeds from June to August. The one-flowered spikelets are arranged in cylindrical spike-like panicles tapering at each end. The leaves springing from the lower part of the stem are long, broad, soft, and of full green colour. Fox-tail is one of our earliest grasses, and forms an important part of the herbage in many rich pastures, yielding an abundant aftermath. It labours, however, under the disadvantage of not attaining its full productive power till the third or fourth year after sowing, and it is therefore not suitable for alternate husbandry. It flourishes best on stiff soils, its produce on a clayey loam being nearly double that on a sandy soil. No. 38 is an analysis of the hay of fox-tail.

Fox-tail and timothy are frequently confused the one with the other. They differ botanically thus: Fox-tail has an awn projecting from the middle or base of the flowering glume, but the floret contains no pale; timothy has no awn from the flowering glume, but a pale is present. Setting aside botanical characters, however, it must be remembered that these two grasses flower at different periods; fox-tail has nearly done flowering when the first inflorescences of timothy appear. The most useful distinction, perhaps, for the general observer is afforded by the appearance of the cylindrical spike-like flower-heads. That of fox-tail is slender, soft, and *silky*, whereas in timothy it is usually longer, stouter, and *bristly*. If the two grasses be placed side by side, and if the silky inflorescence of fox-tail be contrasted with the bristly one of timothy, the distinction will not be forgotten.

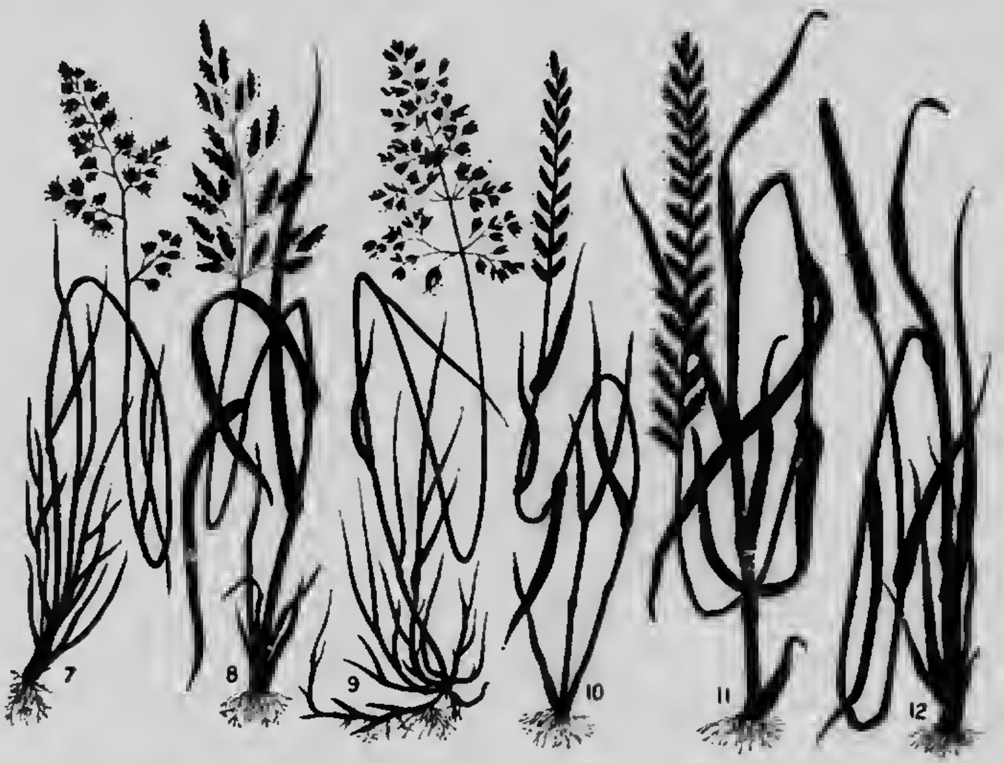
Two other grasses in the genus *Alopecurus* are floating fox-tail, *A. geniculatus*, and slender or field fox-tail, *A. agrestis*, both of which are bad grasses shunned by the farmer. Floating fox-tail grows from 6 to 12 inches high, and *its stem is bent at the joints*, so that it is easily distinguishahle from meadow fox-tail. Animals dislike it, and fortunately its yield is small. It grows chiefly in the vicinity of ponds and streams on clay soils, and may sometimes be seen floating on the surface of a pond; on dry soils it becomes stunted in growth. It flowers in June and July. Slender fox-tail, or, as it is also called, black bent or hunger-weed, is distinguished hy having a more slender inflorescence than meadow fox-tail; in black bent, again, the ligule is long, whereas it is short and ohtuse in meadow fox-tail. Black bent is an inferior grass growing naturally on poor soils; in wheat fields it is a troublesome weed difficult to eradicate, and sometimes it almost smothers the wheat crop. Partridges and pheasants are said to be fond of the seed, which ripens in August. Floating fox-tail and hlack bent are best got rid of hy drainage and liberal application of manure.

Sweet-scented vernal grass, *Anthoxanthum odoratum* (Plate facing p. 228). Root fihrous hut not creeping, stem 12 to 15 inches high. Panicle ohlong, consisting of a series of minor panicles each with four or five spikelets. Florets three in a spikelet, the two lower ones being harren. Flowers in May, and ripens its seeds in June. Each floret contains only *two* stamens, instead of three as in other grasses. This is the grass which imparts the pleasant fragrance to a new-mown hay-field, the odour being due to the presence of a principle named coumarin. Hence it is always recommended in mixtures for parks and pleasure-grounds, as the fragrance is very noticeable during the time the seeds are ripening. It is hardly adapted for close-cut lawns, as its leaves are somewhat broad and spreading, and therefore unsightly. If the lower end of the culm of this grass be drawn through the closed teeth, a lavender-like flavour identical with the odour of the grass will at once be noticed. Cattle do not appear to be particularly fond of sweet vernal, but its seeds are introduced into all mixtures, if only with the object of producing fragrant grass and sweet-smelling hay. Nevertheless, it grows freely in the sheep-grazing districts of the South Downs, and as it is said to improve the flavour of mutton it is considered an essential ingredient in sheep-pastures. Sweet vernal is less productive than cock's-foot, fox-tail, and other useful grasses, but it is ready for grazing very early, and the aftermath, though sparse, contains more nourishment than the flowering crop. The leaves of this grass are of a light green colour, and somewhat hairy on both sides, and the leaf-sheath is roughish when felt from below upwards. Sweet vernal will grow on most soils, but thrives best on deep, moist land. Analysis No. 39 shows the composition of the hay.

Common or creeping-rooted bent grass, purple bent, quick grass, fine bent grass, *Agrostis vulgaris*, has a rather tufted growth, and grows everywhere, preferring dry soils. Cattle and sheep will eat it, but it can only be looked upon as a weed grass.

Marsh bent grass or creeping fiorin, *Agrostis alba*, variety *stolonifera* (Plate facing p. 228), has fibrous creeping roots, and attains a height of about 2 feet. The flowers appear in July, and the panicle is then spreading, but afterwards compact. The florets are awnless and the leaves rough. The nutritious qualities of this grass are inferior, and it is only recommended for permanent pastures because its herbage appears early in spring and lasts far into autumn. It is best grown on peaty soils or irrigated meadows; on light, dry soils its small, wiry underground stems make it as troublesome as couch grass, and it is then called "squitch." It is similar in appearance to the foregoing grass, but in *Agrostis vulgaris* the leaf-sheaths are *smooth*, the ligules *short* and *obtuse*, whereas *A. alba* has *rough* sheaths and *long acute* ligules.

Tufted hair grass, *Aira cæspitosa*, is a not uncommon weed grass, with strong, fibrous, deeply penetrating roots, long



Common Grasses

7. Hard Fescue
8. Meadow Fescue
9. Smooth-stalked Meadow
10. Common Rye
11. Italian Rye
12. Timothy

flat
and
dam
" bu
seldo
Aira
is on
caryo
its b
herba
in Ju
Aira
in dry
useles
Ye
p. 228
I to
panicl
florets
any ot
and rip
stem,
the bri
Yellow
in mix
general
of whic
Hai
what c
simple p
grass, ra
to the
scanty
disappea
—in *A.*
very *sho*
The

flat leaves, and stems often 4 feet high. It flowers in July and August. It usually occurs in large tufts or *tussocks* on damp and marshy soils, and in some districts is known as "bull faces," or "bull pates." Being coarse and wiry, it is seldom eaten; it affords cover for game. Grey hair grass, *Aira canescens*, has a denser panicle than *A. cæspitosa*, and is only about 6 or 8 inches high. Silver hair grass, *Aira caryophyllea*, has an elegant shining, spreading panicle with its branches dividing into threes. It has very scanty herbage, and grows on sandy fields and hillsides, flowers in June, and soon after withers up. Wavy hair grass, *Aira flexuosa*, has panicles with wavy branches, and grows in dry woods and on sandy heaths. The hair grasses are useless to the farmer.

Yellow or golden oat grass, *Avena flavescens* (Plate facing p. 228), has fibrous, slightly creeping roots, smooth stems 1 to 2 feet high, with spreading, erect, much-branched panicles composed of spikelets containing each two or three florets, the individual florets being smaller than those of any other oat grass. It is a late species, flowering in July and ripening its seed in August. The yellow colour of the stem, clothed with delicate hairs pointing downwards, and the bright golden clusters of flowers serve to distinguish it. Yellow oat grass, though it is a weak plant, is recommended in mixtures for dry limestone soils, and for good light soils generally, on which it yields a quantity of *fine* herbage, of which cattle are fond. No. 40 is an analysis of the hay.

Hairy or downy oat grass, *Avena pubescens*, has somewhat creeping roots, stems 1 to 2 feet high, erect nearly simple panicles, and flowers in June. This is a sweet, hardy grass, rarely grown except on shallow limestone soils unsuited to the superior kinds. It grows in solitary culms with a scanty hairy herbage. On rich soils the hairs practically disappear. To distinguish between this and the foregoing —in *A. pubescens* the ligule is *long* and *acute*, in *A. flavescens* very *short* and *obtuse*.

The Wild Oat, *Avena fatua*, is a common weed in corn-fields, and attains a height of 2 to 3 feet. It is said to be the wild form of the cultivated oat, which it much resembles. The spikelets are three-flowered with very long awns, and the awned fruits so closely resemble artificial flies as to be successfully used by anglers as substitutes.

False oat grass, tall oat grass, or common oat-like grass, *Avena elatior* (*Arrhenatherum avenaceum*), is a fibrous-rooted weed grass, common in hedges, and on roadsides and dry soils, attaining sometimes a height of 3 feet, and flowering from May to July. It produces a quantity of bitter-tasting herbage, and contains only a small proportion of nutritive matter, but in its proper place, and in association with other grasses, it is not without some agricultural value. Its composition is shown in analysis No. 41. On arable soils there occurs a weed variety characterised by the formation of a bulb-like growth in the ground, just above the root; to this form the name of "onion couch" is given.

Soft grass, also called meadow soft grass, woolly soft grass, or Yorkshire fog, *Holcus lanatus*, is a plant with fibrous roots and downy leaves, attaining a height of from 1 to 3 feet, and flowering from May to July. It grows naturally on poor light soils and in water meadows, and thrives on peaty soils; it is very productive and easy to cultivate, but has not much feeding value, whether as hay or pasture. Indeed, it has been recommended to sprinkle the hay with salt to make it palatable.

Creeping or bearded soft grass, *Holcus mollis*, has fewer culms, broader leaves, looser panicles, and longer awns, and is much less common than *H. lanatus*, preferring hedges and copses. It flowers in July. On account of its strong creeping roots, it is useful on railway embankments and sandy slopes. These soft grasses, especially *H. lanatus*, sometimes occur to an alarming extent in meadows and pastures; when this is the case no pains should be spared to exterminate them so as to make room for better kinds.

Rough cock's-foot grass, *Dactylis glomerata* (Plate facing p. 228). Fibrous, somewhat spreading roots, rough stems growing 2 to 3 feet high. Flowers from June to August. A glance at the figure will at once enable the reader to recognise this grass whenever he sees it, as there is no other grass so similar to it in general appearance as to be likely to be mistaken for it. As it thrives well under the shade and drippings of trees, it has in America received the name of "orchard grass." It will grow on all kinds of soil, a damp soil with dry subsoil, allowing free growth to its roots, appearing to suit it best. Cock's-foot is really a most excellent grass, as will be seen from the analysis (No. 42) of its hay, the only precaution required being not to let it grow too old before cutting, as it then becomes wiry and tough. It is of rapid growth, forming unsightly tufts, and should enter into all mixtures of seeds for permanent pasture, where the regular cropping of sheep and cattle will ensure its being constantly consumed while young and juicy. The secretary of the Massachusetts Board of Agriculture writes: "This is one of the most valuable and widely known of all the pasture grasses. It is common to every country in Europe, to the north of Africa, and to Asia, as well as America. Its culture was introduced into England from Virginia in 1764. It forms one of the most common grasses of English natural pastures on rich, deep, moist soils. It became, soon after its introduction into England, an object of special agricultural interest among cattle-feeders, having been found to be exceedingly palatable to stock of all kinds. Its rapidity of growth, the luxuriance of its aftermath, and its power of enduring the cropping of cattle commend it highly to the farmer's care, especially as a pasture grass. As it blossoms earlier than timothy and about the time of red clover, it makes an admirable mixture with that plant to cut in the blossom and cure for hay. As a pasture grass it should be fed close, both to prevent its forming thick tufts and to prevent its running to seed, when it loses a large proportion of its nutritious matter and becomes hard and wiry. All kinds of stock eat it greedily when green." Cock's-foot grows wild on most roadsides, and if the young stem is drawn between the closed teeth its sweet juicy character will be perceived.

The genus *Poa* includes the so-called meadow grasses, always noticeable in a hayfield at the time of flowering by their elegant panicles. We shall briefly notice the more important meadow grasses, and then point out how to distinguish between them.

Annual meadow grass, *Poa annua*. This little grass only attains a height of 6 to 10 inches. It grows almost everywhere, and may be seen in flower any time between March and September. It is about the only flowering plant which grows naturally in the squalid courts and lanes of crowded cities, springing up from the earth between paving stones. Being an annual, it is, of course unsuited to permanent pasture, and even for one year's lay it is never intentionally included in seed mixtures, on account of its meagre produce. Nevertheless, as the plant will spring up, produce its flower, and ripen its seeds within a period of six or eight weeks, the annual meadow grass is naturally widely disseminated. An analysis of its hay is given (No. 43).

Smooth-stalked meadow grass, *Poa pratensis* (Plate facing p. 232). Root creeping, and forming numerous horizontal offshoots; stem smooth, round, 1 to 2 feet high; leaves broad, upper leaf shorter than its sheath; spikelets oblong, with four or five florets in each. Flowers from end of May to July. This grass occurs plentifully in all dry meadows, and is of a bright green colour in early spring. As a pasture grass it is considered of medium quality, but as its patch-like mode of growth enables it to overcome other grasses it is not in high favour with the farmer. It is noted for early yield, and should be cut while in flower if intended for hay, as if left till the seeds are ripe a considerable loss in feeding value results. This grass is rather liable to attacks of rust. No. 44 is an analysis of the hay. In the United States of America it is called "Kentucky blue grass."

Flat-stalked meadow grass, *Poa compressa*, also has a creeping root, but its stem is somewhat flattened, and the upper leaf is as long as its sheath. It is called "June grass" in America, and is of little importance.

Rough-stalked meadow grass, *Poa trivialis*. Fibrous root; rough stem, 18 inches to 2 feet high. Flowers in June, and ripens its seeds during second half of July. The ovate spikelets contain three florets. It thrives best in low, damp situations, such as heavy clays, and the moist fertile loams of irrigated meadows, and constitutes a considerable part of the riverside grass. It prefers sheltered situations, as it cannot withstand the sun's heat, and dies off dry, exposed soils in four or five years. It therefore grows best in mixtures of upright grasses, as fescues and rye grasses. Cattle, horses, and sheep are very partial to it, and it yields a fair aftermath. It is quite unsuited to upland pastures. Analysis No. 45 shows the composition of the hay.

Wood meadow grass, *Poa nemoralis*, has fibrous, somewhat creeping roots, and smooth stems 18 inches to 3 feet high. Leaves long and narrow. The panicle is loose and rather one-sided, and the spikelets contain usually three or four florets. It flowers in June and July, the seeds being ripe early in August. This is a common grass in woods; it lies thicker on the ground than *P. trivialis* or *P. pratensis*, and forms a good close sward under trees, and is therefore suitable for lawns. The leaves, which are of a light green colour, are somewhat intertwined below, thus producing a dense growth which enables this grass to displace weeds of one or two years' duration. Wood meadow grass shows a preference for limestone soils, and is susceptible to rust. It produces a fine, succulent, nutritious herbage, and may be relied upon for early spring growth.

As *P. pratensis*, *P. trivialis*, and *P. nemoralis* are all of common occurrence, it is useful to be able to distinguish each from the other two. The reader will already have gleaned certain general distinctive characters; in addition to these, however, some very obvious distinctions are based on the form of the ligule: in *P. pratensis* the ligule is *obtuse* but *prominent*, in *P. trivialis* it is *long* and *pointed*, and in *P.*

nemoralis so very *short* as to be practically *absent*. As the application of these tests only requires the bending of the leaf away from the stem so as to bring the ligule into view, they will be found far more generally useful than the truly botanical distinctions founded on minute differences in the structure of the florets.

Floating sweet grass, water grass, manna grass, *Glyceria fluitans*. Root-stock stout, widely creeping. Stems about 3 feet in height, leaves narrow. Distinguished by its slender, slightly spreading panicle, and long linear spikelets containing from six to twelve florets. Flowers from June to August. This is essentially a water grass, and is readily eaten by cattle and sheep. As it grows naturally by the water-side, it is well adapted for irrigated grounds and moist situations, as in water-meadows, for example. Its herbage is succulent and abundant. Floating sweet grass is cultivated in Germany for its seeds, which are sold under the name of manna-seeds, and used in soups and gruels. Another systematic name for this grass is *Poa fluitans*.

Water meadow grass, or reedy water grass, *Glyceria aquatica*, grows under similar conditions to *G. fluitans*, but has a very creeping root and a stem 4 to 6 feet high. It yields an immense bulk of coarse nutritious herbage, forming in marshy localities rich summer pasture, and yielding winter fodder. It is also called *Poa aquatica*.

Quaking grass, *Briza media*, is readily known by its characteristic appearance. This elegant grass is commonly met with in poor pastures, but is of no agricultural value, its herbage being extremely scanty. To get rid of it seeds of superior grasses should be sown, as in their presence the quaking grass disappears. As it frequently occurs in hay, an analysis (No. 46) is quoted. Other names for it are maiden's-hair, lady's-hair, cow-quakes. Its height is 6 to 18 inches, and it flowers in June. The lesser quaking grass, *Briza minor*, is a smaller variety; whilst *Briza maxima*, an annual, is a fine handsome species with very large spikelets, introduced into our flower gardens from Southern Europe.

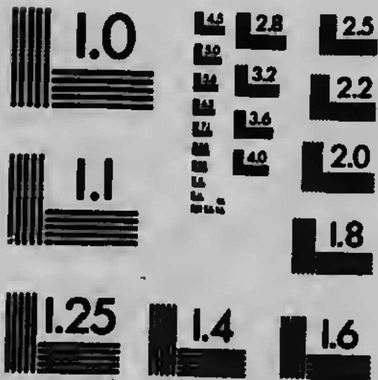
The fescue grasses, belonging to the genus *Festuca*, have, especially just before flowering, a habit very similar to that of grasses of the genus *Poa*. As a rule, the two genera may be distinguished from each other thus: in *Poa* the florets are not awned, whereas in *Festuca* the florets are awned from the summit of the flowering glume.

Sheep's fescue, *Festuca ovina*. Roots fibrous; stem erect, angular, 3 to 12 inches high. Panicle upright, compact up to the time of flowering. Spikelets alternately arranged, and containing from four to six florets with short awns. Flowers in June and July. This, the best known fescue, is a great favourite with sheep. It forms the chief natural grass in the Highlands of Scotland, in the mountains of Wales, and in hilly districts generally, especially on thin limestone soils of rocky uplands, as for example the carboniferous limestone of Derbyshire. It yields a sweet, nutritious herbage; the leaves are of a dark green colour, and grow in tufts, and as they are very narrow or bristle-shaped the herbage has a wiry appearance. Notwithstanding its excellent properties as a pasture grass, sheep's fescue cannot be recommended for the hay-field on account of the smallness of its produce. Probably a variety of *F. ovina* is the narrow-leaved sheep's fescue, *F. tenuifolia*, distinguished by its less tufted mode of growth, its long, slender, light green leaves, and its looser panicle without awns.

Hard fescue, *Festuca duriuscula* (Plate facing p. 232), differs from *F. ovina* in having somewhat creeping roots, and the culm just under the panicle round the smooth, while in *F. ovina* it is usually angular and roughish; again, the upper leaf of hard fescue is smooth on the outer surface, that of sheep's fescue being rough. It grows in moist hilly places, and is a capital grass under cultivation. The composition of its hay is given in analysis No. 47. Closely allied to hard fescue is the red fescue, *Festuca rubra*, which is rather taller in growth, attaining a height of 2 feet or more, and its spikelets have a reddish tinge. It is very suitable for loose dry soils.

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



Meadow fescue, *Festuca pratensis* (Plate facing p. 232). Fibrous root; smooth, round stem, 1 to 2 feet high. The leaves are *flat*, not bristle-shaped, like those of *F. ovina*. The panicle is nearly upright, rather loose, and the spikelets each contain five to six florets. This is a large-growing grass, but its leaves are tender and juicy. It does not grow in tufts like *F. ovina*, nor does it thrive on dry soils, but luxuriates in rich, well-drained clayey loams, and is therefore eminently suited for moist riverside meadows. As an early and productive grass it is recommended both for permanent pasture and alternate husbandry. It yields an abundant supply of herbage quite as early as meadow foxtail, and is superior to the latter in nutritive properties. For hay it should be cut in flower, as it loses much by being left till the seed is ripe.

Spiked or darnel-leaved fescue, *Festuca loliacea*, is very similar in appearance to common rye, *Lolium perenne* (Plate facing p. 232), but the leaves of the former are finer or more bristly than those of the latter, and each spikelet has *two* outer glumes (the usual number), whereas the spikelet of *L. perenne* has only one outer glume, as will be mentioned when treating of that grass. *F. loliacea* has no awn.

Tall fescue, *Festuca elatior*, also has flat leaves, and it is distinguished from the other fescues mentioned by its greater size, its height varying from 2 to 5 or 6 feet.

The foregoing fescues are all useful, nutritious grasses, and will usually be found in natural pastures on soils suitable to each kind. It will be noticed that *F. ovina*, *F. tenuifolia*, *F. duriuscula*, and *F. rubra* are narrow-leaved fescues, whereas *F. pratensis*, *F. loliacea*, and *F. elatior* are broad-leaved.

The genus *Bromus* includes a number of species which are quite useless from an agricultural point of view, and attention is therefore drawn to them to enable the grower to identify them where they occur, and to use means for their extirpation, as the ground which they occupy may be much better filled by more profitable species. The four commonest brome grasses are *Bromus asper*, *B. erectus*, *B. sterilis*, and *B. mollis*.

Rough brome grass, *Bromus asper*, attains a height of 4 to 6 feet, and grows chiefly in woods and copses. It is an annual, and flowers from June to August. The awns are short. Upright brome grass, *Bromus erectus*, grows to a height of 2 to 3 feet, and occurs in sandy fields and waste places on dry soils. It is a perennial, flowering at the same time as *B. asper*, which it resembles in having short awns, but its spikelets are usually of a darker colour. Barren brome grass, *Bromus sterilis*, unfortunately belies its name, for it is productive of a large number of seeds which get scattered and serve to reproduce this undesirable grass. It is from 1 to 2 feet high, and is a common weed grass in fields. Like *B. asper*, it is an annual, flowering from June to August. In outward appearance, also, it is like *B. asper*, but differs from it in its *very long awns*. Soft brome grass, *Bromus mollis*, is perhaps the commonest of the brome grasses. Its height varies from 6 inches to 2 feet, and it is abundant on roadsides and margins of fields, whilst it often occurs in quantity in meadows. It is an annual or biennial, and flowers from May to June or July. The spikelets are shaped like a lance-head, and the awns project a little beyond them. Smooth rye brome grass, *Bromus secalinus*, is an annual, and closely resembles *B. mollis*, but differs in that the florets are rather more spreading in the spikelet. *B. secalinus*, again, is of larger growth than *B. mollis*, and in the former the awns are shorter than the florets, whereas in the latter they are as long as the florets. The rye brome grass is a troublesome weed in wheat and rye fields, and it should be destroyed early in the season, when it is easily distinguished by the different appearance of its foliage from that of the young crop. This plant is the so-called "cheat" of the United States corn-fields. Its seeds, when they get mixed with wheat or rye, make the bread produced from them very unpalatable.

Crested dog's-tail grass, *Cynosurus cristatus* (Plate

Q

facing p. 228). Root fibrous. Smooth upright stem, bearing usually five leaves with smooth sheaths. The leaves are short, rather narrow, and tapering. The plant grows to a height of 1 or 2 feet, and flowers in June and July. The interrupted spike-like panicle, as represented in the figure, suffices for the identification of this grass. It grows naturally on dry pastures, but will thrive well in damp tenacious soils or in irrigated meadows. As its foliage is not coarse, and as it does not grow in tufts, it is useful for lawns and other swards kept under by the scythe. Dog's-tail is juicy and soft at the time of flowering, and for hay (analysis No. 48) should be cut then, as it contains far more nourishment at this stage than later on. Owing to its short and somewhat fine herbage it does not yield a heavy crop. Cattle, sheep, and deer are very fond of it, but they do not care for the culms, and these, brown and withered, may often be seen standing erect late in the autumn, and forming "the bents so brown"; they afford useful material in the manufacture of straw-plait.

To the genus *Triticum* belongs the troublesome weed called couch or twitch grass, but this is more than compensated for by its including that most useful grass the wheat plant. A closely allied genus is *Lolium*, to which the rye grasses belong. *Triticum* differs from *Lolium* in the following particulars: in *Triticum*, as in most genera of grasses, there are *two* outer glumes to the spikelet, whereas in *Lolium* there is only *one*, and that one occurs on the side *away* from the axis, as may be seen by examining the spikelets of any rye grass. Furthermore, the spikelets in *Triticum* are fixed *broadside* to the axis, as may be seen in a wheat ear; in *Lolium*, on the other hand, the spikelets are fixed *edgewise* to the axis.

Couch grass, *Triticum repens*, is a very variable plant, with stems growing from 1 to 4 feet high, and flowering from June to August. This grass, owing to its creeping habit, can only be looked upon as a pest, more especially in arable land, where its straggling underground stems, ramifying in every direction in loose soil, offer serious obstacles to cultivation, and, what is worse, the fragments into which the plough or spade, or other implement, may happen to break up the prostrate stem will themselves become independent centres of growth, and thus spread the nuisance. Animals only eat the herbage when it is quite young, but they are fond of the creeping stem, which is juicy and sweet, and contains about three times as much nutrient matter as the portions above ground. In Italy these underground stems are collected, washed, and sold as food for horses. The sea-wheat grass, *Triticum junceum*, and the dog-wheat or bearded-wheat grass, *T. caninum*, which is awned, are much rarer species than couch grass.

Common rye grass, *Lolium perenne* (Plate facing p. 232), has fibrous roots, and smooth stems growing to a height of 18 inches or 2 feet. It flowers in May and June. Anyone unacquainted with this grass should be able to identify it immediately by means of the figure; it will be noticed that there are no awns. When not in ear, rye grass may be distinguished by its darkish shining leaves with their very prominent midrib, also by the purplish white colour of the bases of the leaves at the crown of the plant. This is the most abundant grass in rich old pastures. Rye grass is liable to great variation, there being a large number of *varieties*. Examples are the Devon eaver grass, *Lolium Devoniensis*, and Pacey's variety, *L. perenne Paceyanum*, which is an intermediate variety as regards size, and sends up a large bulk of good herbage after hay-harvest. *L. perenne sempervirens* is a very green rye grass that keeps its colour well. Analyses of rye grass and its hay are given (Nos. 24, 49).

Italian rye grass, *Lolium italicum*, should perhaps be considered as only a variety of *L. perenne*, which it closely resembles, but it is taller, has longer flower spikes, and is *furnished with awns*, whereas *L. perenne* is awnless. *L. italicum* is an early grass, and its yield when grown on sewage-dressed land is extremely large. As it is not to be relied upon as a perennial, it is best adapted for alternate husbandry. Analyses Nos. 25 and 50 refer to this grass.

The two foregoing rye grasses are excellent forage plants, and are generally grown with clover or sainfoin as rotation crops, when they can be either mown or folded off. Common ye grass on loamy soils forms a close turf, and Italian rye grass can frequently be cut three times in a summer.

Darnel, poison or bearded darnel, *Lolium temulentum*, is a much less desirable grass than its congeners. It is very much like *L. italicum*, but differs from that and from *L. perenne* in the fact that the solitary outer glume is *longer* than the spikelet to which it belongs, and further from *L. perenne* in that it is awned. Darnel is a noxious weed, and poisonous properties are attributed to it; its seeds mixed with cereals, cause vomiting and intoxication in animals eating them. It is found chiefly in cultivated fields; and foreign seeds, notably flax, usually contain darnel seed. Fortunately this grass is not plentiful in Britain, and it is needless to add that where it is observed growing it should be effectually eradicated. It is, however, quite a pest in some of the Californian corn districts, where it is termed "cheat," the same name being given to *Bromus secalinus* on the east side of the Rocky Mountains.

The barley grasses, belonging to the genus *Hordeum*, and bearing a close resemblance to the cereal barley, which is also included in this genus, are rather commonly met with, especially on gravelly roadsides. They are never cultivated, and are therefore to be regarded as weed grasses, the long brittle awns of the inflorescence (as in "bearded" barley) piercing the skin or irritating the intestines of animals which eat them.

Many of the foregoing details, such as height and time of flowering, can only be taken as approximately true, seeing that they vary according to climate, soil, season, and so on. Mixtures of seeds might, perhaps, have been looked for here, but as local variations in soils are so common we could hardly have hoped to construct lists which would have been capable of general application. Indeed, in recent years seed merchants have been bestowing more and more attention upon this subject, and have, as the result of accumulated experience, not only been able to construct general tables, but also, when furnished with full particulars, to "prescribe" mixtures for exceptional soils.

Here we may conveniently introduce a

LIST OF CULTIVATED GRASSES

Agrostis stolonifera	.. Creeping Bent Grass.
Alopecurus pratensis ..	.. Meadow Fox-tail.
Anthoxanthum odoratum	.. Sweet Vernal.
Avena flavescens ..	.. Yellow Oat Grass.
Cynosurus cristatus ..	.. Crested Dog's-tail.
Dactylis glomerata ..	.. Rough Cock's-foot.
Festuca duriuscula ..	.. Hard Fescue.
Festuca elatior	.. Tall Fescue.
Festuca heterophylla ..	.. Various-leaved Fescue.
Festuca loliacea ..	.. Darnel-leaved Fescue.
Festuca ovina	.. Sheep's Fescue.
Festuca pratensis ..	.. Meadow Fescue.
Festuca rubra	.. Red Fescue.
Festuca tenuifolia ..	.. Fine-leaved Fescue.
Glyceria aquatica ..	.. Water Meadow Grass.
Glyceria fluitans ..	.. Floating Sweet Grass.
Lolium Devoniensis ..	.. Devon Eaver Grass.
Lolium italicum.. ..	.. Italian Rye Grass.
Lolium Paceyanum ..	.. Pacey's Rye Grass.
Lolium perenne	.. Common Rye Grass.
Lolium sempervirens ..	.. Evergreen Rye Grass.
Phleum pratense ..	.. Timothy, or Cat's-tail.
Poa nemoralis	.. Wood Meadow Grass.
Poa pratensis	.. Smooth-stalked Meadow Grass.
Poa trivialis	.. Rough-stalked Meadow Grass.

It will be noticed that the fescues, rye grasses, and meadow grasses furnish more than half the whole number. Other genera are, on the other hand, totally unrepresented —*Aira, Holcus, Briza, Bromus, Triticum, Hordeum.*

Before leaving the *Gramineæ* we desire to call attention to a few other analyses of products yielded by this most useful order. No. 51 is an analysis of ordinary meadow-hay of average quality. No. 27 shows the composition of green rye (the cereal, *Secale cereale*, a plant distinct from rye grass), and No. 26 that of green maize (Indian corn, *Zea Mais*), which will not perfect itself in so cold a climate as that of Britain, but is largely cultivated in the United States of America. They both afford green fodder, and green maize is grown in England for conversion into silage, for which purpose it is well adapted. Analyses are also quoted of the following cereals, which are all more or less used by millers in the preparation of various kinds of meal for stock-feeding: wheat, barley, rye, maize, millet, dari, rice, and the nutritious oatmeal (Nos. 57 to 64).

Diseases of Grains and Cereals.—Unfortunately, the grasses and cereals are subject to serious diseases, which arise from the plants becoming infested with the spores of certain parasitic fungi. These spores germinate in the plant and send out in all directions the branches or tubes called *hyphæ*, which break through the walls of the cells constituting the tissue of the plant, and derive their nourishment from the material which the plant had obtained for its own use. As a consequence the plant sickens and the parts attacked become rotten, the fungus meanwhile luxuriating in the destruction and decay which it has effected, and producing fresh crops of spores which by various agencies are transmitted to neighbouring healthy plants, these in their turn becoming also the prey of disease. These fungal diseases are known by such names as *smut*, *bunt*, *rust*, *mildew* and *ergot*. Some ravage one part of a plant, others another.

Smut attacks the young seed, and sometimes it destroys the glumes as well. It is indicated by masses of dark-coloured dust (the spores) emerging from the inflorescence, and perhaps from that portion of the stem immediately beneath. Barley, rye, wheat, and especially oats are attacked by smut, wild grasses being less liable. In warmer countries maize and millet suffer, swellings as large as a turnip being sometimes produced in the former.

The bunt, brand, or pepper-brand infests all kinds of wheat, spelt being less liable to attack than other sorts, and winter wheat less than spring wheat. The fungus, like smut, attacks the young seed, which it destroys and replaces by a black greasy substance of disagreeable odour.

Rust and mildew attack chiefly the leaves and stems, and not often the seeds, so that the injury rests mainly in the very bad quality of the straw; nevertheless, the grains suffer to some extent. Rust is first indicated by blotches of brown rust-coloured dust breaking out on the surface of the plant. Certain spores are then produced which get transferred to the barberry plant, on the leaves of which another stage in the life-history of the fungus is completed, resulting in the production of a new set of spores which can only germinate on wheat or some similar plant. This disease usually attacks wheat, barley, and oats; it is less frequent in rye and pasture grasses. Mildew forms a delicate web-like covering on the green leaves of clovers, turnips, mangels, etc.

Ergot, or ergot of rye as it is frequently called, is a disease more to be dreaded than those already mentioned, for not only does it involve practically the destruction of the grass it infests, but it also produces a substance which is in itself highly dangerous, and which if taken internally is capable of producing abortion in cows and mares, though abortion is much more likely to arise from other causes. The disease attacks the young ovary, or seed-vessel, which becomes at first enclosed by a soft mass of hyphæ-tissue. This is accompanied by a honey-like secretion, and followed by the conversion of the entire ovary into a hard blackish mass, similar in shape to the rye grain, but much lengthened. It is to this hard bluish-black substance that the name of "ergot" is popularly given. Where rye-bread is used the ergot sometimes gets ground up with the rye grains in the preparation of the flour, and very disastrous, sometimes fatal, results have ensued to the people who have eaten it, gangrenous diseases being the usual consequence. Ergot attacks a great many grasses and cereals, rye being notably subject to its ravages. The cultivated grasses which most frequently become ergoted are timothy grass (*Phleum pratense*), fox-tail (*Alopecurus pratensis*), tall fescue (*Festuca elatior*), floating sweet grass (*Glyceria fluitans*), rye grass (*Lolium perenne*). Of weed grasses, those most liablo to attacks of ergot are soft brome grass (*Bromus mollis*), couch-grass (*Triticum repens*), and wall barley grass (*Hordeum murinum*).

Parasitic Flowering Plants.—We may here refer to certain flowering plants which are more or less parasitic on forage crops, and the rise or spread of which the cultivator should do his best to check. Those we have selected are the dodder, broom-rape, yellow-rattle, and eye-bright.

Clover dodder, *Cuscuta minor*, is a plant belonging to the order Convolvulaceæ, which includes the well-known bind-weed, or field convolvulus, *Convolvulus arvensis*. The dodder occasionally becomes a serious pest in clover-fields, where it usually obtains a footing through its small seeds having been sown with those of the clover, especially if the clover-seed is of foreign origin. The dodder-seed germinates in the ground, and the young shoot trailing over a clover stem develops small sucking rootlets which penetrate into the tissue of the host, and enable the parasite to abstract nutriment from the clover to assist in its own growth. Like all truly parasitic plants, dodder contains no green colouring matter, its colour being pale yellow to whitish, except towards the tips of the stems, where it is pinkish. It can easily be discerned from a distance in a clover-field by the light-coloured patches it produces. The stem of the dodder will encircle that of the clover many times, and is not easy to detach. Usually the interlacing stems of the parasite are seen at the surface, the heads of flowers being underneath; the whole plant has a faint aromatic odour. If a mass of dodder be stripped away by hand from the ground, the hands will become sticky, owing to a moist adhesive matter on the surface of the dodder, and the ground which is thus exposed will be seen to have every trace of clover on it destroyed. Other species of dodder attack the flax plant, the heather, and the stinging-nettle.

Broom-rape, *Orobanche minor*, is a yellowish brown plant parasitic on the roots of clover. It is stated that the seeds of this plant remain dormant in the soil until they come in contact with the roots of the plant on which the parasite preys, when they at once germinate. The minute, irregularly shaped seeds get introduced in imperfectly cleaned clover-seed. The height of the broom-rape plant varies from 6 inches to 2 feet. Other species are parasitic on the roots of broom, gorse, and milfoil.

Scrophulariaceæ.—Yellow-rattle, *Rhinanthus Crista-galli*, and eye-bright, *Euphrasia officinalis*, both belong to the order Scrophulariaceæ, which includes such wild plants and weeds as toad-flax, snapdragon, figwort, foxglove, speedwell, brooklime, bartsia, and cow-wheat, most of which are characterised by the irregular form of the corolla, as in the snapdragon. Both yellow-rattle and eye-bright have the reputation of being parasitic on the roots of grasses; they are not, however, completely parasitic, as they contain green colouring matter, and therefore differ from dodder and broom-rape. They generally occur in poor pastures, and their presence is a sure indication of bad soil. To get rid of them the land should be well cleaned and manured. The yellow-rattle is called horse-penny in some districts. The louse-wort and cow-wheat are similar partial parasites belonging to the same natural order.

Non-flowering Plants.—Of non-flowering plants, two may be mentioned as being used for cattle food—Iceland moss and Irish moss. They are unfortunately named, as neither of them is really a moss. Iceland moss, *Cetraria islandica*, is really a lichen, one of that class of curious, many-coloured vegetable growths seen on rocks, old walls, tree-trunks, etc. It grows plentifully in cold regions, upon otherwise barren rocks, and occurs in the mountainous districts of Britain. Its percentage composition is :—

Water ..	10·0
Albuminoids, etc.	8·7
Lichen-starch ..	70·0
Lichen-acids, etc.	6·3
Crude fibre	3·5
Ash	1·5
	100·0

Irish moss, *Chondrus crispus*, is a seaweed occurring plentifully on our rocky coasts. Its composition, as sold, is :—

Water ..	18·8
Albuminoids, etc.	9·4
Carbohydrates (mucilage, etc.)	55·4
Crude fibre	2·2
Ash	14·2
	100·0

Seeds.—The important subject of seeds, with their adulterations, deserves more than the passing note we are able to give it. The old practice of saving seeds from his own crop is now seldom adopted by the farmer, as he finds it more to his advantage to purchase from seed merchants. Adulteration of seeds is either accidental, intentional, or both. Of the two, the accidental adulteration is usually the more injurious; it occurs in imperfectly cleaned samples, so that what is sold as a sample of the seed required contains, in addition to the seeds themselves, small sticks and stones, and seeds of other plants, usually of ordinary weeds, or perhaps, what is worse, the seeds of such plants as dodder, broom-rape, yellow-rattle, Yorkshire fog, soft brome grass, and even ergot of rye, which from its appearance is often mistaken for mouse dung. The best protection which the grower has is to obtain his seed from a thoroughly trustworthy firm, and at the same time not to be too close-fisted, for *bad seed is dear at any price.*

Explanation of the Analyses (pp. 251-2).—All plants contain water, more especially in the green state; after being air-dried they are found to have lost the greater portion of this water. *Albuminoids* are bodies rich in nitrogen, and when they occur in food-stuffs they are the only materials which play the part of *flesh-formers*. Albumin (or white of egg), casein (the nitrogenous compound in milk and cheese), the gluten (the sticky elastic substance contained in wheat) may be taken as examples of albuminoids. *Carbo-hydrates* contain carbon, hydrogen, and oxygen, the two latter being present in the proportion in which they occur in water: in food-stuffs carbo-hydrates primarily perform the function of *heat-givers*, and they are usually present in the form of some modification of starch or sugar. Thus, in a grain of wheat or in a potato the chief carbo-hydrate is starch, in mangel and beetroot it is sugar. *Fat*, also, is a compound of carbon, hydrogen, and oxygen, but the oxygen is present in a smaller proportion than that in which it occurs in the carbo-hydrates. Like these latter, fat assumes the function of a heat-giver in the animal body. In the analyses given on the following pages small quantities of wax and green colouring matter are included under the head of fat. *Crude fibre* is chiefly composed of a carbo-hydrate called *cellulose*, and the fibre being indigestible has no *direct* value as a food-stuff. The *ash*, or mineral residue, is that which is left behind after the plant is burnt in the air; it consists of inorganic substances such as potash, lime, magnesia, silica, and phosphoric acid, which the plant derived from the soil. The value of a plant as a food-stuff must be estimated from the amount of albuminoids, or flesh-formers, and of carbo-hydrates, or heat-givers, present; fat, also, when it occurs, should be taken into consideration.

COMPOSITION OF FEEDING STUFFS

	ROOTS							GREEN FODDER						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
										Red Clover.		Alsike.		
	Turnip.	Swede.	Carrot.	Giant Carrot.	Parsnip.	Mangel.	Beet.	Cabbage.	White Clover in blossom.	Before blossom.	In full blossom.	Early blossom	Full blossom.	Crimson Clover.
Water	92·0	89·0	85·0	87·0	86·3	88·0	81·3	89·0	80·5	83·0	78·0	85·0	82·0	81·3
Albuminoids, etc. ...	1·1	1·4	1·4	1·2	1·6	1·1	1·0	1·3	3·5	3·3	3·2	3·3	3·3	2·7
Carbo-hydrates ...	5·3	7·9	10·8	9·6	10·2	9·1	15·4	3·8	7·2	7·0	9·5	3·5	6·3	7·3
Fat	0·1	0·2	0·2	0·2	0·3	0·1	0·1	0·3	0·8	0·7	0·8	0·6	0·6	0·7
Crude fibre	0·8	0·9	1·7	1·2	1·0	0·9	1·3	2·0	6·0	4·5	6·8	4·5	6·0	6·2
Ash	0·7	0·6	0·9	0·8	0·7	0·8	0·7	1·2	2·0	1·5	1·7	1·5	1·8	1·6
	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0

GREEN FODDER (*continued*)

	15	16	17	18	19	20	21	22	23	24	25	26	27
		Lucerne.											
	Yellow Trefoil.	Young.	In early blossom.	Sainfoin in blossom.	Vetch.	Lupin.	Furze gathered in February.	Prickly Comfrey	Timothy Grass.	Common Rye Grass.	Italian Rye Grass.	Green Maize.	Green Rye.
Water	80·0	81·0	74·0	80·0	84·0	85·3	53·0	89·2	70·0	70·0	73·4	82·2	76·0
Albuminoids, etc.	3·3	4·5	4·3	3·2	2·4	3·1	6·3	1·4	3·4	3·6	3·6	1·2	3·3
Carbo-hydrates	8·2	7·2	9·2	8·2	6·4	6·6	26·4	6·2	15·3	12·8	12·1	10·3	10·4
Fat	0·8	0·6	0·8	0·6	0·4	0·3	1·1	—	1·1	1·0	1·0	0·5	0·8
Crude fibre	6·0	3·0	9·5	6·3	5·4	3·3	11·9	1·8	8·0	10·6	7·1	4·7	7·9
Ash	1·3	1·7	2·0	1·3	1·4	1·2	1·3	1·4	2·2	2·0	2·8	1·1	1·6
	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0

COMPOSITION OF FEEDING STUFFS

HAYS

	28 White Clover.	29 Red Clover.	30 Alsike.	31 Crimson Clover.	32 Black Medick.	33 Lucerne.	34 Sainfoin.	35 Vetch.	36 Pea-straw.	37 Timothy Grass.	38 Meadow Fox-tail.	39 Sweet Vernal.	40 Yellow Oat Grass.	41 False Oat Grass.	42 Rough Cock's-foot.	43 Annual Meadow Grass.	44 Smooth Meadow Grass.	45 Rough Meadow Grass.	46 Quaking Grass.
Water	16·5	16·0	16·0	16·7	16·7	16·0	16·7	16·7	16·7	14·5	14·5	14·3	14·5	14·5	14·3	14·5	14·3	14·3	14·3
Albuminoids, etc.	14·5	12·5	13·0	12·2	14·6	14·4	13·5	14·2	14·3	9·7	10·6	8·9	8·4	11·1	11·6	10·1	8·9	8·4	5·2
Carbo-hydrates ...	33·9	38·2	32·7	32·6	35·2	27·9	34·2	32·8	34·2	45·8	37·0	37·3	40·4	32·6	38·0	44·4	36·8	34·4	40·2
Fat	3·5	2·2	5·3	3·0	3·5	2·5	2·3	2·5	2·6	3·0	2·4	2·9	2·2	2·7	2·6	2·9	2·3	3·2	2·6
Crude fibre ...	25·6	26·0	27·0	30·4	20·2	33·0	27·1	25·5	25·2	22·7	29·0	31·2	30·8	29·4	28·9	23·9	32·6	32·6	30·5
Ash	6·0	3·3	6·0	5·1	6·0	6·2	6·2	8·5	7·0	4·3	6·7	5·4	5·9	9·9	4·6	2·4	5·1	7·1	7·4
	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0

HAYS (continued) — **SEEDS AND CEREALS**

	47 Hard Fescue.	48 Dog's-tail.	49 Common Rye Grass.	50 Italian Rye Grass.	51 Meadow Hay of Average Quality.	52 Rape-cake.	53 Pea.	54 Bean	55 Lentils.	56 Buckwheat.	57 Wheat.	58 Pearl Barley.	59 Rye Flour.	60 Maize.	61 Millet.	62 Dari.	63 Rice.	64 Oatmeal.
Water	14·5	14·3	14·5	14·3	14·5	7·6	14·5	14·0	14·5	13·4	14·5	14·6	15·0	14·5	15·0	12·2	14·6	5·0
Albuminoids, etc. ...	10·4	9·5	10·2	11·2	9·7	30·7	22·4	23·0	24·0	15·2	11·0	6·2	10·5	9·0	15·3	8·2	7·3	16·1
Carbo-hydrates	34·6	45·3	36·1	40·6	41·2	33·5	51·3	52·5	49·0	63·6	69·0	76·0	71·0	64·5	61·6	70·6	76·0	63·0
Fat	2·8	2·8	2·7	3·2	2·3	10·2	2·5	2·5	2·6	3·4	1·2	1·5	1·6	5·0	3·0	4·2	0·5	10·1
Crude fibre	33·2	22·6	30·2	22·9	26·5	8·1	6·3	5·5	6·9	2·1	2·6	0·8	2·5	5·0	3·5	3·1	0·9	3·7
Ash	4·7	5·5	6·5	7·8	6·2	9·9	3·0	2·9	3·0	2·3	1·7	1·1	1·6	2·0	1·6	1·7	0·5	2·1
	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0

CHAPTER XIII

HAY-MAKING

To the dairy-farmer it is always a matter of great importance that the hay crop be well secured, free from rain and well made; and the hay harvest in a fickle climate like that of England is a period of considerable anxiety and activity. Most dairy-farmers depend to a large extent on the hay crop for the wintering of stock, and some depend wholly on it; hence it is very desirable that the crop be harvested in good condition. Hay that is well harvested, cut at the proper time, and neither under- nor over-dried, is very nearly as valuable as its equivalent quantity of green and succulent grass; while badly harvested hay, cut much too young or too old, sunburnt with too much exposure, or badly weathered by showers of rain, is so much reduced in value as to be no better, and sometimes worse, than so much straw.

Time of Cutting.—The time to cut meadow grass is when the complexion of the field *begins* to wear a brownish tinge. At this stage the bulk of the grasses are flowering, and some of the earliest ones have gone to seed. Very heavy crops should be cut earlier than this, particularly sewage grass, or they will become laid and rotten in the bottom. Clover should be cut when the majority of the heads are in blossom, for if it stands till it has done flowering, the woody fibre increases, and the nutritive qualities decrease in proportion. All grass and clover should, in fact, be cut a little under- rather than over-ripe, as at this stage they contain a considerable quantity of sugar, gum, mucilage, albuminous and other soluble compounds, which are all liable to be washed out by repeated or long-continued showers of rain, and particularly so after the hay is partly made.

While the grass is still newly cut and fresh a coating of waxy or oily matter is found on its epidermis, giving it a waterproof covering and protecting it from injury by rain; this protection remains so long as the grass is fresh and unbruised, but when it has been turned and knocked about repeatedly the fibres are more or less bruised or broken, the cell-walls are lacerated, and the juices containing the soluble constituents begin to ooze out and escape, unless the drying proceeds pretty rapidly, sealing them up in the stems and leaves. If rain falls at this period the drying is checked, the escape of sap-constituents is promoted, and fermentation sets in, during which the two most valuable properties of the day are destroyed, viz. albumen and sugar. So in showery weather it is advisable to leave the grass or half-made hay quite alone; for stirring during rain, and when there is no certainty of getting them dried and made up into cocks in good condition, does much more harm than good. To make up into cocks hay that is wet with rain-water is an effectual way of spoiling the stuff, and until the rain ceases and the wet can be got out of it, it is best to leave it quite alone. The stirring bruises the hay all the more—a result that is easily produced when it is full of rain-water—and cocking it up wet only promotes fermentation, so that no good whatever, but great harm, comes of messing about among it in wet weather.

The following analyses by the late Dr. Voelcker illustrate the mischief which is done to hay by rain and improper making:—

Average Composition of Good Clover Hay

Moisture	16·60
*Nitrogenous substances	15·81
Non-nitrogenous substances	60·00
Mineral matter (ash)	7·59
	100·00

* Containing nitrogen, 2·52.

CLOVER HAY INJURED BY RAIN AND BADLY MADE

Moisture	20·45
*Nitrogenous organic matter	8·50
Non-nitrogenons substances	64·27
Mineral matter (ash)	6·78
	100·00

* Containing nitrogen, 1·36

There is no good whatever in stirring hay about in damp weather. It is not enough that it is not raining and that the hay has no rain water in it, for if the atmosphere be damp no moisture will evaporate from the hay, consequently no drying is going on, and the hay is far better left alone without the bruising it gets in stirring and knocking about. It is sun, or wind, or dry air, or all these together that do the drying; and, however valuable it may be with them, stirring is absolutely mischievous without them.

Mowing Machines.—The invention of the mowing machine and its general adoption throughout the country have completely changed the "toil and moil" of hay-making. With a two-horse grass-mower, ten or twelve acres of grass may easily be mown in one day, by one man and two horses. The three chief things to be attended to in using a grass-mower are sharpening, oiling and driving; the rest will then take care of itself. A good machine is an immense advantage to a farmer, if he has a careful man to drive it, or if he drives it himself; by setting to work at three o'clock in the morning several acres may be cut before the heat of the day comes on, and without oppressing either man or horses. The grass is down ready for the morning's sun; and both man and horses, after an hour's rest, are at liberty for other work.

Tedders.—Grass that is cut by machine lies in good form for drying, and it may be left so until next day if there is other work to do; and, indeed, as a rule it is as well left until next day, unless the weather is unusually hot and there is a danger of its becoming sunburnt. It is

Martin's Patent Swath-Turner

t
r
p
a
t
it
h
r
n
n

tu
su
is
a
in
ex
sw
ha
tu
to
ho
his

req
ted
and
a h
the
for
wh
eno

difficult to shake out machine swathes by hand or with a fork, when they want tedding, simply because they are so much spread over the land; and to do the work well a tedding-machine, or hay-maker, is required. However valuable a mower may be, a tedder is hardly less so; indeed, the latter will do all that is required in settled weather to make the hay dry enough for stacking, and it is a good plan to keep it going all day, repeatedly stirring the hay about, mixing it well up together, leaving it so light on the ground that sun and wind can get freely into it, making it better and quicker than can be done by hand. In very hot weather the tedder is particularly valuable; the hay requires to be constantly kept stirring, so that the sun may not scorch a portion of it while the rest is still under-made.

Swath-Turners.—Quite recently, however, swath-turners have come a good deal to the front, in many cases superseding tedders. Some farmers consider that a tedder is not needed where a first-rate swath-turner is at hand. In a very fine summer for hay-making that may be true, but in any case a tedder following a swath-turner will do excellent service. An illustration is given of an excellent swath-turner; and it may be mentioned that its makers have evolved a fine machine, a combination of a swath-turner and a side-delivery rake. This combination is said to be capable of making unnecessary both a tedder and a horse rake as separate machines. Each farmer must consult his own judgment, and his own pocket, simultaneously.

Horse-Rakes.—In good weather the hay will not require touching at all by hand. The mower cuts it; the tedder stirs it about, leaving it light on the field; the sun and wind dry it, and it is ready for stacking. At this stage a horse-rake will be found a most useful implement, doing the work of six or eight men, who are thus set at liberty for carting and stacking. A horse-rake with four-feet-six wheels will collect the hay into rows that are quite thick enough to cart from, leaving the ground much cleaner than would be done by hand, and in long hay leaving it so clean that it will require no raking afterwards; in short hay it will generally be found necessary to rake the ground after the "putting-in" is done, but this the horse-rake will do, crossing the direction taken before and raking perfectly clean.

Hay-Barns.—Among the most useful of modern farm equipments is the hay-barn, which is simply a permanent shed for the storage of hay or of corn. In a climate whose fickleness is proverbial, and in which good seasons for securing crops are the exception and bad ones the rule, it is a great advantage to be able to avoid rick-making.

The most approved and satisfactory kind of hay-barn is built wholly of iron; the pillars are of cast-iron, standing on and strongly bolted to large slabs of stone that stand a foot or two out of the ground and dip a foot or two into it, and the roof is of corrugated and galvanised sheet-iron, well braced and bolted, and firmly attached to the pillars. The hay-barn should have a raised floor, so that the hay is kept off the damp ground. The best kind of floor is asphalt, well laid down.

If the hay is got hurriedly on account of the weather, and is rather soft, it is a simple matter to leave a sort of chimney here and there in it to allow the heat and steam to escape; this is done by sawing a long-enough pole down the middle and nailing strips of wood from one half to the other to keep the two sides 3 inches apart; the strips must be let in flush, to allow the hay to settle down. This improvised chimney will keep a hay-rick from scorching, the heated air escaping freely and cool air taking its place. Chimneys should be duplicated in big ricks, leaving a space of about 2 yards between them. The present writer evolved this plan of cooling a hay-mow, and has seen nothing else so effective. The chimneys are set up, and remain year after year,—five of them in one hay-barn.

CHAPTER XIV

THE MILK TRADE

THE trade in country milk to our cities and towns has now attained enormous dimensions. In many dairying districts throughout the entire country, wherever there is a contiguous railway, cheese-making has for the most part succumbed to the milk trade. Entire parishes which but a few years ago were mainly devoted to cheese- and butter-making now scarcely produce any cheese at all, and very little butter. The change is striking and complete. In other parishes, too—one side only of which is, perhaps, within sufficiently easy reach of a railway—the revolution is making its way. The farms lying nearest to the railway commonly send off the whole of their milk the year round, while those on the other side make cheese in the summer months. But when winter approaches and milk becomes scarce, and when, in consequence of colder weather, it can easily be delivered in town in perfect condition, the demand for it increases according to its scarcity, and the farmers who are constantly engaged in the milk trade hunt up the milk of those who are not, in order to supplement their own diminished winter production. During at least five months of the winter season the price of milk is such that many cheese-making farmers are glad to dispose of all they can possibly spare, and milk-selling farmers are equally glad to buy it and collect it from the outlying farms, sending it off to town along with their own. There are two great reasons for doing so. First, it follows that he who can send to the city salesman the largest winter supply—for milk is seldom too plentiful in winter—will be the better able to dispose of his summer's milk on favourable terms;

the salesman, in fact, is always willing in summer to do his best for the farmer who can send him most milk in winter, and thus the winter's milk in a sense sells the summer's. And, secondly, as it is much more costly to produce a large quantity of milk in winter than in summer, it follows that it is much to the advantage of the milk-selling farmer that he should buy all the milk he conveniently can in winter from his neighbours, even if he pays for it a price which leaves him but little direct profit; and his neighbours, in their turn, cannot do better than sell it to him at the price he can afford to pay.

It follows, then, on this system, that many farmers are in a sense milk dealers, but they buy in a retail and sell in a wholesale way, and that only—or chiefly—in the winter-time. We know cases in which farmers have bought up the winter milk of the patrons of one or other of the cheese factories. The patrons deliver it at the factory, as a central depot, and the farmer fetches it away. This arrangement is about as good as any that can be thought of for profitably and conveniently disposing of the small quantities of milk which cheese-making farmers usually produce in winter. The plan, in fact, may be adopted so early in the autumn and continued so late in the spring as the price at which milk is selling may suggest. When, for instance, the milk is only worth 6d. a gallon for cheese-making, and sells at 8d. to the trade, then should cheese-making cease for the time. A comparison of values will thus go hand in hand with the law of supply and demand in the milk trade; and herewith is provided a basis on which dairy farming to a considerable extent—so far as we can see—will henceforth be conducted.

These influences are now changing the aspect of dairy farming throughout the length and breadth of England. Numbers of farms which were at one time devoted to the one speciality of cheese-making—farms whose every operation was designed to be chiefly subsidiary to this one thing are now devoted to a changing variety of pursuits, and their eggs are no longer all in one basket. Though they are themselves too far from a railway to adapt themselves to the milk trade, they yet contribute no insignificant share to that trade. Cheese-making is followed, of course, but less extensively than it used to be, and butter-making has in some measure taken its place. One important way in which these outlying farms contribute to the milk trade is in producing autumn and early-winter calving cows, which are sold when on note to the milk-selling farmers; and to keep up this supply a maximum number of young stock is raised. Thus it follows that even on farms that cannot, by reason of distance from a railway, cultivate the milk trade conveniently, except in the indirect manner already spoken of, cheese-making has greatly diminished, and it is probable that we have at least one-third less cheese made in the country than was the case thirty years ago.

The milk trade is, of course, a ponderous affair, for milk is a heavy and bulky product. A man who milks thirty cows sends his half-ton of milk away, day by day, scores of miles to be consumed. Without railways this would have been impossible. Stephenson was greater than Macadam, and the iron road is doing what the turnpike must for ever have left undone. Twenty miles of turnpike place an effectual bar on the milk trade, but one or even two hundred miles of railway do not, and it is likely that some day Scottish and even Irish milk will find a daily market in the metropolis. As the matter already stands, the counties of Derby, Stafford, Nottingham, Wilts, Hants, Gloucester, Somerset, and many others, are largely employed in feeding London with milk.

Refrigerators.—During warm weather farmers always aerate and cool the milk before sending it away, by means of one or other of the refrigerators on the market, and even in winter it is well to get the warmth and odour of the cow out of it. The water at its warmest comes in contact with the milk at its warmest; and as the milk descends, cooling as it falls, it comes last in contact with the water where both are at their coldest; thus the cooling is gradual. As the milk flows over the tubes it is thoroughly aerated, so that the two processes are completed together. Various patterns of refrigerators suitable for cooling milk have been invented, but the principle is identical in most of them.

Railway Cans.—The milk cans ("churns" is absurd) do not differ much in general pattern, but some of them are more strongly constructed than others, and consequently more serviceable; the best of them have the fewest possible seams in which the milk can lodge, and the lids are so made as to be easily attached and detached.

One of the chief annoyances to the farmer in the milk trade is the knocking and smashing which the cans undergo. They are roughly treated by the railway officials, by the servants of the farm, and apparently by everybody else. It is chiefly the empty cans which are most roughly used; the full ones, being heavy, cannot be tumbled about so easily; and they may not be turned topsy-turvy, or the milk would be lost. But the empty cans are pitched here and there with all the contempt which comes of familiarity; the lids and the rims are smashed, the sides are crushed in, the name is chipped off, and it is not easy to imagine a more forlorn-looking object than a railway milk can of six or eight months' service. From this cause the farmer's loss is heavy, because the cans usually are his property; it is, therefore, necessary to use only cans that are made in the best manner and of the strongest material.

Bad Debts.—Another cause of annoyance and loss is found in the bad debts which the farmers too often contract with urban salesmen. Years ago this evil was, perhaps, more common than now, for at that period too many men of straw went into the milk trade,—men who had nothing to lose. At the period when the trade began so rapidly to expand, numbers of new salesmen in the towns sprang up, and farmers were not awake to the dodges of the trade.

Hence many of them were let in smartly at times by means of unpaid accounts.

Again, the London demand for milk fluctuates day by day, unless the weather remains fine and bright; in wet, cold weather it falls off instantly. The city salesmen have to watch these fluctuations closely, or they will often have a quantity of milk on their hands which they cannot dispose of, and which is, for the most part, a loss; and when they see symptoms of a falling off in the demand, they at once telegraph to the farmers to hold back one or two meals' milk; thus the farmer has the milk thrown on his hands, and he must at once make either butter or cheese of it. Another and a less satisfactory dodge of some salesmen is to keep back the empty cans, so that the farmer cannot, if he would, send his milk; this is worse than a telegram, fc. the farmer is uncertain what to do, and he thinks it possible that the cans have gone astray on the railway, which they sometimes do; he tries then to borrow cans, thinking the salesman is wanting the milk, and all the while his own cans are probably standing in the salesman's yard.

The wholesale price of milk varies with the season, though the public seldom gain the benefit of a reduction. In some districts the farmer sells his milk by the "barn gallon," as it is termed—that is, 17 pints to the gallon, or half a pint over-measure at each imperial gallon. Most of them are not aware that under the Weights and Measures Act, 1878, 41 and 42 Vict., ch. 49, sections 17 and 19, it is illegal to sell by such measure. The selling by barn gallon is an old custom, in which the extra pint was thrown in—for the same reason that an extra lb. of cheese is thrown in at the cwt., and an extra oz. of butter at the lb.—in order to improve the bargain to the buyer. Farmers in other districts sell their milk at so much "a dozen,"—that is, a dozen quarts; this custom is not illegal, but it is rather clumsy. Others sell by the standard imperial gallon, which is the best.

Town Dairies.—The sources of our towns' and cities' milk-supply are not where they formerly were, except to a limited extent. It is hardly too much to say that forty years ago, no appreciable quantity of milk was sent into town by rail, except over short distances; and it is equally pertinent to remark that the cities of the kingdom and many of its towns, now receive almost all their milk from the country districts, brought, in many cases, long distances by rail. This new order of things had begun to recommend itself to the milk-salesmen some time before the cattle plague, or rinderpest, had wiped out so many town dairies in a wholesale manner, and so created an extraordinary demand for country milk. Many of the cow-sheds that were ruthlessly emptied by the plague in 1866 were never filled again, and so the country milk trade sprang at one bound into a prominence which has since gone on, and promises to go on, increasing.

Just before the advent of that terrible rinderpest the number of cows in the metropolitan district was estimated to be 24,000; and the quantity of milk brought in by the different lines of railway in the year 1865 was upwards of 3.000,000 imperial gallons, which in two years' time had more than doubled. This rapid expansion of the trade in country milk was due chiefly to the cattle plague. To provide London with milk would now, on the old system, require a vastly larger number of cows than in 1865; and if this increased number had been provided for within the metropolitan area, the danger in time of contagious diseases would have been proportionately increased. Happily, however, the tendency is to keep fewer cows in London and its suburbs, and to obtain a larger supply of milk from the country.

Formerly the dealers were seriously incommoded by surplus milk at times when the consumption of it suddenly fell off. This often occurs in weather that is unfavourable for preservation of milk in fresh condition. The only thing to be done with it then, if it was going sour, was—in the words of one of the greatest of urban milk-salesmen—"to pitch it into the sewers." But this was obviously the worst possible use to which milk could be put. Surely it might have had the butter taken out of it by churning. However, there are now appliances by means of which the loss that was formerly almost unavoidable may to a great extent be averted. For instance; whenever a glut of the market is to be expected a lot of milk can be run through the separator and the cream made into butter; or the milk in bulk may be at once sterilised, after which it can be handled to the best advantage.

The Milk Standard.—After long years of hesitation, a standard of quality for milk has been adopted as the law of the land, in a somewhat happy-go-lucky fashion. Obviously, in reference to so variable a product as milk, the law relating to it could not well be like unto the laws of the Medes and Persians,—no doubt, a relief in respect to various laws which from time to time require alteration. Regulations are as follows:—

1. Where a sample of milk (not being milk sold as skimmed, or separated, or condensed milk) contains less than 3 per cent. of milk-fat, it shall be presumed for the purposes of the Sale of Food and Drugs Acts, 1875 to 1899, until the contrary is proved, that milk is not genuine, by reason of the abstraction therefrom of milk-fat, or the addition thereto of water.

2. Where a sample of milk (not being milk sold as skimmed, separated, or condensed milk) contains less than 8·5 per cent. of milk-solids, other than milk-fat, it shall be presumed for the purposes of the Sale of Food and Drugs Acts, 1875 to 1899, until the contrary is proved, that the milk is not genuine, by reason of the abstraction therefrom of milk-solids, other than milk-fat, or the addition of water.

3. Where a sample of skimmed or separated milk (not being condensed milk) contains less than 9 per cent. of milk-solids, it shall be presumed for the purposes of the Sale of Food and Drugs Acts, 1875 to 1899, until the contrary is proved, that the milk is not genuine, by reason of the abstraction therefrom of milk-solids other than milk-fat, or the addition thereto of water.

It will be noticed that the words "it shall be presumed" occur in each of the three paragraphs cited above, and they may be taken as a tacit admission that the fixing of an absolute, unalterable standard of quality for milk is regarded as impracticable.

It will also be noticed that the percentage required of solids not fat varies in paragraph 2 from that in paragraph 3. How it should occur that a larger percentage of solids not fat is expected from separated than from whole milk does not at first—or even at second—sight appear to be obvious. Nor, indeed, is it any more obvious in paragraphs 2 and 3, how the percentage of solids not fat can be lowered, in either whole or separated milk, by any feasible means other than the addition of water.

Adulteration of Rich Milk.—The most important point is the absence of any restriction against lowering rich milk down to the standard, or nearly so, either by the abstraction of a portion of the milk-fat or by the addition of a carefully calculated percentage of water. It is no doubt true that the standard promulgated by the Board of Agriculture is below the average quality of milk in all but the spring and early-summer months, and considerably below the best samples of cows' milk. Once the percentage of solids in milk above the standard is known, why should not the quality be reduced to—or slightly above—the level laid down in the standard? Not to do so would make it seem as if a present were made to the consumer of the amount of quality over and above the adopted standard. We leave this matter *sub judice*.

The Circular.—The anomaly herewith alluded to was at once pointed out in the press; and subsequently the Board of Agriculture issued a circular, as follows:—

In the Regulations the limits below which a presumption is raised that the milk is not genuine were necessarily fixed at figures lower than those which are usually afforded by genuine milk, in which the proportion of milk-fat and non-fatty solids very frequently exceeds the percentages specified above. It is therefore important that local authorities should keep steadily in view the possibility of the artificial reduction of the quality of natural milk to the official limits by the abstraction of cream, or the addition of separated milk, or of water, and arrangements should be made for the taking of samples and the submission of the same for analysis whenever the existence of malpractices of the kind is suspected.

The circular gives corresponding warning in respect to the adventitious though only delusive enrichment of cream by the addition to it of gelatine.

The circular is obviously supplementary and subsidiary to the Regulations, but it is a necessary supplement. The whole thing, however, only emphasises the opinion that the sale of milk on a basis of quality, as almost every other commodity is sold, would—once it became a general custom—be found to work more satisfactorily than any conceivable standard fixed by the dictum of the Board of Agriculture, or by Act of Parliament. Scientific resources are available anywhere to ascertain the quality of milk in its most valuable constituent, viz. butter-fat, and the sale of milk on a quality basis is now perfectly feasible.

Be that as it may, it is probable that the promulgation of a standard by the Board of Agriculture is calculated to do some measure of good, whatever harm it may do. All this remains to be seen. But it can hardly be expected to promote the breeding and feeding of cows with the object of producing milk of the very best quality; though it may place a useful check on the practice of breeding and feeding for quantity at the expense of quality.

The milk trade has effected various transformations within thirty years. Urban cow-sheds are almost wholly a feature of the past. With the introduction into urban districts of milk from country districts an improvement was obvious in the condition of that important fluid, and consumers instantly signified their pleasure by greatly increasing the demand. The public are now thoroughly alive to the fact that country milk brings a not unimportant modicum of country health to the children in crowded urban districts, and the consumption of milk everywhere goes on increasing. To maintain this "stream of tendency" in full vigour, it is necessary that every precaution should be taken to ensure the quality and condition of milk reaching and keeping up to the highest possible standard.

Foreign Milk.—And to this end foreign milk coming to this country must be jealously watched for purity as well as quality, although it is hardly likely that the trade in it will assume very large dimensions. All the same, the relatively small importations of milk from France, Belgium, and Holland have elicited a demand that all milk coming to us therefrom shall undergo the keen microscopical and chemical examination which alone can be regarded as equivalent to the supervision employed in respect to our own milk production.

Pasteurisers.—Pasteurisation is a development of the old homely idea of boiling milk. The Pasteuriser is designed to raise milk to a high temperature, generally from 150°—180°; thereby destroying the greater number, if not the whole, of the germs which the milk may contain, rendering it more wholesome, and enabling it to be kept sweet at least twenty-four hours longer than would otherwise be the case.

The general type of this machine takes the form of a large chamber surrounded by a steam jacket and containing a rotary dasher or stirrer, which is actuated in some patterns by a belt and in others by a steam turbine; this keeps the milk in constant agitation, and saves it from being burnt. The in-coming milk is admitted at the bottom, and the hot milk escapes through an outlet near the top. By closing the top of the apparatus and increasing the speed of the stirrer, an action similar to that of a pump is obtained, and the milk is elevated so that it is delivered from 3 to 8 feet higher than the inlet, an arrangement which is of great advantage in some cases, as the milk is delivered at a height sufficient to enable it to gravitate over a refrigerator.

As this process necessitates the raising of the milk to the high temperature mentioned, it requires a considerable supply of steam to heat it and an abundance of cold water to cool it; but by means of a Regenerative Heater a very great economy may be effected in this way. The Regenerative Heater consists of a vessel so arranged that the hot milk, after leaving the Pasteuriser, passes through the interior, whilst the cold milk, on its way to the Pasteuriser, passes over the exterior; by bringing the hot and cold milk into proximity, the temperature is equalised, with the result that the work of both Pasteuriser and cooler is considerably lightened. The following figures show the working of this machine:—

Temperature of new milk	76°
Temperature after leaving Regenerative Heater, warmed to	134°
Temperature after leaving Pasteuriser	178°
Temperature after leaving Regenerative Heater, cooled to ..	103°
Temperature after leaving Cooler	56°

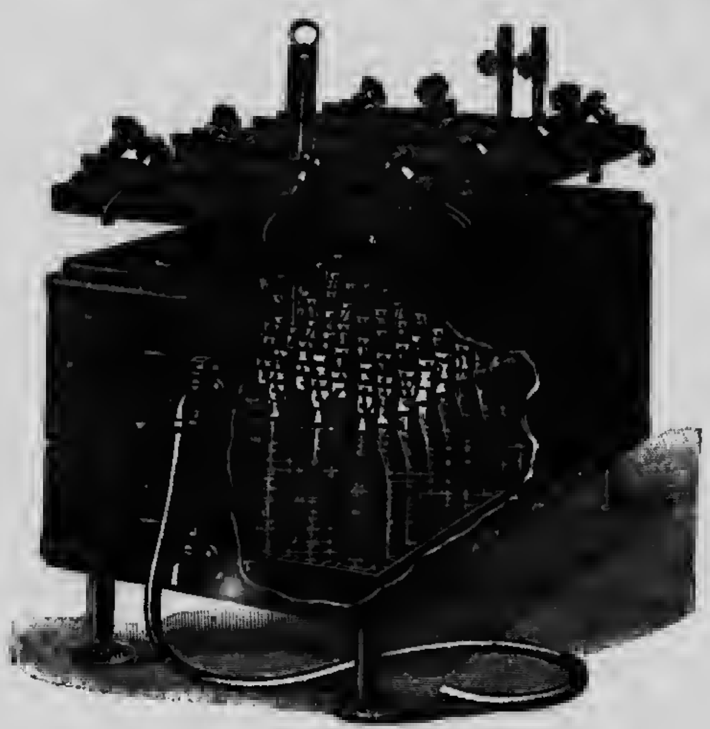
It will be seen that, whereas the Pasteuriser would have been required to heat the milk to the extent of 102°, its work was so lightened by passing the milk over the Regenerative Heater that it only had to heat it 44°, and the cooler, instead of having to cool the milk 122°, had to cool it 47° only.

It is not too much to say that the result of this invention is to economise at least half the steam and cold water required, or to double the capacity of the apparatus with the same consumption of water and steam as before.

Sterilisers.—The scare of tuberculosis and the conveyance of other infection through milk brought into existence the process of heating milk under the exclusion of external air, so that germs which it might contain were killed more effectually than in pasteurising, and there was no possibility of any others obtaining access to it. The sterilising is generally done in glass bottles, but larger cans are occasionally used. The advantages are twofold—first, the destruction of any bacteria the milk may contain, and second, so long as the bottles are unopened the milk will keep sweet.

The general introduction of this process into the United Kingdom is due to the Dairy Supply Company, Limited, who showed a complete plant at work at the Leicester Show of the Royal Agricultural Society of England. The "Simplex" steriliser is the latest type, fitted with their patent closing caps, by means of which each bottle is hermetically sealed without the possibility of external air obtaining access to it.

The "Simplex" steriliser for household use possesses advantages similar to those of the larger apparatus, but it



The "Simplex" Steriliser

is constructed for use on a kitchen range. The process is simple, and the bottles are perfectly closed whilst still in the heated vapour by using the patent closing caps supplied for this purpose.

Testing Appliances.—The large development of the milk trade, and also the establishment of butter factories and creameries, calls for great care in seeing that the milk purchased or sold is pure and of good quality. The old-fashioned cream tubes cannot be relied upon to do this. The percentage of non-fatty solids in milk is fairly constant; it is the fat or cream which varies principally, and which it is most necessary to verify. To supervise this, Dr. Gerber's Butyrometer is the best apparatus. It is made in sizes to deal with from two to twenty-four samples at one time, by means of measuring a definite quantity of milk and acid, mixing them in a test tube and rotating them at a high speed. The fat is separated from the remainder of the milk and driven into a narrow tube graduated to show the percentage of fat contained in the sample.

The Milk Trade and Co-operation.—For the account following hereafter I am under an obligation on certain points to notes contributed by two largely interested and practical experts in factory cheese-making when accommodating itself to a railway-borne milk trade, and who are both tenants of dairy farms in the southern half of the county of Derby, which enjoys the unique distinction as having been first in adopting co-operative cheese-making in England, as recounted in Chapter XXIII.

One of these correspondents is Mr. George Tomson, of Marston-on-Dove, who for a quarter of a century or so has performed with credit the secretarial duties appertaining to a cheese factory, where cheese-making—whenever necessary or desirable—works in conjunction with a wholesale supply of milk to whomsoever may require and pay for it. There is no better co-operative safety-valve in a wholesale milk trade than a factory which, conveniently situated near a railway station, can at any time become a cheesemaking plant in respect to surplus milk whenever the milk trade is more or less over-fed. This surplus occurs suddenly at times, and any loss it might inflict is minimised by promptly converting milk into cheese.

There are difficulties in this, as in most other mundane arrangements, but difficulties are preferable to losses.

Without difficulties, indeed, there would be but little zest in business enterprise. Certainly there are plenty of difficulties in the milk trade to redeem it from monotony. One of these is the difficulty of keeping all co-operative members of a milk trade that is combined with cheese-making in a contented state of loyalty to the business and to their fellow members thereof.

In the early days of factories in England many timid farmers were averse to combination as a principle designed to confer mutual benefit. The whole thing was alien to their experience. They had all along been "paddling their own canoes," and preferred to go on paddling. And now, in these later days, some men will break away from a co-operative milk business in order to trade independently with some urban milkman or other who offers a higher price. These farmers hasten back again when they have burnt their fingers.

Meantime, it must be said that, in some respects, the trade in railway-borne milk has been hitherto in a state which leaves a good deal of room for improvement. Let us venture to hope—against intrusive doubt—that Mr. John Burns's Milk Bill will straighten out the existing tangles of an industry whose importance is great and even enormous. The growth of less than half a century, the trade in country milk has not only abolished town milk root and branch, but has brought about a transformation scene on many thousands of dairy farms throughout the length and breadth of England.

Law and the Standard.—The chief tangle is found —so it is alleged—in the uneven and inconsistent justice which in different courts of law is dispensed in respect to charges of milk adulteration, or of milk skimming, based on the butter-fat of incriminated samples falling below the official standard. This standard is not a hard-and-fast legal enactment, invested with all the majesty of law, but rather a recommendation which is suggestive of roguery when such samples show on analysis a percentage deficiency in the most valuable constituent of milk. This standard, indeed, suggests a presumption that such deficiency indicates tampering with milk after it is obtained from the cow. There have been many arbitrary convictions of innocent dealers in milk that was shown by analysis to be more or less below the standard. Farmers, too, have been similarly persecuted, even when it has been shown that the gravamen should rather have been borne by honest but incompetent cows.

But we cannot impeach a cow, however deficient her milk may be in what is understood as quality. We cannot issue a summons to Nature, requiring her attendance before a bench of rural, and still less of urban, justices of the peace. And so it has occurred, times unnumbered, that man has been mulcted of money because of a common enough variability in Nature's way of building a cow, and for lack of wit and wisdom on somebody's part. But this is not always so. An instance recently occurred in which Lord Rayleigh's manager was "had up" for having supplied an East-end dairymen with milk that disclosed a deficiency of fat, bringing it below the standard. For the defence it was explained that the milk was from Dutch-Holstein cows, a breed that is notorious the dairy world through for giving milk of quality decidedly inferior to that of any English breed of cows. Thereupon the case was dismissed, just because—in absence of any charge of tampering with the milk—the Court refrained from convicting Dame Nature, the mother of us all.

Another case, which occurred at Hull, and was cited in the *Dairy World* of March, 1911, runs as follows :—

"DIVERGENT ANALYSES.

"At Hull, on the 1st inst., Mrs. Smith and her son Oswald, of Dunswell, near Hull, were summoned in respect of two samples of milk containing 2·92 per cent. of fat and 9·25 per cent. of non-fatty solids, and 2·93 per cent. of fat and 9·7 per cent. of solids respectively. The samples were examined by three analysts—viz., Mr. Foster, the county analyst, Mr. Owen, the York City analyst, and the

Somerset House analyst, with the following results :—Sample I.—Mr. Foster: 2·92 per cent. of milk fat; Somerset House, 2·33 per cent.; Mr. Owen, 3·22 per cent. Sample II.—Mr. Foster, 2·93 per cent.; Somerset House, 2·49 per cent.; Mr. Owen, 3·06 per cent. In reply to Judge Dodd, Mr. Foster said he was unable to account for the figures submitted by the Government analysts, because no data were provided. The witness was cross-examined by Mr. Payne, for the defence, and stated that he did not agree that milk might be under the standard of 3 per cent. Milk below 3 per cent. in milk fat must have been adulterated. Mr. John Evans, analyst, for the defence, admitted in cross-examination that it was not milk of average quality, but it was above the legal standard. Both defendants gave evidence denying any adulteration; Mrs. Smith stating that they had not a cream separator on the premises. There were forty-eight cows on the farm. Judge Dodd said the bench had come to the conclusion that the milk supplied was below the standard. They imposed a fine of £2 10s. upon each of the two defendants, for each of the two summonses, making in all £10, and £2 1s. costs, with a solicitor's fee of four guineas."

Obviously there is something that needs straightening out in these discrepant results. It all springs from want of precision in what stands for law in some courts, but is in reality only a recommendation which leaves far too much to the interpretations which may be accorded to it in different judicial minds.

There are clearly two courses open to any bench of justices—viz. either to dismiss a charge when it is clear that milk has not been tampered with, although it is below the standard, or to convict purely and simply on the ground that it *is* below the standard. In this latter phase of the situation we look for discrimination and find it not leaning toward the benefit which a doubt is understood to suggest.

One important point is emphatically urgent as a legal enactment in any comprehensive Milk Bill that may be introduced into Parliament. We who are called upon to administer the existing legislative recommendations are anxious to know whether or no we are to go back to the cow for evidence on alleged adulteration of milk, whenever such evidence is identifiable and available. It is essential to know whether a defendant in a case of alleged adulteration of milk may, by going back to the cow, supply himself personally with an undeniable *alibi* in respect to such adulteration, subject to evidence adduced being duly authenticated.

These considerations lead up inevitably to the highly important question of selling milk both wholesale and retail on a quality basis. Assuming that a man who keeps Dutch cattle because their milk-yield is large, and the law shall admit the evidence of the cow, how will his position compare with that of other men whose cows give less but richer milk? How does the existing standard act when an appeal is made to the cow, and the cow demonstrates the fact that her milk is not up to the standard?

So soon, indeed, as an Act shall come into force allowing an appeal to the cow, wherever such appeal can be made with precision and satisfaction, what becomes of our existing hypothetic standard of quality?

The fact seems to be that the laying down of a standard of quality in milk which is so variable—not only between cows of different breeds, and indeed between different cows of the same breed, but even in any cow herself according to different states of health, different moods and fancies, different food, different treatment, different weather—is only to make confusion worse confounded in the milk trade. Further than that, it serves to perpetuate the disadvantage under which the man whose cows produce rich milk labours as compared—from a profit point of view—with the man whose cows consistently yield milk which falls below the very moderate quality indicated by the current standard. Yet, after all, there is no legal standard of quality for milk in this country. And those who have to administer the law have only a "presumption" to guide them to a verdict.

Sale on Quality Basis.—Again, it is obvious that the sale of milk on a quality basis must—as it ought to and will—become a predominant feature in the trade, otherwise an Act admitting, and, indeed, requiring, an appeal to the cow, and a verdict based on that appeal, would do great harm to the producer of milk above the average in quality. It rests with the dealers whether or not the sale of milk on a quality basis shall become a broad and general rule and custom. That it has not done so already is owing, first, to the fact that the trade in country milk did not happen to start on that basis when the trade itself started, now approaching forty years ago, and next, to native reluctance to interfere with a new business by imposing unfamiliar rules and regulations upon it. We who are old enough to do so may remember that the trade in its infancy simply grew from small beginnings, in a tentative and erratic sort of way, and was not in any way made to order and turned out according to specification.

It may be said, safely enough, that producers of country milk that is rich above the average are seldom if ever paid the price they ought to be. This higher quality is a characteristic of superior herds of cows here and there, and of farms in certain districts—herds that have been bred long enough for quality *plus* quantity of milk, and farms of good grass land intelligently improved for dairying purposes.

How this deprivation of intrinsic value in the trade may be remedied, short of adopting a general practice of selling milk on a basis of inherent quality, does not appear. Yet it is evident that the remedy is not free from difficulties. But then—as one may venture to inquire—is any far-reaching readjustment of business interests ever free from difficulties?

It may be said, and, indeed, often has been said, that a dairy of milk whose quality is known to be of a high order is, in one way or another, really paid for on a scale correspondingly above the general run of prices. This may be so in certain cases, and may not be so in other cases that are equally deserving.

One of the largest wholesale dealers in milk, resident in the midland counties, declares that " a retail dairyman who gets hold of a really good dairy of milk rich in cream will make any effort rather than lose that dairy." And this statement, under current conditions general in the trade, is about all that can be said to show that high-quality milk is in such favour in certain cases as to command a relatively high price.

Of what benefit to the farmer is the high quality of his milk if he is not aware of its high quality? And there are many farmers who, practically ignoring the question of quality, keep their attention fixed on the quantity of milk produced by their cows, knowing very well that quantity counts, whatever quality may do.

It is well known to everybody who takes an intelligent interest in the subject that milk varies more or less in quality, and sometimes considerably so, from the same cows under regular feeding. Feeling this to be the case, and having an intuition that absolutely uniform quality is not attainable, farmers naturally aim at quantity rather than quality, at the same time keeping on the right side of the standard.

The standard so far adopted as to quality of milk in the trade does not appear to have had much influence in the way of inducing many dairy farmers who sell milk to get rid of such cows as yield milk of inferior quality. Nor, indeed, was it ever likely to bring about this much-desired reform. Nothing less than the sale of milk on a basis of quality seems likely to accomplish much in that direction.

In reply to my query: "Do you think a minimum standard is really calculated to induce farmers to get rid of such cows in their herds as are yielding inferior milk?" comes the answer as follows: "I do not think farmers, as a rule, give this any consideration; for, generally, the standard will be reached when the milk of a number of cows is put together. But just now (March), morning's milk very barely reaches the standard."

This capable expert in milk goes on to say: "Milk has reached a price this spring (1911) that it has not touched for nearly thirty years. This in the Midlands is in a large measure owing to buyers like Nestlé or Cadbury clearing such enormous quantities for condensing in the one case and for chocolates in the other." Nestlé's Milk Company has had a large establishment for several years at Tutbury, by the banks of the Dove, and at the present time are erecting another at Ashbourne, which is at the foot of the Peak country of Derbyshire. Presently we may perhaps see them at Hartington, in the valley of the Upper Dove. All this points to a fact which has been vaguely known for a long time—viz. that the milk of Derbyshire, especially on the better soils of the carboniferous limestone, is sound and of good quality. There cannot be any better soil—wherever there is enough of it—for producing good milk that will keep as sweet as any other and longer than most.

Again, this milk expert, dealer, and farmer, who for many years has had a factory as a supplementary item in the business available for turning surplus milk into cheese in summer time, considers cheese-making, in this irregular and desultory way, anything rather than advisable if it can possibly be avoided. The sale of milk outside "the trade," even at a loss, is preferable to cheese-making. No less than thirty thousand gallons were sold in 1910 *at a loss* (during the few weeks that milk was over-plentiful) by this one wholesaler of milk to the great condensing firm at Tutbury.

Price of Milk.—Meanwhile, there is difficulty in accommodating the recent advance in wholesale prices of milk in the shires to retail prices in the cities, simply because retail and daily customers are soon irritated if prices fluctuate. A change once a year is thought to be too often in the towns, whatever the shires may think. For all that, however, it seems more likely now than for a generation past—the demand for milk showing so substantial an increase year after year—that whatever the towns may think, there is looming up before us an appreciable and most probably a permanent increase in the retail price of milk, and, indeed, in the wholesale price as well.

Up-to-date milk vans form in themselves an improvement greatly to be desired in the interests of the milk trade, and these have need to be supplemented by greater security against tampering with milk cans *en route*, and at the railway stations to which they are consigned. Lastly, there exists a fervent hope that the railway companies will improve still further the methods in vogue for handling return empties.

But it does not appear that there is much room for reductions in milk rates on the railways, for when twenty gallons of milk are carried one hundred and ten to one hundred and thirty miles for 1s. 4d., empty cans being returned free of cost, there seems but little room for complaint on the score of railroad charges on milk. If all railways would make their charges on this basis, a grateful public would rest and be thankful on this particular point.

Co-operative Dairying.—The spirit of co-operation —as an economical and still more truly as an ethical principle applied to business matters—has but seldom shown itself a hardy perennial in the mental botany of British farmers. Only here and there and quite sporadically has it found, so to speak, a congenial moral climate to flourish in. Mr. Tomson deplores the weakening of this spirit of mutual self-help in connection with English cheese factories of long standing.

"Sadly to relate," he says, "these institutions with two or three exceptions have ceased to be co-operative under farmers' direct management," and he enumerates a list of them to which the word "co-operative" does not apply altogether as he would have it apply. An uncertain proportion of the patrons of a cheese factory are apt to break away from association, once they see—or think they see—a chance of doing better for themselves by selling their milk independently, but for all that such unstable co-operators are willing enough, nay, anxious, to join an association when the market has the individual at its mercy.

"In times of agricultural depression," remarks this able secretary, "these organisations are in demand, but in prosperous times some men become lukewarm or even cold toward them." What such men will do in the present period of brisk demand for milk remains to be seen. Probably they will separate themselves from associations and trade again as individuals—until depression comes once more.

Various well-meant efforts have been and are being made to promote the spirit and practice of co-operation amongst dairy farmers in the British Islands. Dairying, in point of fact, offers scope for development of the beneficent principle of co-operation—scope which is looked for in vain elsewhere in the wide and varied domain of our island agriculture. Cheeseries, creameries, the milk trade, form a trio of interests and industries at once modern and unique in their way as developments of dairying. Within forty years these features have been evolved, and within a generation or so of human life have brought about a transformation in dairying if not in dairy husbandry,—though to no small extent in that as well—in many counties where grass land predominates. Before the advent of the seventies of last century there was no milk trade as we have it now. All milk produced on dairy farms was made into cheese or butter, which were produced chiefly in roomy farm-house kitchens, and as a rule with the aid of the simplest and fewest contrivances.

In the fall of 1910 the writer went to an auction sale at a farm on which the family—now distributed—had been tenants for more than a century, and in an old-fashioned, inconvenient back kitchen, cheese had been diligently made twice a day in the season throughout that period. Two or three imposing looking and ancient cheese kettles of brass shone brightly through sheer constant use, morning and evening, chiefly if not wholly by feminine members of the family. The farm was a large one, and the quantity of cheese made in those brass kettles, each of a capacity up to some forty or perhaps fifty gallons, must have been enormous. These old cheese tubs—as their oaken equivalents were wont to be called—are now disestablished all over the country, and when one happens to come into the market it is snapped up, like old pewter, as a scarce thing and a relic of an order of things which has almost wholly passed away, perhaps never to return. Very proud indeed some of the old-world farmers' wives used to be of their brass cheese kettles, long after the usurping kettle of tin had replaced worn-out brass ones elsewhere.

The first "Cheeseries" established in the United Kingdom.—The doom of farm-house dairying was sounded forty years ago, when two associated cheeseries of an American type were set to work in England, one on the fringe of the county town of Derby and the other at Longford, a few miles away. These were not strictly co-operative ventures to begin with, because a guarantee against loss—a guarantee, indeed, that 6½d. per gallon would be paid for the milk—was necessary to induce farmers to send their milk to them to be made into cheese.

This establishment of associated dairies for cheese-making was the first great effort made in England to teach farmers how to co-operate, and they had to be taught—most of them—as babes and sucklings, so shy were they, so infantile in timidity, lest the project should be a failure. It is most difficult to realise nowadays how elemental were the intuitions of most dairy farmers in England on this subject forty years ago; how essentially individualistic were their instincts. For this was at the root of all the distrust and suspicion with which the project of co-operative dairying was regarded by many farmers upon whom it was well and correctly calculated to confer substantial benefits. All that distrust has died down long ago, yet for all that—such is the predilection of Englishmen, to each of whom his house is his castle—there is still but little co-operation amongst dairyers, and especially in the milk trade.

Problems to be Solved by Co-operation.—The greatest and most important, and at the same time the most imperative, problem to be solved in the wide and complex domain of agriculture in this country is that which the milk trade shows up so plainly, and the final solution will not be found independently of co-operation, in some way or other. Co-operation simply means the collective action of individuals; and its antithesis is found in isolated action by individuals, each "paddling his own canoe."

By Act of Parliament alone we are not likely to secure a wholly satisfactory milk trade, or a wholly pure milk supply. It cannot effectually regulate the practice of a vast number of individuals acting separately and independently of each other, as so many farmers apparently prefer and even love to do. Parliamentary Acts must needs be supplemented by co-operative rather than by bureaucratic administration. And it is out of the rank and file of milk-selling dairy farmers that such co-operative movement must spring, if it is to be worth the name. Medical officers of health in the great urban districts are at the wrong end of the stick, and all their vigilance is discounted by atmospheric conditions which prevail wherever their "beat" is located. Some of them seem incapable of differentiating between country milk and urban filth, in respect to infantile mortality. These fail to recognise in country milk the only bit of rural living which the children of the slums can have, the one thing which keeps many of them out of an infantine grave.

It would seem that we must look to collective or associated action by farmers themselves to place the milk trade upon a sound and satisfactory foundation, and this means that the supply of milk from the fountain-head may become all that the consuming public can reasonably expect, and, in fact, demand. This fundamental dairying must come from the inside of dairying. Neither Parliament nor municipal authorities, nor "principalities or powers," with official inspectors acting under them, can ever secure perfection in cows, or in the milk which they yield so bountifully. "Legal 'suasion" alone is not likely to bring about a fundamental and permanent improvement. But "moral 'suasion," which can only emanate from co-operative association, going hand in hand with the other sort, is calculated to accomplish all that we may confidently hope for.

Cheeseries—or cheese factories as they were unluckily named at the start of the business—lend themselves effectively, and also profitably, as safety valves to a wholesale trade in milk from districts which are fortunately provided with them. And these institutions, which are only subsidiary at most to the trade, are not necessarily inimical to the unavoidable "middleman," correctly so-called. On the contrary, they and he may become mutually useful to each other, particularly when milk is too plentiful, or the reverse.

Co-operation and Adulteration.—An essential and fundamental principle in true and genuine co-operation is the absence of anything that is calculated to deceive the public in regard to the quality of whatever co-operation may wish to sell and the public may want to buy. Treachery is a parasitic plant that will find no suitable soil in true co-operation, though it may try to do so at times. Co-operation, indeed, is and must be Argus-eyed for the detection of fraud within its own domain, within the sphere of its own operations. Co-operative cheeseries, indeed, are well within the capacity of farmers to manage successfully in connection with a large milk trade, if only they can secure the services of a capable secretary. It is considered, however, by some who have had experience in it that desultory cheese-making has disadvantages of its own that are inherent, and therefore it may be better to sell surplus milk at a loss to condensing establishments than to make cheese at a loss in co-operative cheeseries. But this does not necessarily apply all-round.

It is understood, in some cases, that to reduce milk above the standard nearly to the standard, separated milk has been utilised. It has also been rumoured that condensed milk, made in Germany or elsewhere, has been similarly employed, though in an opposite direction, to raise the quality of separated milk up to the standard which, as a presumption, the courts of law require in alleged cases of milk-adulteration which are cited and haled before them—condensed milk made from milk whose cream has been removed.

An appeal to the cow, as an incorruptible witness in the natural quality of her milk, is allowed where reasonable doubt occurs as to milk having been watered or skimmed. The appeal should be made under conditions which prevailed when the suspected milk was squeezed from the cow's teats. And this because the same cow's milk will vary from day to day and meal to meal, and on account of weather, state of health, and so on. As a matter of fact, there is no reliability attachable to any cow's milk, so far as absolutely uniform quality is concerned.

It is to be hoped that, ere long, a practicable and simple system of selling milk daily on a basis of quality may be adopted. The quality of milk is, nowadays, readily and speedily ascertainable, and a quality-basis system would greatly relieve work in the courts, though it would not, perhaps, to any marked extent diminish the need of vigilance on the part of inspectors who are constantly on the look-out for cases of adulteration and misrepresentation.

Legislation on the subject of marketed milk may be expected pretty soon, and it behoves dairy farmers who cater for the milk trade to put their cow-houses in order. Many of them have done so already, and a marked improvement in the quality of trade milk has been the sequel. These steps in the right direction must be duplicated wherever they are needed, until a really and generally pure milk supply has been attained.

But what will be the result, in respect to the rearing of young bovine stock, and to the breeding and fattening of pigs, of our insular milk trade, which is constantly and rapidly expanding?

CHAPTER XV

BACILLI IN DAIRYING

THE predominant achievement of our time, so far as the art and science of dairying are concerned, is a remarkable evolution of light out of darkness that will distinguish the last quarter of the nineteenth century for all future time, in the dairy world, as pre-eminent over all that preceded it.

Whether or no the current—the first—quarter of the twentieth century will bring forward anything so vitally important to the business of making cheese and butter remains at present a problem still awaiting solution. To find words that would convey an adequate understanding of the transformation which has been brought about by the science of bacteriology is a task of great difficulty, and the attempt, perhaps, had better not be made. But it is necessary to the subject which occupies the attention of this book that a good deal should be said concerning a matter which, to all intents and purposes, supplies a new and scientific basis to an ancient and familiar industry, where, previously, all knowledge appertaining to it was simply empirical, and not of much account at that.

Finding a Bacillus.—There was a great show of beating about the bush long before the secret of the whole mystery of "milk ferments" could be persuaded to come out into daylight. The scent was strong—if a sporting expression may be employed—but it was years before the hidden game could be brought out of cover. Everybody was aware forty years ago, and had been aware for centuries, that the souring of cream in butter-making and the coagulation of milk in cheese-making were processes of some importance, but at the same time were quite, if not more so, as supremely mysterious and esoteric. Many heads were sorely puzzled and muddled about the great conundrum of what is now known to be lactic acid, and many guesses at the riddle were ventured upon in a more or less tentative and apologetic way and manner. The dairymaids of old knew the effects of milk fermentation by the mischief which followed as a sequel, but they could not form any reasonable conception as to what was the why and wherefore of it all. The results were only too often seen in cheese that had cracks and running sores, and in butter that became rancid in a very few days' time.

In the case of cheese, indeed, there were more disasters than in the case of butter, just because in the former the casein of milk is involved as well as the butter. And casein, being an albuminous constituent of milk, was more subject than butter to disasters of one sort or another through the action of ferments of various kinds. This was the true inwardness of the thing, no doubt, as some of these ancient dairyers perhaps suspected, but none of them could divine what was the cause of so much annoyance at times, especially in cheese-making dairies. The whole thing, indeed, was a sort of *ignis-fatuus* which, luring them into many a slough of despond, constantly eluded their grasp. It would, perhaps, have for ever escaped, had it not been for the microscope, which reveals to us the marvellous domain of the infinitely little.

Bacterial Isolation.—In keeping with the discovery of bacilli of many species, some of them more or less allied to each other, is the isolation from all others of certain microbes, or bacteria, or bacilli, or whatever else they may be named, and the cultivation in gelatine, and of course in vacuum, of these isolated entities, in order that what is correctly called a "pure culture of a lactic acid bacterium" may be available for use in milk for cheese-making and in cream for butter-making. These two donations of experimental and practical science to the art of dairying have done much to bring about a thoroughgoing transforma-

Photograph by Clarke & Hyde Press Agency

A Laboratory devoted to Bacteriological Research in connection with Dairying

tion in many dairying circles, and their mission of reform is, as yet, only in its initial stage.

It may be borne in mind by dairyers that milk, like natural modesty uncontaminated, is a charming and delightful asset, of high intrinsic worth, which needs protection against the many dangers by which it is surrounded. Milk, indeed, is a facile absorbent of ferments whose germs exist in unimaginable myriads in the atmosphere of swampy, low-lying districts, in thickly populated places, and whereever insanitary conditions prevail. And it is so because it affords almost the best of all foods in which these ferments can multiply—which they do at an almost incalculably rapid rate.

Good Bacteria and Evil Ones.—In his interesting book called "The Bacillus of Long Life," to which I am indebted for several ideas on the subject, Mr. Loudon M. Douglas remarks: "The majority of intelligent people are now acquainted with the fact that the germs of bacteria are to be found everywhere on the surface of the earth, in air and in water, and that they are the sole cause of the decay of all manner of perishable articles." (The words "everywhere on" are too comprehensive; they might stand if they were confined to habitable districts, but they are not applicable to high mountains or to arctic regions. In the vast mountain range of the Sierra Madre, in Mexico, I had a demonstration of the presumable absence of germs. Our party shot a few deer, whose flayed meat was exposed to a temperature of over 80° Fahr. for several days—the nights were cool enough at an altitude of several thousand feet—and during the whole time there was no suspicion of the taint which betokens incipient decomposition.)

Mr. Douglas goes on to say: "The distribution is unequal; bacteria are much more plentiful where there is decaying matter—in dirty houses, sewage, or other contaminated matter, etc. Milk is a splendid food for bacteria, and numerous varieties multiply in it exceedingly, and many of these are injurious, producing putrefactive changes which render the milk unwholesome, even poisonous in some cases. Others are beneficial, and are absolutely necessary for the souring of milk for making butter or cheese and for the ripening of the latter."

Cleanliness in the Dairy.—For a long time past the need for cleanliness of everything appertaining to a dairy in which cheese or butter is wont to be made has been urged. All dairy reformers who have written on the subject have referred to cleanliness as a *sine qua non* wherever milk should be manipulated. It was advocated as a panacea for most of the ills that dairying is heir to now, or was ever heir to in the past,—almost the only panacea for general use that anybody could think of. For they had, in the old days, no conception, no intuition, no idea that when cheese or butter was a failure, the cause thereof could be anything but dirt of one kind or another. And there can be no manner of doubt as to the desirability—as, indeed, to the necessity—of having the dairy, its walls, its floor, its benches, and all its paraphernalia, kept in a state which signifies a constant warfare against dirt of all kinds which, —as really in every other place where food is made up—is matter out of place, and therefore to be got rid of or kept at a distance.

For with dirt there is lurking disease. And the kinds of dirt are legion, if only we could realise the fact,—solid, liquid, and atmospheric dirt. Dairies, indeed, are always liable to dirt introduced from the outside, chiefly perhaps in milk from cowsheds, unless constant care against it is exercised. There are few things about a dairy farm that, generally speaking, stand more in need of improvement than a cowshed, and not in winter only or mainly, but in summer too, if it is the habit—as it commonly is—to milk the cows in the sheds. For in the summer there is much greater activity and fecundity amongst the various germs which cause fermentation and decomposition in milk—germs which, in some places, exist in myriads in a single cubic foot of air. In winter, of course, there is more solid and liquid dirt about farmyards which acts as breeding-ground for these various microbes.

It must be borne in mind that where filth is, there will the ferments be which promote decomposition. Under these conditions the atmosphere is wholly impregnated with the germs of various kinds of putrefactive bacteria, and a high temperature assists these to become predominant. And it is here that the question of cleanliness becomes especially pertinent. The farmers and dairymaids of old who lime-washed the walls of their cowsheds and dairies at least once a year were wise in their day and generation. Those were wiser still who, in addition to lime-washing the walls, frequently swilled the floors with clean water, and who cleaned the cows' udders of dust and dirt (if any) before milking. They were ahead of their time who did all this; and ahead of the present time, too, indeed.

Atmospheric Infection of Bacteria.—Be that as it may, it is certain that cleanliness alone is not all that is necessary to salvation in the dairy, though in itself it is simply but absolutely indispensable to complete success in dairy work. But it is not cleanliness of cowsheds alone, or of dairy, or of utensils, or of persons, but also cleanliness of air. And this atmospheric cleanliness does not simply mean the absence of "smells," or of dust, or of smoke, but also the absence of deleterious bacteria which, getting into milk, will soon play mischief with it, especially when it is warm.

The subject of atmospheric infection by bacteria of, for instance, milk and fresh meat has not yet received the attention it deserves, and increasingly deserves, in all damp and thickly peopled countries. Confining our discussion of it to dairying, it may be stated with all reasonable confidence that in the interior of dairies where cheese or butter is made—and cheese more especially—the atmosphere of the place, in respect to its germ-laden condition, is of greater importance than most people seem to think. There are cheese-makers and butter-makers nowadays in numbers many times multiplied as compared with forty or fifty years ago, who are aware that the air of dairies is too commonly impregnated with undesirable microbes, most of which prey on milk when they get a chance of doing so.

On one occasion, in August, 1909, at the Lancashire County Council Farm and Dairy School, situated at Hutton, near Preston, the principal of that most useful institution —Miss Macqueen—took samples of air in and about the cowsheds, and developed the microbic contents thereof in air-tight jars of glass. The results were a striking confirmation of the statement that the air of cowsheds, where animal life is concentrated, abounds in bacteria of various kinds, most of which, fortunately, are harmless, and apparently useless, being neither more nor less than normal exhalations in such places. But it would be an act of temerity to admit gratuitously such germ-laden air into a dairy where it would have free communication with uncovered milk. There would be small danger of contamination so long as the milk remained warmer than the air, in which state the air would not condense on the surface of the milk, and deposit thereon its cargo of bacilli.

Fortunately, milk is seldom colder than the air around, unless it has been refrigerated by the aid of water colder than the air. But, in any case, even when the milk is cool enough to offer a condensing, colder-than-air surface, the activity and fertility of the bacteria are proportionately reduced. There is, however, no great reliance to be placed on immunity brought about in this way, and something better must be found to relieve the dairymaid of the danger arising out of contamination contributed to milk by means of a heavily germ-laden atmosphere. These remarks apply to dairies badly situated for ventilation with air that is not charged with microbes from places where they are generated in numbers that defy computation—dairies out of date, and deficient in sanitation as well as in suitable ventilation, deficient, too, in water supply, and in the various convenient fittings which are a boon in modern dairies.

In well-situated, well-built, well-equipped, well-arranged modern dairies, there is little or no risk from atmospheric contamination during the time required for milk to coagulate in cheese-making, and in butter-making for cream to "separate." It is all a question of situation, of cleanliness, of temperature, and of ventilation with air that is good enough to use for that purpose. It is on these conditions that the safety of milk in the dairy mainly rests; and herein we discern the skill of old-time dairymaids who turned out cheese and butter equal to the best that is made to-day. But the modern dairymaid, possessing herself of recent knowledge which science has raised into a system by researches into the domain of bacteriology, can secure good results with the certainty given by knowledge of the causes and effects of the processes employed.

The scrupulous cleanliness in dairy work that was practised long ago by the most careful and intelligent of dairymaids of the time was, indeed, a basis to work upon that is equally applicable to all periods of which we have sufficient records to enable us to form an opinion. Milk, in fact, is so delicate, so complex, and so susceptible a fluid, that care and cleanliness concerning it cannot ever become unnecessary. The old-time safeguards were cleanliness and low temperatures, and by these means really good results were commonly achieved. But these means were the limit, then, of what people knew of safeguards in respect to milk in dairying, and these indeed are the technical legacies which they bequeathed to subsequent generations of dairymaids. Those legacies are as much in operation now as they ever were—more so, in fact, inasmuch as they are now more clearly known to be imperative and indispensable.

An Ideal Dairy.—But in the days before the nature and functions of the lactic acid bacillus were discovered, it was possible to go too far in low temperatures, and even in cleanliness so far as the atmosphere was concerned. The writer saw an almost immaculately clean dairy, near the city of Londonderry, in one of the early 'eighties of the nineteenth century. That dairy had been built and equipped without economy of outlay, and one of its chief features was a copious supply of cool and sparkling water running through a series of oblong and shallow cisterns, end-to-end of each other, whilst the walls were covered with white or creamy encaustic tiles and the floor laid in cement to facilitate cleaning and swilling when work was over for the day. It is hardly at all necessary to add that all the equipments were of the best and latest types.

A more nearly ideal little private dairy could hardly be imagined—and certainly could not be desired—for practical butter-making. And yet, for all that, the owner was not happy, for, as he pathetically exclaimed: "After all this outlay in building and equipment, I cannot make butter nearly equal to that of a little farmer beyond, whose dairy is a part of the grimy dwelling-house."

Well, here was a case of cleanliness carried too far, in conjunction with a low temperature and the freshest and sweetest of atmospheres. On the other hand was the rude dairy of a small farmer's none-too-cleanly cabin, "built of mud, wid tach and all complate"—if one may quote an old song of Old Ireland—in which butter was made that was sorrowfully but frankly admitted to be really a more desirable article than that produced in the "nattiest" little dairy one ever saw.

And the whole thing lay in a nutshell there, if only the kernel had been taken out and we had known what it was. If only we could have seen that all active bacterial life was prevented in the ideal dairy, and that in the cabin it was not. Herein lies the problem which at that time was pretty rapidly approaching a practical solution, whose sequel was destined to bring about fundamental changes in the twin arts employed in the making of cheese and butter. Truly, indeed, the whole secret lay in a nutshell, and our helplessness lay in the fact that the shell had only been cracked at that time, not opened!

Bacilli Acidi Lactici.—But it was shortly to be opened, and the microscope then revealed the intensely interesting and supremely important fact that the kernel consisted of what is now known as a bacterium, the lactic acid bacillus—to use a simple term, the ferment—without whose assistance the finest cheese or butter cannot and could not ever be produced. This is the central truth in dairying, and, in point of fact, ever has been since cheese and butter were first made at all, thousands of years ago.

"But how came it to pass," someone may ask, "that the lactic ferment was in use throughout all dairying time, and people then knew nothing about it?" Well, just the same may be said in respect to the leavened bread of those who died ages ago, and to fermented wines, to the "koumiss" (fermented milk) of nomadic Tartars of ancient days, and to various other foods and drinks.

There have been many tunes running through the mind of the people long ago which could only centuries afterwards be set to music. It is in the order of life that we shall at first, and commonly for a long time, just merely "see through a glass darkly," or not see at all, the why and wherefore of many processes which are obviously beneficial. No further explanation need be offered concerning the necessarily empirical state of dairy knowledge right up even to our own day! To all intents and purposes we ourselves of this day were groping in the dark concerning what is now seen to be the supreme crux in dairying—the constellation grouped under the generic name of *bacilli*, which exercise influences whose scenes of activity are in one way or another, for good or for ill, literally universal throughout the habitable portions of this mundane spheroid.

A Huge Tribe.—And they are a stupendous family, these bacilli, though each unit thereof belongs to the class of the infinitely little! They may be accepted as diminutive when we are told that a small army of them would find room for a pitched battle with another army on a stricken field about as big as a pin's head. Here it will be owned that powerful microscopes and keen intellects were required to differentiate from each other the many kinds of bacilli which accommodate themselves in milk when they can, and to work out the life-history of the lactic ferment, which has a greater influence on cheese-making most of all, but on butter-making too, than the dairymaid herself.

The species belong to one great order, and are known to science under the general name of *micro-organisms*, and are differentiated into classes, each of which has its appointed work in nature. The class more immediately concerned with dairying are generically spoken of as *bacteria*, within which the *bacilli* that produce useful lactic acid in milk are the most familiar to students of dairying. These bacilli consist of several varieties and are rod-shaped, most of them straight, though some are curved, and they differ somewhat in size; say on an average their length is such that about ten thousand of them at least would be required, end on end, to stretch the length of 1 inch, and, placed side by side, some forty thousand of them would find sleeping-room—if they ever do sleep—in the same space.

These micro-organisms are not strictly a loving and peaceful fraternity, because the different kinds try to obtain supremacy or even to annihilate each other, and where in any medium they have all alike "fair play and no favour," it becomes a question of the survival of the fittest species or variety. These denizens of the under-world of the infinitely little are, indeed, in agreement with the rest of orgànic nature as we know it, and they, too, belong partly to the animal and partly to the vegetable kingdom.

The Beneficent Bacillus.—Bearing in mind that one supremely beneficent and indispensable kind of the bacterial genus which naturally haunts a dairy is the lactic acid bacillus, and that all the rest are either subordinate in usefulness, or neutral, or else more or less pernicious in either cheese-making or butter-making, it becomes obvious that scientific observation and investigation were needed, long ago, to establish dairying on a foundation which would enable all intelligent and painstaking dairyers to command success in their art. This investigation was tentative in the first and active in the second half, and was consummated in the fourth quarter of the nineteenth century.

It may be said, indeed, with the confidence which comes of conviction based on extensive observation, that in the latter half of the nineteenth century more progress was made in practical dairying based on scientific teaching than was made in the whole of time preceding—which includes at least several thousands of years. This progress is being maintained, and there is still a great deal that is occult awaiting solution, notwithstanding the fact that the central triumph has been achieved in the discovery and isolation and in the pure culture of what is so well and favourably known as the lactic acid bacillus.

It is equally well known that other bacilli commonly associate themselves, when they can, with *Bacilli acidi lactici*, some of whom may presumably assist the true lactic acid bacillus in its beneficent work. These various bacilli are almost always present in milk, we are told, even immediately after it is abstracted from the cow, and as each kind naturally paddles its own canoe as best it can, there is inevitably a strife for supremacy without delay.

Strife for Mastery.—Assuming that a given mass of milk in a cheese tub or kettle is impregnated with good and bad bacilli—which, indeed, is said to be commonly the case, the strife for mastery begins without any preliminary conferences, and the condition and character of the cheese made from that milk depend most of all on which kind of bacillus has gained ascendancy before and during coagulation. This seems to be a fairly straight proposition, and it certainly embodies what one may call the "boiled-down essence" of what is so far demonstrably and clearly known as this one concrete point.

The struggle for supremacy—in milk as a medium—

between different nations of bacilli is not exactly a battle of giants, but its results are sometimes beyond the capacity of giants of flesh and blood to accomplish. Victory naturally, though not necessarily, rests with the biggest battalions. And, therefore, the trained and educated cheese-maker will, by the aid of a pure culture of the lactic bacillus, which he can incorporate with milk that has been either sterilised or kept at a low temperature to reduce the fecundity of bacilli already in it, thereby secure the supremacy of big battalions that are friendly to his work.

It is pertinently thought that, amongst the different kinds of bacilli which are to be found commonly in milk, there are some that possibly do good work as auxiliaries to the lactic bacillus. This may be so. It probably is so. And herein lies the chief microscopical and chemical problem to whose solution dairy experts may haply direct their abilities. It is now known, as definitely as anything terrestrial can reasonably be known, that the lactic bacillus is indispensable to success in cheese-making, and fortunately it is always present in milk, in greater or lesser proportion.

This provision of nature it was that saved many of the old-world cheese-makers from disaster, and, on the other hand, the converse of this immunity frequently occurred where deleterious bacilli had gained the upper hand in milk. In the presence of these disparate results, the dairymaid who failed was hopelessly and painfully helpless in those far-off mediæval days, and, indeed, is so in modern days as well,—at all events in places where modern dairying is not in vogue.

There is no question that in many cases where inferior cheese, particularly downright bad cheese, is the curse on a dairy, it is, oftener than not, the misfortune rather than the fault of the dairymaid that she has been, and in places still is, a victim of bacteriological environment. She knows not how to escape from her foes, which indeed are they of her own household; that is to say, of her dairy atmosphere. Walls, floor, ceiling, everything is impregnated with micro-organisms. Probably the surroundings of the dairy—its location, aspect, foundation, construction, elevation or depression, and so on—are most of all to blame for the mischief done to milk both outside and inside the dairy.

A Keeping Test for Butter.—Some ten or twelve years ago, about a dozen samples of show butter, at a local town, were placed in a dry cellar after the show had closed, as a test and an experiment in respect to the keeping property of each sample. After a given time—somewhere about twelve days, if my memory fails me not—the samples were brought out and examined. The result was very remarkable and interesting. Two or three of the samples had kept remarkably well. The rest were in various stages of decay, in evidence whereof there were moulds well established on all of these, in varying degrees. These fungi were of different tints to an extent that was very surprising, and the flavours and odours of the samples were different in consonance with the moulds; so far, at all events, as variety went. The well-kept samples were doubtless free from deleterious bacilli when they were made, but were plentifully impregnated with lactic bacillus to an extent which enabled them to repel the attacks of moulds in an ill-ventilated cellar. All the ill-kept samples were presumably infected with injurious microbes which, being predominant over the lactic bacillus, encouraged the intrusion of moulds. The most curious feature in the case was the remarkable variety in the moulds, whose germs were possibly in the butter when it was obtained from the cream. It was one of the most tantalising puzzle cases I have met with during a long career in the domain of dairying.

An instance of this character bids one to pause before he ventures to lay all the blame on dairymaids' shoulders, and at the same time it goes to show that the keeping property of butter depends on certain conditions of which no dairymaid of old could be expected to possess any but the vaguest cognisance. Things are greatly changed nowadays, and there is no such excuse that can be held as valid in regard to modern dairyers. They can now learn, if they will, a good deal that is worth knowing.

Sour Whey.—In all advanced establishments where cheese or butter is made, the idea of using pure cultures of the lactic acid bacillus is quite familiar. Presumably it is used in the form of what is called "a starter" in most, if not indeed in all of them. In this form the lactic ferment is a perfected and thoroughly understood application of the crude and recondite "sour whey" of the old makers of Cheddar cheese in the earlier half of the nineteenth century, and presumably for centuries aforetime. The lactic bacillus flourished in whey which contained all of that on which it fed with avidity, viz., the lactose or sugar of milk. But it was anything rather than a pure culture in whey that was kept from one day to another to be added to the fresh milk that was about to be made into cheese each day.

Later on the sour whey practice was dropped for the most part, and the necessary lactic ferment was developed by keeping the curd at a temperature of some 90° to 95° Fahr., in the cheese tub, before grinding into pieces like currants and raisins in size, and necessarily before putting it into press-vats. This was a better process than that in which sour whey was a prominent feature.

Soured Curd.—Again, we find the same thing in the practice now commonly followed in Lancashire dairies, and, indeed, to some extent in those of Derbyshire and elsewhere—the practice of keeping a few pounds of curd from each day's make, to become acid during the interval, for mixing with the fresh curd of the following day. This kept curd, which amounts to about 8 to 10 per cent. of the fresh curd of each day's make, is kept through the night in a room whose temperature would be such that the curd would become perceptibly acid to smell or taste by the time when the fresh curd would be in a state to receive it, namely, when it had been through the mill. Here was the lactic acid bacillus well developed in the few pounds of curd kept through the night in a pan, and covered by a cloth, ready in the morning to impregnate the fresh curd that had recently coagulated.

A Dairying Mission.—Some 30 years ago I undertook a mission amongst the dairy farmers of the Fylde country of Lancashire, lying between Preston and Blackpool—a fine dairying district! I went on behalf of the Preston *Guardian*, and a series of typical farm dairies had been selected by the late Mr. William Livesey, of Preston, who for a long period was interested, as a dealer in cheese, in the well-being of Fylde cheese-makers. Three types of farm dairies came under my ken, in which three qualities of cheese—good, bad, and indifferent—were respectively and pretty constantly made.

It was a mission not heavily loaded with difficulty, for wherever fine cheese was found there was the soured curd practice in constant application, and wherever bad or indifferent cheese was going the wrong way in the ripening-room the sour curd feature was conspicuous by its absence. Wherever I went it was early enough to watch the whole process from coagulation of milk to pressing of curd, and when I found the soured curd in use I knew pretty well that I should find good cheese ripening upstairs.

At one farm on my list, a few miles from Blackpool, I found the dairymaids to be two delicate-looking, care-worn, refined young women, who were obviously weighed down by anxiety over something or other. Their father was a widower, and he too had a careworn expression on a face that—to use someone else's words—was "sicklied o'er with the pale cast of thought."

I watched the girls making the cheese, and when the curd had gone through the mill and was about to be vatted for press I said to them : "But where is your soured curd ?" They looked at me with amazement clearly enough written on their faces. "Soured curd ?" said the elder one. "I don't know what you mean." Here was the explanation of the sorry lot of cheese I afterwards saw in the ripening or curing room—cheese that could not be either ripened or cured in any satisfactory sense of the words.

A distressingly inferior roomful of cheese it was that I was ushered into upstairs, with timid apologies. There were cheeses that were inflated by some gas-producing bacillus that needed lactic acid to checkmate its nefarious work; cheeses that were badly cracked, cheeses with running sores, cheeses that were "sweet," cheeses that were bitter, cheeses that had a repellent odour—all of which calamities were owing to the absence of the one corrective in kind, namely, a strong and predominant impregnation by the lactic acid organism. And all this abomination was produced in one of the cleanest and most orderly looking farm dairies it has ever been my satisfaction to see.

"But where is your soured curd?" I inquired.

"We know nothing about soured curd," said she. "Our aim is to keep our milk and curd as sweet and fresh as we possibly can."

"Yes, that is obvious," said I. "But will you be surprised if I tell you that that is just where all the mischief springs from in your dairy? Your milk is cooled down as low as possible throughout the summer, is it not?" was my query.

"Yes, indeed," was the reply; "we cannot allow our milk and curd to become soured."

"And therefore your cheese is, as you sorrowfully know, a long way off being what you would like it to be," was my rejoinder here. "Miss Singleton," said I, "will you give a trial to soured curd? Will you keep to-day about 3 lb. of curd out of each 30 lb. cheese you are making? Keep it in a pan, with a cloth covered over, and in a fairly warm room, until you make your cheese to-morrow, and then mix it well amongst your fresh curd, which will have just then passed through the curd-mill. Will you mark your to-morrow's cheeses by pressing a penny into the flat side of each of them, and notice how they go on?"

This kindly-mannered young dairymaid promised to do so, and I went away.

It was several years before I learnt anything about the result of my counsel to the sisters, and then a widely and well known farmer, who knew the family, and whom I met at a show where he was judging Shires, told me that they had carried out with the most satisfactory results the instructions I had given. And nowadays, he said, "they are winning prizes at the shows with their cheese!"

I was afterwards informed by Mr. Livesey that the soured curd practice had become universal in the Fylde after my articles appeared in the Preston *Guardian* in the year 1882, and that now "it is as difficult to find a bad dairy of cheese as it formerly was to find a good one."

The whole thing was really at the time at my finger's ends, for several years previously my father had, in a way accidentally, but at the same time intuitively, discovered the great merit of soured curd in cheese-making. This it was that I had in mind in the Fylde, and whatever credit may be given to what I wrote some thirty years ago is due not to me but to my father, who died seven years before. This particular method of applying the services of the *bacillus lacticus* to ordinary hard-cheese making in the British Islands is a marked improvement on the acid-whey method, and may be recommended to people—if there are really any such in these days of universal publicity—who know not whence to obtain a pure culture of the bacillus.

It has been already indicated that there are many genera and groups of bacilli in nature—genera which embrace various species, groups including several families, families having different branches. And there is a further differentiation amongst species, some being more vigorous and more prolific than others, and therefore better equipped for the race of life.

The Bacillus Bulgaricus.—The dairying world is beginning to be interested in and informed concerning in one singular lactic bacillus, which is believed to be an effective life prolonger, a health-ensurer, a corrector of certain intestinal processes of the *genus homo*. We are assured, on authority that will hardly be questioned, that many Eastern nations have been taking soured milk, from time immemorial, as a chief article of food, and that as a consequence thereof these people are noted for longevity, for freedom from non-communicable diseases, and for bodily activity and virility prolonged a good deal beyond the traditional span of human life.

This particular individual item of the numerous family of the infinitely little in nature is now scientifically and commercially known as the *Bacillus Bulgaricus*. The fashion for soured milk is proceeding westwards in Europe at a constantly increasing rate; but in England, at any rate, it will not be altogether a novelty. For it is true that sour skim-milk—"sour douk," as they call it in Scotland—and butter-milk have long been considered good fluids to drink in the British Isles.

It must be understood, however, that the *Bacillus Bulgaricus*, though of the same species, is a much more vigorous ferment than the *Bacillus acidi lactici* which is the representative of the genus in this country, and in Western Europe generally. The native bacillus, which is indigenous here, and which for many centuries has been doing an enormous amount of unrecognised work in British dairies, is in itself an excellent medicinal corrective, but it falls short of the power and energy—so we are assured—which characterise the Eastern variety. Why this should be so we cannot say, except on the hypothesis that Nature will always, in different countries and climates, develop varieties of the same thing and endow them with properties differing in one way or another from the parent stock, wherever that may have originated.

In an article communicated in 1910 to the *Daily Telegraph*, Sir Ray Lankester quotes Dr. George Herschell to this effect: "We are undoubtedly indebted to Metchnikoff for the brilliant conception that the daily use of *yoghourt* (the Bulgarian sour milk), or its equivalent, could be utilised in the treatment of disease, and that by means of it, or preferably by the use of a pure culture of the principal bacillus, we might assist the colon bacilli to inhibit abnormal putrefaction in the intestines."

Mr. Loudon M. Douglas tells us, in his volume already mentioned, that amongst the Eastern peasantry at the present day, "soured milk is known as *yoghourt*, a word which is spelt differently according to the locality in which it is used." And he quotes from a Varna correspondent, who says, "The culture which is used for the preparation of *yoghourt* is known as *maya*, or as Bulgarian *maya*." The milk which is to be converted into *yoghourt* must first be freed from all bacteria by boiling and being allowed to cool to the temperature of 45° C.; it is then inoculated with *maya* and maintained at an even 45° C. during several hours. There are two kinds of *maya* or ferment, one known as sour and the other as sweet *maya*. This *maya* is simply the name of the "culture"—the "leaven"—of the bacillus with which these Eastern peoples inoculate their milk to make it sour, all in primitive style.

But it is not only in the souring of milk to produce *yoghourt* that the *Bacillus Bulgaricus* is being employed. The dairyers of the British Isles are now familiar — or ought to be—with the idea of lactic cheese in which the remarkable presence of the *B. Bulgaricus* is obvious to taste and smell. The "St. Ivel Lactic Cheese" is a dainty little brick of curd, for all the world easily mistaken for a cream cheese, done up in tinfoil. Its consistency, indeed, and also its appearance, are suggestive of a half-ripened cream cheese, for there is no symptom of even an incipient crust upon it. Further, the flavour of this cheese is very similar—almost identical—with a well-soured cream cheese a couple of days old. The ordinary so-called cream cheeses of the countryside are, indeed, presumably as rich and no richer in cream than this lactic cheese, both being made from fresh, new milk, and not from cream alone. This at all events is a broad comparison between two products of the dairy, and they differ most in the one being impregnated with the *Bacillus acidi lactici* and the other with the *Bacillus Bulgaricus*. The latter has a pronounced but rather pleasant acid flavour, which goes well with "standard" brown bread, and we may take it for granted that this bacillus of Eastern derivation is a searching and excellent corrective of accumulated and accumulating intestinal troubles in the human digestive apparatus.

There can be no hesitation as to preparing soured milk, and soured cheese too, in this country, providing always that the souring is brought about by the lactic ferment of the East, pure cultures of which are already obtainable in most countries where milk production occupies a prominent position in rural economy.

This Eastern custom of living mainly on soured milk has been in vogue many centuries; in point of fact, from time immemorial. The milk used chiefly is cow's milk; but in some countries, where cows are not numerous, but other mammalian quadrupeds are, camel's, buffalo's, mare's, sheep's, or goat's milk is similarly used as a general article of food. The existence in nature of lactic acid has long been known—at all events in the spontaneous souring and coagulation of milk. It is said that it was *isolated* by Scheele as far back as 1780, but the bacillus which brings about lactic acid in milk, by means of the sugar of milk technically known as lactose, was not isolated and developed as a "pure culture" until about one hundred years later. This "pure culture" is calculated to be of vastly greater service in the making of cheese and butter than any discovery which science had ever previously made in dairying.

It is thought that in soured milk and soured cheese British dairying may find another string to its bow, or possibly two strings. But not yet as regards milk, whatever may be the case with cheese. Dairying, indeed, has been for the last forty years in a state of transition, and to-day the trade in country milk, which was scarcely dreamt of forty years ago, is quite the predominant feature. Whether there is room for a sour-milk or an acid-cheese side in it, on anything like a scale which might bring appreciable benefit to dairying in the British Isles, remains to be seen. But in any case, and in view of the mighty changes which the current generation has seen evolved, he would be a rash man who ventured on a confident prediction either one way or another.

Spontaneous Development.—Be it understood that some lactic acid will always spontaneously develop itself in milk whose temperature is 85° Fahr. or upwards, and that in a few hours' time as a general thing. It has been considered, indeed, that milk contains the lactic bacillus even at the time when it is taken from the cow. This may or may not be literally true in all cases, and in that sense will be difficult if not impossible of proof. Be that as it may, however, milk will early become perceptibly acid, at a temperature approaching blood-heat, 98° Fahr., which, indeed, is its temperature as it is being extracted from the cow's teats. Whether or not milk has in it, to begin with, bacilli of a genus which causes lactic acid to manifest itself in milk, it is sure to absorb them from the atmosphere of a dairy, which is constantly impregnated with them. And hence it follows that the quick cooling of milk to about 50° to 55° Fahr., immediately after milking, is an excellent practice. In the milk trade it is peremptory; in the dairy it is desirable, except in cool or cold weather, for cheese-making purposes.

Be it also borne in mind that, properly understood, the lactic bacillus is a most beneficent thing in nature, and also in art—the art of dairying. It must be brought within the ken of all dairyers as a well-established axiom, that first-class cheese and butter cannot be produced without the aid of the lactic ferment intelligently employed. We may accept the statement that in all cheese-making and butter-making the lactic ferment is present, and that wherever the cheese is a failure it is so because other ferments which do nothing but mischief are predominant over the one thing needful, namely, the lactic ferment.

Fortunately, however, for all dairyers past and present who have never had the opportunity of learning all there is to be known at present about bacilli in the dairy, these lactic bacilli have always been at hand to help them. Other kinds of bacilli were not always there, and in every case, indeed, their room was quite as good as their company, to say the least of it. During the absence of these, good cheese was made anywhere and everywhere when ordinary care was taken.

"Starters."—A "pure culture" of the lactic acid bacillus is obtained by isolating the microbe with the aid of a powerful microscope—which, indeed, is indispensable—and afterwards cultivating it on gelatine and in vacuum. Thus obtained, the *Bacillus acidi lactici* is free from contact with other kinds of bacteria which operate differently, producing disparate results. Separated from all others and impregnating "separated" and pasteurised milk, this "pure culture" is an influence for great good in the hands of an intelligent maker of cheese or butter.

Used accidentally, unintelligently, and in conjunction with other and antagonistic bacteria, as was unavoidably the case prior to pure cultures, the influence is not for good unless the right bacillus is predominant over all the rest, which may or may not be the case. As the proof of the pudding is in the eating, so is the proof of the cheese in the ripening of it. It is in the ripening-room that the tale of suitable or unsuitable bacilli unfolds itself.

What is called a "natural starter," in distinction from a "pure culture starter," is obtained by taking a pint or a quart of milk from a healthy cow, and placing it in a clean room whose atmosphere is as pure as it can be in a crowded country and a damp climate. The vessel containing the milk must have been scalded thoroughly beforehand, and the temperature of the room should be about 70° F. in summer and about 75° in winter. The milk generally absorbs sufficient bacilli from the air to become more or less sour, which denotes incipient or advanced fermentation, as the case may be. This soured milk is poured into a vessel containing seven or eight times the quantity of separated milk which has been pasteurised. Enamelled vessels, now so general and excellent, are preferably used for this process. The two milks—the fresh milk impregnated and the other pasteurised—should be stirred several times, for thorough mixing, in the first two hours or so, and then the vessel should be covered by a muslin cloth and left undisturbed until the whole of the contents have become sour. Assuming that the process has been carefully carried out, and that the prevalent bacterium in the atmosphere of the premises is the true lactic bacillus, this natural starter may conceivably be equal to a pure culture starter for all practical purposes in the making of cheese and of butter.

The pure culture starter similarly requires pasteurised skim-milk as a matrix, but not the fresh milk to begin with. The separated or skim-milk is readily pasteurised if raised to a temperature of 185° F. and kept there a short time, and this treatment is required in order to give the pure culture complete and solitary possession as the bacillus which converts the mass of milk into a starter for use in milk for cheese-making and in cream for butter-making. The starter is so named because it starts the necessary fermentation in milk or in cream as the case may be. It may be true that a given natural starter is all that is necessary in a given dairy. In point of fact, this equality with a pure culture starter may be taken for granted, providing the souring of the fresh milk has been brought about by the desired bacillus. And this presumes that the predominant bacterium in the dairy atmosphere is the *Bacillus acidi lactici*, and none other.

A pure culture might be obtained in any private or public dairy having a laboratory attached, and a skilled microscopist at command. But it would not pay. Pure cultures are obtainable, ready for use, in the separated milk that has been pasteurised and made ready for their reception, or indeed they may be obtained ready for use in milk or in cream from most of the dairy schools, in bottles, through the post. Private dairies will be well advised to purchase starters for their own use, and indeed two or three such dairies adjacent to each other might combine in purchase and distribute in practice. A good starter having been obtained, there is no difficulty in keeping up the "leaven" for weeks, without a fresh supply from the fountain head.

It is not, however, desirable, as a rule, to try to keep up a starter at home by fresh relays of skim-milk pasteurised. In this way, indeed, the ferment may easily become weakened and attenuated until it is no longer as potent and vigorous as it must needs be if uniformity of product is to be maintained. The best, because safest, method is to get a fresh supply of the starter from some place or other where the preparation of it is made a speciality, and get it often.

The quantity of it to use in a given quantity of milk or of cream should always depend on its strength. Herein lies an argument in favour of buying starters ready for use, or ready to put into the separated milk for souring. Instructions as to quantity are sent out with the starter, and consequently there is no uncertainty on that point. The people whose business it is to prepare pure culture starters for sale are able to indicate the strength of them as ferments, and therefore are able to give reliable directions for use of the speciality they supply.

It must, however, not be hastily assumed that the possession of a reliable starter will alone enable a cheese-maker to produce a first-rate article. The cheese-maker must treat the milk as milk for cheese-making ought always to be treated, but frequently is not.

There were certain dairies in the days of yore which had won, and for a long series of years had kept, a valuable asset in the form of reputation for turning out excellent cheese. The why and wherefore of all this was an occult problem which no one then could satisfactorily solve. On the other hand there were dairies—both kinds in the same locality, perhaps in the same parish or hamlet—which had a bad name for inferior cheese. This was equally a puzzling affair. Again, a dairymaid who had been making good cheese for several years at a given farm was unable to do so when she tried her hand elsewhere. And vice versa, a dairymaid who had been a failure at one place became a success at another. All this was naturally puzzling and annoying, plus a cause of loss which—obviously gratuitous and avoidable if anyone knew how to circumvent it—was very irksome to put up with.

The whole trouble was no nearer to hand than was the remedy for it. The difficulty lay in diagnosing the mischief and in discovering the remedy. I cling to the belief that, as a rule, wherever bad cheese was made the fault lay not alone with the dairymaid, but with the dairy and its environment. Everything turned on the dairy, the atmosphere, and the management.

It follows, therefore, that the danger to dairying in old as in modern times has lain, and will ever lie, in lack of cleanly air, cleanly dairy, cleanly equipments, cleanly management in the farmyard, and cleanly dairymaid. That anything which may emanate from science can be expected to neutralise such uncleannesses seems asking for what is unreasonable.

Battle Half Won by Science.—Science has won for us more than half the battle, in isolating and cultivating and testing different kinds of bacilli, more especially the best of all of them—the lactic bacillus. It remains for dairy managers—great and small alike—to reap the results of the victory by administering, in painstaking manner always, the rules and regulations of which many editions have been tabulated from time to time, and with which every intelligent dairyer is familiar.

CHAPTER XVI

BUTTER-MAKING

THE production of milk in the system of an animal is at once one of the most necessary and one of the most interesting processes in the economy of Nature. The most advanced investigations into the structure of the mammary glands reveal to us that the interior of a cow's udder is composed first of all of a wonderful ramification of ligaments and tissue which, interlacing each other, support the udder in position; in this structure blood-veins pass to and fro, and milk-ducts, cavities, glandules, lobules, and vesicles are distributed. If we pass a pliable probe up the inside of the teat it traverses a duct, or tube, which opens into a reservoir communicating with other reservoirs or with ducts; following one or other of these ducts, the probe finally comes to a small saccular cavity, and it goes no farther. Within this cavity and its vesicles and cells the fats of milk are produced; and there are numbers of similar cavities.

The fat of the animal is constantly being supplied to these cells, and they, by a process which may be likened to budding, throw it off in the form of cream-globules. These globules, or buds, or fatty-pollen as we may term them, when perfected, drop off into the cavities, in which they come in contact with and are taken charge of by the liquid therein, which also contains casein, albumen, and milk-sugar that have transuded from the tissues; they are carried along through duct after duct into the acini, or milk cisterns, and finally are extracted through the teats. The product is the emulsion which we know as milk.

Milk under the Microscope.—When milk is placed under a powerful microscope the cream-globules in it, like the lobules and vesicles in which they were formed, appear variable in size; their form, however, is always rounded. It follows, then, that these cream-globules have actually been part and parcel of the system of the animal; they will, consequently, always partake in a measure of the nature, character, and condition of the cow by which they are produced; and as cows differ greatly in these respects, so must there be differences in the quality of their milk.

The subtle process of transudation by means of which the ordinary fat of the animal is changed into the particular form we are familiar with as butter, and the means by which are obtained the no less interesting odour and flavour of butter, both of which differ so much from anything else we know, are among the delightful mysteries of Nature. But it is evident that the milk-glands are the seat of a wondrous activity to supply the countless myriads of infinitesimal globules of fat which are found in milk; and they are the no less wonderful theatre of marvellous processes which produce the singular and delicate flavour, aroma, and colour of butter.

It will now be understood that milk is a compound fluid, made up in a beautiful way of several distinct elements, and as such is subject to physical as well as chemical change. We all know that when milk is left at rest in a vessel for a time the lighter portion of it rises to the surface; this lighter portion is called "cream," and is easily distinguished and separated from the "skim-milk" beneath. These cream-globules were first found by Leeuwenhoek in the year 1697; and Fleischmann in our own day has calculated that the largest of them weigh about ·00000004 milligrammes, and that a pound of milk, containing 4 per cent. of butter, contains about 40,000 millions of them. Yet for all this they are not so crowded as we might think, and it has been discovered that between each two of them in fresh milk there is space enough for a third to pass without touching either; this, as it affects the rising of the cream, is an important matter. The whole of these globules never rise to the surface, no matter how long the milk may remain at rest, because some of them, very minute in size, have not buoyancy enough to rise through the superincumbent mass of milk, and we never find skim-milk which does not contain a great number of them. Skim-milk, indeed, is distinguished under the microscope by the absence of the larger globules, and by the lessened number of globules in a given space. Cream globules contain or are composed of fatty matter, and fat is lighter than milk, hence they may be regarded as tiny balloons which seek the position to which their specific gravity entitles them. Some of them, however, are so tiny that the amount of fat they have is not enough to float them to the surface, not even enough to sustain them *in situ*; it has been noticed that, instead of rising or remaining in position, a few of them slowly sink toward the bottom.

The Rising of Cream.—Everyone is more or less acquainted with the natural process by which cream rises to the surface of milk which has been at rest for a few hours, yet there are comparatively few who understand the delicate and interesting theories which the process embodies and the influences by which it is effected. Among the more advanced dairymen of Europe and America different practices in the setting of milk prevail, and some of these are so diametrically opposed to each other in their theoretical as well as their practical aspects that it is as difficult to reconcile them as it is to ascertain which is really the best. It is therefore expedient that we appeal to the natural laws which operate in the rising of cream, in order to gain a clear view of what is right and what is wrong in the matter. The late Professor L. B. Arnold, in his day one of the leading authorities on dairy matters in America, wrote as follows about cream-raising in open pans; it is an admirable piece of close reasoning :—

"The first prominent fact in the separation of cream from milk is that it rises by reason of having a less specific gravity than the milk with which it is mingled.

Skimming off the Cream

Churning

s
c
s
c
t
A
f

s
w
b
to
T
h
th
ar
fla
las
an
hig
the
eig

"The average specific gravity of milk is about 1·030. The difference between this and ·985 brings the cream to the surface; it is so little that the cream makes haste very slowly. The globules never all come to the surface. Other circumstances being the same, the largest ones rise soonest, as they are specifically lighter, and in rising meet with less resistance in proportion to bulk than the smaller ones. Many of these never make a start towards the surface at all. Neither do the large ones always rise; some of them settle instead of rising. In placing in a glass tube 16 inches long, milk on which the cream appeared to rise perfectly, leaving a blue skim-milk, and letting it stand twenty-four hours, and then drawing milk from the bottom of the tube, globules of good size ($\frac{1}{2000}$ of an inch in diameter) appeared mingled with the smaller ones. As globules of unequal size remained at the bottom, it is evident they did so because of a difference in their composition which made them specifically heavier. Those remaining at the bottom of a deep vessel appear less opaque than those which rise to the surface, those rising first being the most opaque. Analyses of skim-milk show that about one-eighth of the fatty matter never gets to the surface.

"The smaller the globules the slower they rise, and some of them dwindle down to such minuteness that they would not rise through 3 inches in a week, if the milk could be kept sweet that length of time. Cream will continue to rise till the milk gets thick, be that time short or long. The best part rises first. If milk is skimmed every twelve hours, and the cream of each period churned separately, the product of the first period will be the highest flavoured and the highest coloured, and the colour, quantity, and flavour of each successive skimming will diminish to the last, but the keeping qualities will grow better. The fourth and fifth skimmings will be quite pale and insipid. Where a high-coloured butter is desired it is not advisable to continue the process of creaming too long. What will rise in forty-eight hours at 60°, on milk 4 inches deep, is all that is generally profitable to separate. What comes up after that is so white and tasteless as to do more injury, by depressing flavour and colour, than it can do good by increasing quantity.

"The second essential point is the fact that fats expand and contract more than water with heat and cold, and more than the other elements of the milk. The difference of specific gravity between milk and cream is varied by the circumstance of temperature. It is greatest when hot, and least when cold, and this fact materially affects the rising of the cream.

"As fat, of which cream is chiefly composed, swells more with heat and shrinks more with cold than water, of which milk is chiefly composed, it is evident that, if other circumstances are alike, cream will rise better in a high temperature than in a low one, since the fat in cream, by swelling more with heat, will be relatively lighter when both milk and cream are warm than when both are cold—the temperature in both cases neither rising nor falling, but standing without change. Most people seem to have the opinion that milk must be cooled to make the cream rise fast, and that the colder they get it the faster the cream will rise. The fact is exactly the reverse when the temperature is stationary. The colder the milk, the slower the cream rises, because there is less difference between the specific gravity of the cream and milk, and because the milk is more dense and offers more obstruction to the motion of the cream-globules. It does not rise so fast at 60° as at 160°. In butter-making the waste of butyraceous matter is confined almost wholly to the minutest particles of cream. These rise with great difficulty and very slowly. Those who make butter from whey often heat the whey to 170°, when the difference in specific gravity between the fat in the cream and the water in the whey becomes so great that the cream all rises to the top in a short time. By cooling to 60° a much longer time is required to effect the same result.

"Water is a better conductor of heat than fat; hence, when the temperature of milk varies either up or down, the water in the milk feels the effect of heat or cold a little sooner than the fat in the cream does, therefore the cream is always a little behind the water in swelling with heat or shrinking with cold—thus diminishing the difference between the specific gravity of the milk and cream when the temperature is rising, and increasing it when the temperature is falling. The difference between the specific gravities of milk and cream when both have the same temperature is but little; it is barely enough to give a sluggish motion to the cream."

From time immemorial butter-making in England has been a primitive, simple sort of business, the principles of which have not been understood, and until the second half of the nineteenth century the utensils and appliances used were of a simple and almost rude character. The vessels in which the milk was set to cream were usually of wood, and the milk-rooms were generally used for a variety of purposes, and not kept specially for the milk. Later on milk-pans were made of brown earthenware, which was glazed inside. In recent years these pans have been to a great extent superseded by others made of tin or of iron pressed into shape and enamelled, and, last of all, glass ones have in some places come into use.

Importance of Cleanliness and Ventilation.—It is necessary to remember, as, indeed, we have insisted in other chapters, that milk-rooms should always be kept scrupulously clean, well ventilated with pure air, free from impure odours of any kind, whether from within or without, and as dry as is convenient. Almost everything is capable of throwing off or of absorbing effluvia or vaporous compounds, some of which are beyond the scope of chemical estimation; and it may sound strange to some when we say it would be next to impossible to devise a compound liquid more susceptible than fresh milk to effluvial influences. Nature never intended that milk should be exposed to the air, but taken direct from the body of the parent to that of the offspring. This is clear enough; and the uses to which the requirements of civilised life consign the great bulk of it are just as clearly outside its natural functions. It is what chemists call a transition compound, and as such is fickle and transitory, and requires the most intelligent and careful treatment. Being a quick and powerful absorbent, it is expedient to keep it far enough away from any kind of odour that would taint it. An odour of any kind, be it pleasing or nauseous, will surely taint the butter through having first been absorbed by the milk. The odour of oil, for instance, of onions, of decaying vegetable or animal substances—any odour, in fact, especially if it be of a pungent character—will be absorbed by the milk which comes in contact with it, and will be reproduced in the butter. The milk-room, therefore, must be kept perfectly clean; floors and walls and ceiling, windows and doors—all must be free from impurities of any kind. If milk is spilt on the floor, it must be carefully cleaned away, and not allowed to decompose in the crevices between the tiles or pavement. So with anything else that is at all likely to emit an undesirable odour.

Ventilation is no less useful than cleanliness, provided it can be done with pure air. But if the air from the outside is likely to be tainted with impurities from cesspools, farmyards, or what not, it is better to keep the milk-room dry, so that the gases from the milk may pass off into the atmosphere, and so away, rather than that the moisture in the atmosphere should condense on the surface of the milk—a possibility that is likely to arise. There is little or no danger of taints from the air being absorbed by milk so long as the milk is warmer than the air, because atmospheric moisture will not condense on the surface of a liquid warmer than itself; but if cold milk were placed at rest in a room whose temperature is 10° or 20° higher, condensation from the air would immediately commence. It is owing to this law in physics that milk enjoys so much immunity from cowshed taints; its warmth—higher than that of the air—is its safeguard, save in very hot weather, when the air is sometimes warmer than the milk.

It must also be borne in mind that all vessels with which the milk comes in contact must be well scalded with boiling —not merely warm—water, and well scrubbed with a hard brush after each time of using, and especially so if they are made of tin or wood. Sour milk has a marked faculty for tainting vessels in whose pores or crevices it can find a lodgment; it decomposes there, and if not removed will turn fresh milk sour; each time a vessel is emptied of its milk it must be thoroughly cleansed before other milk is put into it. If these matters are faithfully attended to, the milk will throw up pure, sweet cream, and the cream will produce butter with a flavour and aroma fitted to gratify the palate of an epicure.

Heating Milk.—A good deal of importance is attached by many people to the practice of heating the milk soon after it is drawn from the cow, and before it is set for creaming, up to 130° or 140°, and then cooling it down to 60° or 70°. There can be no reasonable doubt that this practice, if intelligently carried out, is a sound one. In the first place, it will expel the animal odour from the milk; it will, for the time being, checkmate germs leading to decay that the milk may naturally contain or that it may have absorbed from the air; and it will dissipate the peculiar flavour which some kinds of food—turnips, for instance—impart to milk that is produced by their aid. This system of heating and then cooling will enable the milk to remain sweet a longer time than cooling without heating; and after the cooling has been done it is a good plan to place a cover over the milk, the more nearly air-tight the better, in order to keep the milk from contact with the atmosphere. Only a particularly pure atmosphere could do the milk any good at this period, therefore it is as well to exclude it altogether. The system prevents alike the hasty souring of the milk in summer before the cream has risen, and the bitterness so commonly developed by long standing in winter; but it is a perilous system when left in the hands of a careless or otherwise incompetent person, for if carried too far the delicate flavour of the butter is liable to be dissipated, and if the after-cooling is not carefully finished the milk is apt to turn sour. The most recent science teaches us, as we shall presently see, to pasteurise the milk in order to free it from all kinds of bacilli, afterwards inoculating it with the lactic acid bacillus, which alone can be relied on for proper ripening of milk or cream.

Professor Conn, of America, considers that "milk as it is drawn from the cow contains great quantities of bacteria," most of them liquefying bacteria and other non-acid species. Pasteurised milk has been relieved of all kinds, and is open to receive the bacillus that will do good in plenty and harm none at all. But this cream-ripening is not yet generally understood.

Creamers.—A number of "creamers" of one kind or another, all of them naturally dependent on cold water, were designed in the latter part of last century. The best known of these in England was the "Jersey Creamer," perhaps one of the most useful of its kind. Cooley, Hardin, Weldon, and others in America, not to mention still others in northern Europe, designed each his own creamer, which was more or less popular for a time, according to its merits. The principle was the same in each and all, necessarily so —viz. the more or less rapid cooling of the milk by means of flowing or stationary cold water—flowing, by preference, where a constant run of water cool enough was available; if stationary, then ice was necessary to lower the temperature sufficiently. The object of each and all of them was to facilitate cream-rising and to exclude bacterial and other contamination from the air. The principle they embodied touched the fringe of the science of bacteriology, for the most part unwittingly. They made no provision for, and recognised no need of, giving a free hand to the lactic ferment in the ripening of cream, as it is now understood.

Be this as it may, one and all of them suddenly became obsolete and out of date. The transformation has been rapid and effectual, though as yet not completely finished.

The invention of the separator, over a third of a century ago, has done more than anything else ever did to revolutionise one very important part in the process of butter-making all the world over, and all old notions of cream raising have been scattered to the winds.

An early form of Cream Extractor

Centrifugal Cream Separators. — At the International Dairy Show, held in Hamburg in March, 1877, we saw at work the instrument of which we give an illustration. As will be noticed, it consists of two wheels on a stand, one of which actuates the other by means of a belt. In the upper wheel four glass tubes, containing milk, are securely placed; the lower wheel is then turned by hand, giving the upper one upwards of 1,000 revolutions per minute. Whirling round at this great speeds brings centrifugal force to bear on the milk in the tubes, and the cream, being lightest, collects at one end, and the creamless milk at the other; the separation is complete and clearly defined, as in an ordinary cream-gauge. The time required by the centrifugal machine to complete the separation of cream from milk was from ten to thirty minutes, according to circumstances.

A thoroughly effective machine, known as De Laval's Centrifugal Cream Separator, wholly different from the preceding one in construction, but acting on the same principle—viz. by means of centrifugal force—was introduced to the notice of the British public at the Kilburn Show of the Royal Agricultural Society in 1879, since which time many types of this most excellent machine have been brought out, and the best are simply but emphatically perfect. This invention has absolutely revolutionised butter-making almost everywhere throughout the world. (*See* plate facing this page). The separator, indeed, in the space of twenty years or so, has conquered the empire of butter-making! It is now unnecessary to describe the different systems of cream-raising. They are rapidly becoming things of the past. Farmers who milk half a score cows consider it well worth their while to buy a separator. The increase in the butter product will, they know, soon reimburse them.

Other machines are now arranged so that the milk may pass through them without being separated at all, but leaving behind it all dirt, no matter how fine it is, that may be contained in it. These are largely used for purifying milk, in which respect they are far superior to any strainer or filter.

A wholly Novel and Simple Separator.—During the whole of the interval which separates us from 1878, efforts to simplify and improve the "separator" have been continuous. In its current form, however, mechanical complication is unavoidable, though the instrument in work is simple and easy enough, and undeniably efficient.

Now, however, an entirely new departure from the current style and form of separators is about to be introduced to the notice of everybody whom it may concern, by a well-known inventor, Mr. G. F. Strawson, whose permission I have to make this announcement. The invention has been patented, and is being perfected in its simplicity, which is amazing.

It is not a machine in any sense, the only bit of mechanism about it being a tap through which milk runs in a continuous stream from a pan, which is replenished from time to time, and falls on a gently sloping, tin-covered oblong table over whose surface it spreads in a film, gently progressing toward the lower end.

The table is a specially shaped flat vessel, whose edge

"Humming Bird" Separator
(Bradford & Co.)

A Usual Form of Separator

Strawson's New Separator

Alfa-Laval Turbine Separator

"Daisy" Separator for Hand Power (Dairy Supply Co.)

Alfa-Laval Belt-Power Separator

all round is turned up a little, just to prevent overflowing of milk, but having at its lower end two small spouts, one for cream and the other for skim-milk.

There are no wheels or disks or shafts, no parts in motion, absolutely nothing to wear and tear, nothing that needs oiling, unless it be the tap, and that but seldom if ever, for the butter in the running milk should haply oil it well enough.

The only labour is to turn the tap, to replenish the pan with new milk, and to dispose of the cream and the skim-milk. There is nothing about it to break or wear out, and nothing wanted in the way of duplicate parts.

So far as experimenting has hitherto gone, this new device in cream separators seems best adapted for dairies of up to twenty gallons an hour. But, as one may think, if up to twenty in separating capacity, why not to four or five twenties, or even more? We have seen this creamer in action, and are convinced of its efficacy in separating cream from milk.

Treatment of Cream.—But for their brittleness, there is nothing better than glass or glazed earthenware jars to place cream in, if it is not wanted for churning at once. It is an advantage that cream should not be churned until it has been skimmed at all events twelve hours; by standing this or a longer time, according as the weather is hot or cold, it obtains a degree of *maturity* which is conducive to a larger yield of butter. The question of sourness is an important one in butter-making; for if old cream that is sour be churned along with fresh cream that is sweet, the inequality in their condition will cause more or less of the butter to be left in the butter-milk. Sour and fresh cream that are intended to be churned together should be well mixed and allowed to stand for some hours before churning, so that it may be all alike in condition; and the colder the weather the longer should it stand, because the souring of the fresh cream will proceed more slowly than if the weather were warm. The temperature, however, may be artificially regulated.

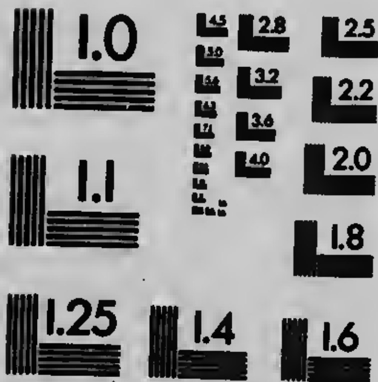
White flecks sometimes appear in the cream and are conveyed to the butter. The general cause of them lies in the coagulation of drops of milk by the action of some special species of bacteria not yet determined, and these germs will be developed sometimes by a strong light falling on the milk, as in the case of pans set near to a window; sometimes again by a current of air playing on the surface of the milk: the germs may be in the air, or they may be latent in the milk; in either case the air will tend to develop them. Hence it is better to cover up the milk: this keeps it alike from air and light, neither of which it requires if it has been properly treated beforehand. Flecks will not easily occur in milk that has been scalded and cooled, and afterwards covered up; the scalding kills the germs which are the cause of the flecks, and the cooling and covering prevent their re-introduction. Sometimes they will appear in one cow's milk and not in another's, and they are commonest in the autumn when the cows are being let dry and the milk remains longer in the udders; but judicious treatment of the milk and cream will checkmate them at all times. When these white flecks are in the cream they may be separated from it by running the cream through a fine wire sieve, pouring on warm water at the conclusion, which washes all the cream through, leaving the white specks in the sieve.

Colouring Matter.—In winter, especially, butter is commonly so pale in colour that its value is lowered if the colour is not restored by artificial means. This is done in various ways, but the colouring matter must always be mixed with the cream just before churning—not with the butter after it. No kind of colouring matter can be incorporated with the butter after churning, without so much working in that the grain of butter would be injured; and none is yet known that will not injure the butter by coming into direct contact with it. Some people use the juice of carrots, and this is harmless enough, except that, as a crude vegetable matter, it soon decays, and so injures the keeping property of the butter. Others use a preparation of annatto, a vegetable extract from *Bixa orellana*, specially prepared for the purpose, and, so long as the public demand high-coloured butter, that is on the whole the best colouring material to use—in moderation. In recent times, various people have produced artificial colouring matters for butter which are quite as satisfactory as anything artificial can well be expected to be. So clever, indeed, are some of these colours that they give to winter-butter a rich, warm, golden tint, which can hardly be surpassed by the natural tint of summer. The most recent colouring pigment for butter is, as we learn from the *Journal* of the Board of Agriculture, obtained from coal-tar. "Butter from Holland, Australia, and the United States is very frequently deepened in tint by this new pigment. 'Butter yellow' is generally supplied by the trade, ready dissolved in oil, either cotton-seed, rape, linseed, or sesame oil." The possibility exists that this will to a great extent supersede annatto, though its influence on the human system is not yet fully known. We may, however, assume that it is harmless, so far as its origin is concerned. The tint should be bright enough, anyway, if it is equal to other tints in aniline dyes obtained from coal-tar.

Churning.—The temperature of cream is a matter not to be overlooked at churning-time. It must needs vary according to the state of the weather and the time of the year. In the hottest weather it has no need to be below 55°, in a fairly cool room, or the labour of churning will be increased without any advantage to balance it; in winter it may without detriment be raised from to 60° to 65°, or even 70°, in very cold weather, and when the cows are eating dry fodder, in order to reduce the labour of churning; but in summer to have it above 60° will cause the butter to be soft; 60°, in fact, may be regarded as the normal temperature, to be varied as circumstances may require. By having the cream below 65° in cold weather, the labour of churning will often be great; and if it is below 60° it

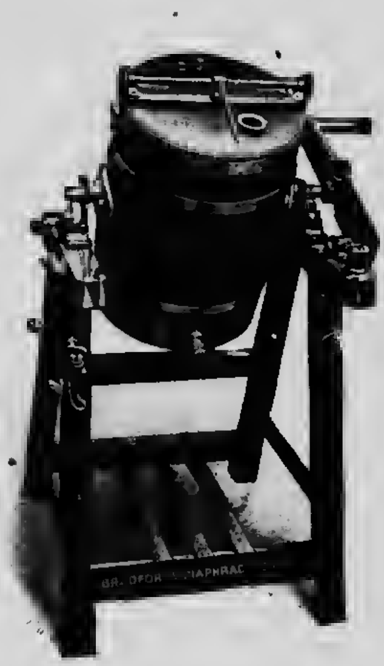
MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



can hardly be churned at all until the temperature is raised. In raising or lowering the temperature of cream, the process should be gradual; the best way is not to pour hot or cold water into it, but to place the cream in a tin vessel and surround it with either hot or cold water as the case may be. It is in winter, when the cows are on dry food, that difficulty in churning is experienced; in summer, when they are on grass, the butter forms readily. Cream that has soured *a little* will churn more easily and at a lower temperature than sweet cream; but care must be taken that it is not *very sour* or the quantity of butter is diminished, and its flavour ruined; and in extreme cases of souring the cream may be so far injured that the butter will not "come" at all in the churn. A very good system of introducing the desirable acidity is to pour a little sour buttermilk into the cream, say a quart to four or five gallons, before the latter is put in the churn. This system takes away the bitter taste which butter commonly has in wintertime, and it has the great advantage of introducing the acidity at the right moment. Or it may give to cream that ripeness which is essential, by being added to it a few hours before churning.

It may be said that acidity in butter-making, as in cheese-making, is absolutely beneficial when judiciously employed. The danger in both lies in developing it too early and too far. Incipient acidity, in fact, may be regarded as a stage of ripening, but it is a stage which should be held in check. Both cheese and butter will be the firmer and better in all respects for a little employed acidity, and have more of "character" about them, but it should in both cases be employed at the right time. We do not hold with cream being allowed to go as sour as it likes before churning, and we think it would be far better kept sweet until churning-time, or nearly so. The finest butter we saw in the old days—the firmest, having the most "body," the clearest and richest in colour, with a mild and pure flavour, and having a perfect "grain"—was produced



"Diaphragm" Churn (closed)

"Fishback" Churn

"Diaphragm" Churn (open)

from sweet cream into which a little sour buttermilk was mixed before churning-time.

This was a remarkable instance of what may be called scientific prevision, inasmuch as modern research and experiments have amply demonstrated the correctness of this method of ripening cream. This indeed, is inoculation by the lactic acid bacillus, as it is found in butter-milk of several days old; though it cannot be regarded as a pure culture of that bacillus. It is obvious that the dairy in question was the home of a bacillus by means of which the finest butter was made, and this in ordinary dairies is the crux of the question. Almost all depends on the sorts of bacteria prevalent in any dairy where milk and cream are left to their own devices. Many dairies are impregnated with a predominant bacillus which prejudicially affects the flavour of the butter; and here we may almost certainly find an explanation of many of the failures which are still so common in farm-house butter-making. The remedy is known in these days. It has been found in the sterilisation of milk and the use of pure cultures of the *bacillus acidi lactici*. But first of all the dairy rooms should be effectually disinfected, or the mischief may reassert itself at any time.

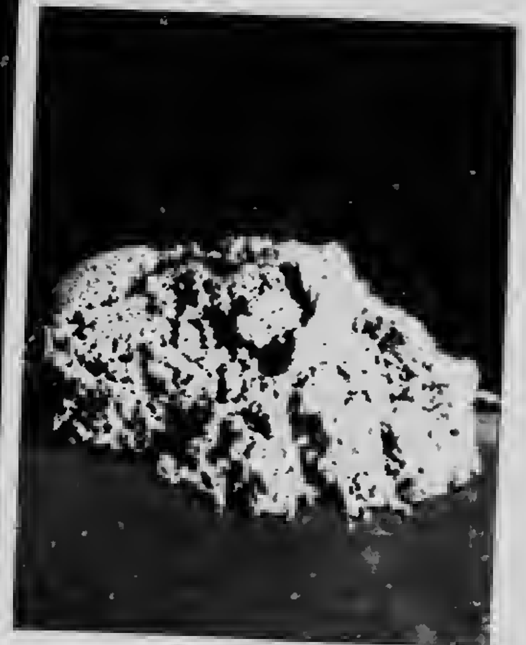
When cream churns reluctantly—that is to say, when the butter is slow in coming—it is customary to use one or other of the various sorts of "butter-powder" that are in the market, some of which are very useful. We have known refractory cream that refused to yield up more than a small portion of its butter quickly reduced to submission by the use of butter-powder, and the second yield of butter has been larger than the first. In winter, especially, cream is apt to swell out very much in the churn; at such times it is well to put a little dissolved carbonate of soda in the cream just before churning begins. A little salt, too, prevents the swelling, and helps the churning. This fermentation is caused by some kind of bacterium whose influence is prejudicial to the butter. It can be checkmated by introducing the lactic acid bacillus early enough to enable it to become predominant.

It may be laid down as a rule that, the longer it is since the cows calved, the longer time will the churning occupy. This is understood to be owing to the average size of the cream-globules being smaller than when the milk is from cows that have been calved a shorter time. Thus it is that cream of the milk of Jersey cows churns more easily than most other kinds—the cream-globules in it are, on the average, larger; and this is one of the chief reasons why Jerseys are better "butter-cows" than most others. Scalding the cream up to about 160° Fahr. will diminish the time and labour required in churning it; it must be borne in mind, however, that it is easy to scald cream to its injury. Scalding the milk while still fresh has a similar effect in abridging the time used in churning the cream from it. In this case, however, the milk must be cooled to 70° before setting it to cream; and scalded cream must be cooled to 60°, and without delay, before churning it.

The object of churning is to detach from the cream the globules, which consist of tiny granules of butter-fat. If these granules are crushed too much by over-churning or over-working the "grain" of the butter will be injured. But if the structure of the granules is left intact, a piece of butter at 60°, if broken across, will have a clear and distinct fracture like unto that of cast-iron, and if seen through a magnifying-glass will show a granular appearance; whereas, if the grain is destroyed the butter is greasy, the flavour is more easily lost, and the butter will not remain sweet so long. In all the processes through which butter passes, the grain should be specially considered and preserved; too much *friction*, either in or out of the churn, will injure it. At the commencement of the churning the motion should be slow, but when the cream is well mixed together the speed may be gradually increased until it has reached the rate for which the churn is adapted, say about fifty revolutions per minute; and when the cream begins

Grains of Butter in a Churn
(Churning is now nearly finished)

Apparatus for "Working" and Making-up Butter



Butter Granules
(Final stage of churning. Butter ready for "working")

to break into butter the speed must be reduced again so as not to "over-churn" or injure the grain of the butter. It is not advisable in any case to subject the cream to very violent agitation; a moderate, steady, and uniform rate of churning will make the best and most butter; and in summer the rate of speed must be slower than in winter.

Washing and Working.—It is important to stop the churn before the butter is fully gathered; that is, while it is in grains like mustard-seed, and before it is compactly massed together in a lump by the continued action of the dashers. The reason is this . that as butter immediately after churning always contains more or less buttermilk that must be removed by washing and working, the removal is more easily accomplished before the butter is massed together than afterwards. By pouring cold water into the churn just at the time when the butter is about to gather, and lowering the contents to 54° or 55°, the butter does not mass together but remains in small star-like pieces, and the lower the temperature the smaller will be these pieces, while at a temperature of 65° to 70° they readily mass together. The cold water may be put into the churn in two or three instalments, and the churn slowly turned a few times. The advantage derived from this method lies in enabling the buttermilk to be washed out without any of the ordinary working, and this can be done by draining it out of the churn, putting water in its place, stirring the butter carefully, and repeating the operation until the water runs out clear and free from buttermilk.

Scientific progress in connection with butter-making has, in all the more advanced dairying countries, led to the adoption of mechanical butter-workers, "Scotch hands," and so on, by means of which the butter can be thoroughly washed and worked without being touched by the dairymaid's hand at all. It is absolutely certain that the use of butter-workers is sound practice, to be earnestly recommended wherever butter is made. Butter in the making, indeed, ought not to be touched by the human hand.

There are various butter-making machines on the market which may be used effectually for three purposes: first, for getting the buttermilk out of the butter with the aid of water; second, for getting out the buttermilk by means of working only, and without the aid of water; and third, for thoroughly incorporating the salt with the butter. They perform these various offices by *pressure*, and without *friction*, so that the grain of the butter is not injured. The separation of buttermilk ɹhould, however, be effected in the churn, by repeated washings with water; and the butter-worker should be used only for pressing cut excess of water, and for consolidating the butter.

Salting.—Where people dry-salt their butter, the object of working butter is threefold: to get out superfluous water or buttermilk as the case may be; to work in the salt; and to make the butter cohesive and compact. It is, however, more general now to make a brine and—after "washing" the butter—to salt in the churn. For this method there are many favourable reasons, in preference to that of dry-salting; on the other hand must be cited that you know not what proportion of salt the butter has absorbed from the brine.

The flavour of butter is an inherent property, but it is developed by lactic acid in the cream, and is rendered more apparent by means of salt, just as is the flavour of beef or mutton, and butter entirely free from salt is more or less insipid. Salt, too, is a preservative, and in that capacity from ¼ ounce to ⅛ ounce of salt to 1 lb. of butter may be chosen at discrecion; but, at the same time, well-made butter, free from caseous matter, and from superfluous water, will keep for weeks in a cool pantry. Heavily salted butters are now generally out of favour. It is desirable to emphasise the recommendation to use none but the very finest salt, so far as purity and quality are concerned.

On the question of aroma, it may be said that this is developed by means of lactic acid, though, like flavour, it

Mechanical Butter-Worker

s
t
l
l
i
a
i
T
c
is
re
ro

is inherent in butter. As in fruit-ripening, so in the ripening of cream, flavour and aroma are both developed.

Legal Quantity of Water in Butter.—The Board of Trade have issued regulations on a vexed point—viz. the percentage of water which butter may reasonably be allowed to contain. The quantity beyond which butter may be fairly said to be overloaded with water is now declared to be 16 per cent. No one can justly say that this standard errs on the side of severity; and, indeed, by many experts, a standard of 12 per cent. would not have been considered too low. And when we reflect that the inclusion of water above 12 per cent., and probably even above 10 per cent., is a matter depending on manipulation, it will appear that 16 per cent. is a very lenient standard. The principle involved is wholly different from that which corresponds to it in respect to a milk standard. Butter is a product whose quality, in respect to surplus moisture, rests wholly with the dairymaid. In respect to milk it rests with the cow.

CHAPTER XVII

CHEESE-MAKING

It seems, with regard to many things, to be a principle in the human mind to praise the past at the expense of the present. We are never tired of referring to the "good old times," and of wishing that they were with us again or that they had never left us. So it is the opinion of many people that English home-made cheese nowadays is not so good as it was in the olden times—say a century ago; and the opinion is presumably sound, though it does not admit of proof, for if our cheese has gone downhill in quality within the recollection of those who are living, it is safe to assume that it is worse now than it was in the days of those who are dead. In any case we may allow that if English cheese has not actually gone worse it has relatively done so, for American, and especially Canadian, cheese is certainly much better on the average now than it was forty years ago, and it therefore follows that our own suffers more in comparison with it now than it did at that period.

Anyway, however that may be, cheese-making in these as in all previous times is an art that is practised in a perfect manner in comparatively few private dairies. And yet cheese-making is not very difficult; success in it depends mainly on care, industry, cleanliness, and the "know how." There is a great difference in people. A few seem to have acquired by intuition a mastery over technical details, the importance of which science has been years in demonstrating. In the domain of cheese-making these will generally be women, at all events in private dairies; they hit upon one scientific truth after another by

Cutting the Curd

a
ca
th
in
va
an
na
pa
an

do
ve
thr
the
sca
scr
wa
sea
be

in t
mil
low
inju
indi
kin
And
mus
only
imp
with
four
Shou
dair
crea
baci
cooli

a process of reasoning which neither they nor anyone else can explain, but which is often correct nevertheless, and they do the right thing at the right time, without caring to inquire into the why and wherefore of it. Experience is a valuable thing in cheese-making, but it will not make anyone a first-class cheese-maker who does not possess natural or acquired habits of immaculate cleanliness, patient industry, and unceasing attention to principles and details of management.

Cleanliness.—It is to be deplored that cheese-makers do not always take pains to keep perfectly clean all the vessels and utensils used for milk. Much cheese is injured through this sort of carelessness. As we pointed out in the chapter on Butter-making, vessels require to be well scalded with boiling water after every time of using, well scrubbed with a hard brush, and well rinsed in clean cold water. Care must especially be taken to clean out all the seams and joints of all the vessels, and they should always be cleaned before they have had time to become sour.

Bacillus Acidi Lactici.—Much inferior cheese made in this country owes its bad flavour to contamination of the milk by dirt or bacteria, or both. The atmosphere in damp, low-lying districts is charged with bacilli, some of them injurious, others harmless, and yet others useful and even indispensable. Much depends in any given dairy on the kind of microbic ferment which is predominant in the air. And it is here, in the domain of the infinitely little, that we must search for the causes of spoiled cheese, as a rule. If only the atmosphere of a dairy happens to be mainly impregnated with the *bacillus acidi lactici*, rather than with any other of the forty or fifty kinds which are to be found in some localities, the task of the dairymaid is easy. Should other microbes predominate, the scientifically trained dairymaid checkmates them by inoculating the milk or cream with the desired "pure culture" of the lactic acid bacillus, when she is ready to make cheese or butter, or by cooling the milk or cream when she is not. In respect to these bacilli, much depends on which of them is first in the milk. Spongy "floating curd" is now understood to be caused by a microbe, known as the "micro-ovum," finding its way into the milk, and not being forestalled and checkmated by the lactic bacillus.

Temperature.—Another practical fault in cheese-making—formerly very commonly committed in farm-houses—lies in "setting" the milk for coagulation at varying temperatures. Some dairymaids still go by the "rule of thumb" in deciding the temperature of the milk, and they leave the thermometer, if they have one, hanging up against a wall from week's end to week's end, regarding it as a curious but unnecessary instrument, and trusting to their own hands instead. Now it is impossible to set milk at a regular heat in this manner, for the dairymaid's hand at the best, is not a very reliable thermometer; still, we admit that some dairymaids are surprisingly lucky in the setting of milk by guess. But with irregular setting it is certain that results will vary more or less, though regular setting will not alone secure uniformity in the cheese; but if regular setting will not secure it, other conditions being neglected, surely irregular setting will not. When we contend for a regular temperature of setting, we do not mean that it shall be unvarying throughout the whole of the year, for this would be equivalent to a certain amount of irregularity. Temperature of milk at setting time must, indeed, be lower in summer than in spring or fall.

Rennet.—The practical fault next in order is that of using badly prepared rennet; and, as everyone knows, a great deal of cheese is injured in flavour in this way. Clean rennet, pleasant-smelling, is a *sine qua non*, as, indeed, is many another point in cheese-making. Nothing is better than a glazed earthenware jar in which to macerate rennets, and the following method will produce a perfect rennet-liquid :—Mix a brine of salt and water, one part salt to twenty parts water by weight; boil it for half an hour, after which let it stand till it is cold; to two gallons of the brine add six rennet-skins and one ounce of saltpetre. The mixture will be ready for use in a month, and will be good for a long period if kept from the air. During the month the skins should several times be gently rubbed between the hands, and at the end of it be removed finally from the liquid, while the jar should be kept covered as much as possible, in order to exclude the air. This rennet will be of a uniform strength, and the milk will coagulate in the same time each day, if the right quantities of each are mixed together. The ordinary practice in farm-houses is to put a piece of rennet-skin in soak each day for the next day's use. By this plan the strength is not all got out of the skin, and the liquid, though fresh, is not uniform in quality. Rennet-liquid ready for use is now a standard item in dairy requisites, and reliable brands of it are constantly on the market. As a general rule, this prepared rennet is more satisfactory than the home-made article, which it is rapidly displacing in all progressive dairies.

Cutting the Curd.—We come now to "breaking" or "cutting" the curd, at the stage when coagulation is far enough advanced; and here it is that practical faults of a serious kind are commonly committed. The object of cutting the curd is, we need hardly say, to enable it to separate itself from the whey. In the first place, we may state that mistakes are often made as to the particular stage of development which denotes that the curd is fit for "cutting" or "breaking." No exact time can be laid down with reference to this matter, for the period of coagulation will be influenced, firstly, by the temperature of the milk; secondly, by its condition as to freshness; thirdly, by the strength of the rennet; and fourthly, by the quantity of rennet that is used. But coagulation should, in the making of ordinary kinds of hard cheese, be always perfected in fifty to sixty minutes; if these limits are exceeded in either direction, the curd may be too soft in the one case and too firm in the other. If, however, the milk is always sweet, and is set at a uniform temperature, and the rennet used is uniform both in quality and quantity, the milk will vary very little as to the time required in coagulation, and the period when it will be ready for cutting may be predicted with tolerable certainty. The test of readiness is when the curd breaks cleanly over the finger when you dip into it and try to raise a portion of the curd.

First, as to the instruments. It may be stated that curd-cutters should never have rough and ragged edges, and it is better that they should be sharp rather than blunt; but in any case the edges should be smooth, not rough, and this is a point that is too frequently overlooked. The reason why the cutters should have sharp, smooth edges lies in the fact that such edges bruise the curd less than any other. At the period of cutting, the curd is very tender indeed, and an instrument that will pass through it with the greatest ease and with the least friction is to be preferred to any other; but curd-breakers not a few in common use in this country are rough, clumsy instruments, better calculated to crush than cut the curd. The curd should be *cut* or *split*, not *crushed*. The old custom was to pass a wooden bowl or a skimming-dish gently through the curd, to and fro, time after time, until it was separated into moderately small particles, passing the curd, too, repeatedly between the fingers; and but for its tediousness and irregularity of action, this old method was not the worst we have seen. By breaking gently in this way, or by cutting with an instrument whose edges are smooth and sharp, little or no harm is done to the curd; but by using a coarse, clumsy, ragged-edged breaker, the curd is bruised, and some of its butter and its casein passes off in the whey, and is lost to all but the pigs.

Curd should be cut very slowly and gently, especially at first, and at least a quarter of an hour should be given to the operation. To hurry the cutting has a similar effect to crushing the curd with a rough, blunt instrument; that is to say, a portion of the casein and of the butter is released and escapes with the whey; and wherever there is much whey-butter the cheese is never of first-rate quality. After the curd has been cut through twice or thrice it should be gently turned over by hand, and the cutter should again be used; as the whey goes on leaving it the curd shrinks in bulk and hardens, and as it does so the cutter may be used a little faster, so that the whole mass shall be cut into small pieces. The cutting is an important matter with regard, also, to the separation of the whey from the curd, and to this end it is expedient that the curd should all be cut, none of it being left in lumps. Whey left in causes the cheese to heave and bulge, and to come to an untimely end; it is also, in part, the cause of bitterness in the cheese, according to the kind of ferment. It is a ferment that degrades the colour where annatto is used, but it is not the well-known lactic acid ferment.

The first object, then, in cutting the curd is, obviously, to liberate the whey; it is, in fact, the first operation that can be performed for this end; and the subsequent cuttings, and pressings, and turnings, and finally grinding, until the cheese is at length put under pressure to form it into shape are all done with the same object. And as the efficacy of all these subsequent operations depends so greatly on the way in which the first one of cutting is performed, we see the necessity of impressing on all cheese-makers the great importance that attaches to cutting the curd at a proper time, in a proper manner, and by a proper instrument.

Getting out the Whey.—The operation of getting out the whey is, of course, all-important in every sense, but it is commonly performed in a very imperfect manner, and an enormous quantity of cheese is annually more or less ruined from this cause alone. No matter how carefully the milk has been preserved from taint and dirt, how clean all the vessels have been kept, how regular the temperature, how uniform the rennet, and how careful the cutting, no cheese can be first-rate unless the whey is properly got out of it. This point missed, all the rest is depreciated.

The necessity of getting out all the moisture—over and above the quantity which the cheese may safely be allowed to retain—will now be apparent. This is effected, first, by the cutting of the curd; second, by pressure; and third, by a moderate amount of acidity, where such is intelligently employed. Acidity in cheese-making is the most effectual means of expelling the whey, but it must be employed with great caution, for though it is a capital servant, it is a bad master. This acidity may be produced in various ways; the best way of producing it is by heating up, by means of steam or hot water underneath the vat, the mass of curd to a temperature of about 98° to 100°, and letting it rest for a time; or it may be produced by adding about two quarts of sour whey to each hundred gallons of milk at the time when the rennet is mixed with it. The best way of producing it is, however, by the use of a pure culture of the lactic acid bacillus. At the same time, it may be admitted that by the use of sour whey the same result may be obtained, provided the whey is soured by the lactic acid bacillus, and is not too far gone on the way to decomposition.

But though no heating of the curd and whey shall have taken place, and no sour whey have been used, acidity will arise afterwards in the curd, if it is left without salt for some time: in a few hours in warm weather, and in twenty or twenty-four in cold, an uncertain amount of acidity will have developed. Some of the more successful farm-house cheese-makers that we have known have unconsciously employed the agency of acidity in expelling the whey, and they do it in the curd by not applying any salt to the cheese until the following morning. These are cases where the cheese is salted on the outside only, as in the Derbyshire system of making. In this system the whey is "dipped" whilst there is still no acid perceptible, and there is no apparent acidity in the curd when it is vatted and put in press. Now, as there is no acidity just then, it ought to be allowed to develop a *little* afterwards, and

Salting and Grinding the Curds

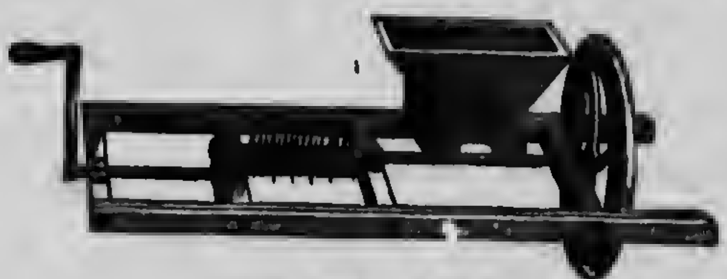
r
e
t
d
i
e

cu
is
cu
ha
th
pi
be
it
led
the
the
esc

this it will do if no salt is applied; but if salt is applied, even to the outside, at the time the cheese is first put into press, the curd will hardly turn acid at all, and in this case the whey may not be sufficiently expelled, while if the cheese is left in press until, say, the following morning *without salt*, a gentle acidity will have been developing slowly during the night, and, as it has developed, will have assisted in expelling the whey. In warm weather sufficient acidity for the purpose will develop in the course of six to ten hours, and a careful dairymaid will *then* apply the salt without waiting till the following morning. This application of salt checks the further development of the acid, which by the following morning might have become too pronounced.

In the Fylde of Lancashire it is customary to keep from one day to another, unsalted, and in a room whose temperature is not low, a portion of curd to mix with the cheese of the succeeding day. This portion of curd that is kept, representing about 5 per cent. of the bulk, becomes perceptibly acid in the interval, and it serves to inoculate the fresh curd, which is made into cheese on the following day. It is to be observed, however, that this simple means of inoculation must be used in moderation, or a rapid-ripening early-decaying cheese may be the result.

Grinding the Curd.—The operation of grinding the curd may be regarded as a necessary evil, and as such it is seldom performed with entire success. The old plan, before curd-mills were invented, was "crimming" the curd by hand; that is to say, working it well and repeatedly through the fingers; and this way of reducing the curd to fine pieces was better than grinding it in any mill whatever, because it did the curd less harm than any mill would do it; but the labour of crimming was considerable, and this led to the introduction of curd-mills. The object of grinding the curd is threefold: first, to cause it to pack evenly in the press-vat; second, to assist the remaining whey to escape; and third, to enable the salt to be uniformly distributed through the entire cheese,—that is to say, where salting the curd is practised. Previous to grinding, the curd usually becomes comparatively tough and solid, and in passing it through a curd-mill it is, of course, very much crushed and bruised, and this not infrequently causes a good deal of butter and casein to flow out with the whey when the cheese is put under pressure; the liquid that runs out of a newly milled cheese that is put under pressure is commonly white instead of green, and the white in it is so much loss to the cheese. This is caused by the iron pegs



Curd-mill with Knives

or studs with which the mill does its work. Various things have been designed to obviate this, the latest and most harmless being a mill in which there are sharp knives in place of the studs (*see* the illustration), and these cut instead of crushing the curd, so that less of it escapes with the whey. This curd-mill is intended to be used across the top of a factory milk-vat.

Salting.—The quantity of salt put into cheese whilst it is still in the curd stage varies greatly in different dairies. A great deal of cheese is injured by over-salting, a great deal also by under-salting, and this is the result of the haphazard manner which too commonly prevails. A certain amount of salt is necessary to preserve the cheese, and the quantity should be governed by the amount of fat in the cheese: the richer the cheese, the less salt is required. Salt is necessary not so much to give the cheese a saline taste as to check fermentation: but as a given

Filling Cheese Vats

a
c
t
S
ta
it
of
ar
to
th
m

of
wi
ou
it
mi
bef

of
sea
left
bee
in t
risi
of r
abo
mill
bree
corr
good
appl
of cu
R
less i
faults
newly

amount of fermentation is necessary to the ripening of the cheese, an overdose of salt checks the ripening by reducing the ferment too low, and the cheese does not ripen properly. Salt, being a powerful antiseptic, wholly prevents fermentation if a large quantity of it is used, and in this event its effect is similar in some respects to an over-development of lactic acid; that is to say, the cheese is hard and dry, and ripens improperly or not at all. On the other hand, too small a quantity of salt does not sufficiently check the fermentation, particularly in poor cheese that has too much whey left in it, and early decay is the sequel.

The salt should be of the finest description, pure, and of good quality, and it should be mixed as evenly as possible with the recently milled curd; the best way is to spread out the curd thinly and evenly, and then sift the salt over it by means of a sieve. The salt and curd should be well mixed up together by hand, and then left to cool for a time before vatting.

The right quantity of salt will depend on the quality of the curd—whether or not it is rich in butter—on the season of the year, and on the proportion of the whey still left in the curd at the time of salting. If the milk has not been skimmed at all, and all the butter is consequently left in the cheese, ½ lb. of salt to 25 gallons of milk in summer, rising in autumn to about ½ lb. of salt to about 20 gallons of milk, will, under ordinary circumstances, be found to be about the proper rate at which to salt the curd; but as milk varies in the percentage of solids, according to the breed of the cows, it is obvious that a milk-basis is a less correct one to go upon than that of the curd itself, and a good plan is to weigh the curd just before grinding it, and apply the salt at the rate of ½ lb. of salt to 20 lb. or 25 lb. of curd, as the case may be.

Ripening.—Much well-made cheese has been more or less injured in the ripening by one or another of the following faults:—First, damp and badly ventilated rooms; second, newly built or newly plastered walls; third, a temperature that is too high (above 75°), one that is too low (below 60°), or one that is continually varying between these points or beyond them; and lastly, turning it too seldom.

Some people think cheese ripens best in darkened rooms; this question, however, is not settled; but darkened rooms are useful in the heat of summer to discourage flies; it may be this is the only good they can do; and they do harm where they prevent the cheese from being carefully examined from time to time. During the first month the cheese should be turned once a day, in order to prevent the moisture from settling too much toward either side of the cheese, and also to give free play to moisture evaporating from all parts of the cheese alike in turn. When the cheeses are more than a month old they will do with turning a little seldomer, and when they are nearly ripe twice a week is often enough to turn them. While ventilation is necessary to the proper ripening of cheese, cold draughts are detrimental; and whatever fresh air is admitted should at all times be as clean and pure as may be obtainable. We have known cheese very much injured by newly plastered walls; the fresh lime in the plaster exerts a bad influence especially on the flavour of the cheese, and particularly so if the room is damp and ill-ventilated. This, however, is owing, not to the damp emanating from the plaster, for that does not amount to anything important, but to the keen antiseptic property of fresh lime, which paralyses the bacterial contents of the air, which are necessary to the complete ripening of the cheese. You do not need a literally pure air in a cheese room, even if that were feasible, but an air that is well possessed of the special spores which bring about in the cheese on which they rest a fungoid growth on the rind of the cheese that influences—at all events in the case of such soft productions as Brie and Camembert—the subsequent ripened flavour that is so much prized by epicures.

Old cheese-rooms whose walls and air are well filled with spores which form the characteristic mould on cheese are much to be preferred before new ones, unless these new ones are well prepared by pieces of old cheese scattered about. The French makers know the value of old ripening rooms, which, indeed, command high prices when they come into the market.

During ripening the cheese is passing through a slow process of fermentation, and it is expedient that this fermentation should be fairly regular and uniform as to rate; if the temperature fluctuates a good deal—say between 55° and 75° Fahr.—the fermentation will proceed in a fitful manner, now going too fast, now too slow, and the ripening cannot be as satisfactory as when the temperature of the room is nearly stationary. A cheese-room should always be furnished with a thermometer, and this should be consulted each day, means being taken to prevent the irregularities of which the thermometer will not fail to give timely warning.

In regard to the art of cheese-making more especially, though of butter-making too, it may be said that, in times prior to the middle of the nineteenth century the whole thing was empirical. Then scientific research came forward, and the result is that the art has made better progress toward precision and mastery of fundamental principles than was done in all previous history.

CHAPTER XVIII

CHEESE-MAKING (*continued*)

CHEDDAR AND CHESHIRE CHEESES

At the foot of the main chain of the Mendip Hills in Somerset, and on the margin of the "Marsh," once covered with water when Glastonbury was Avalon, and now among the richest grazing grounds in the country, lies the village of Cheddar, which, according to a local poet, is—

> "Famous for capital C's,
> Cliffs, and Caverns, and Cheddar Cheese."

Here, hundreds of years ago, originated the system of cheese-making which, borrowing its name from its birthplace, has since made that name a household word among thousands who have never seen the grand cliffs and stalactite caverns which are perhaps the most interesting natural curiosities of the county.

But it is with the cheese we have to do. Its origin is lost in obscurity, but we can trace its existence through at least three centuries. The historian Camden, who wrote in the reign of Elizabeth, speaks of Cheddar cheese being famous in his day, and of such great size as to require two men to set one on a table; from which we may infer that the custom of making up the milk of several farms into one cheese was practised in the sixteenth century as it was about one hundred years ago; for the holdings in the neighbourhood of Cheddar were doubtless then, as now, comparatively small. Here we have—inferentially at least—the first instance of associated dairying: and it is curious to note that the idea remained undeveloped for more than two centuries.

Fuller, in the seventeenth century, remarked that "the worst fault of Cheddar cheese is that they are so few and so dear, hardly to be met with save at some rich man's table."

The little village of Cheddar, nestling beneath the lofty rocks, is an idyllic cradle for the system; well watered, sheltered by hills on the north and east, and catching the breezes from the Bristol Channel on the west, a place for healthy people and healthy cattle, for pure milk and clean, cool dairies! These natural advantages, especially the shelter from cold winds and the abundance of water, were obviously favourable to the production of fine dairy goods, but the great secret of the success of those early makers was that they pursued a system of manufacture the principles of which were both scientifically and practically correct; they made for their cheese a reputation for excellence, and passed away, their names unknown to fame, leaving as a rich legacy to succeeding generations the method they had slowly lifted out of the chaos of all preceding time in the dairy.

The Cheddar System.—The inherent principles of the Cheddar system have not yet been improved upon; all that has been done is to be found in improved appliances, and in the demonstration of principles, along with certain improvements in the application thereof.

Since the beginning of the last century the introduction of rules, wherever practicable, has done much towards simplifying the method. The importance of having definite rules for the guidance of the cheese-maker cannot be overrated; but they must possess enough elasticity to allow them to accommodate themselves to all kinds of changing circumstances, for no two days' experiences may be alike.

Prominent among those engaged in their introduction was the late Mr. Joseph Harding, of Marksbury, who not only brought the theory of Cheddar cheese-making into definite shape, but also successfully practised it.

Mr. Harding was the author of pamphlets on the method; he lectured upon and taught it in various districts of the kingdom, notably in Ayrshire, on the invitation of the Agricultural Society of that county; and included among his pupils many Continental dairymen. An American author —the Hon. X. A. Willard, of Little Falls, New York, who visited Marksbury in 1866 as a deputation from the American Dairymen's Association—says of the system, as he there saw it carried out, that in his opinion it is "the only process from which American dairymen can obtain suggestions of much practical utility." *

The cheese of America and Canada, vast quantities of which have, for about half a century, annually come to England, is made on the Cheddar system, which Mr. Willard did so much to recommend.

A well-made Cheddar cheese should possess mildness of flavour, quality or richness, and compactness of texture, should cure slowly, and keep for a long time. When a Cheddar is not mellow, is full of holes, or "shaky" in texture, when it cures quickly, loses its mild flavour, acquires a sharp taste and has a tendency to early decay, we may safely say that it was made either from bad milk or without due regard to principles; and in the vast majority of cases the latter is the cause of failure.

The *size* and *shape* of a Cheddar cheese are not matters of importance. Cheeses made by the system which we are about to describe, whether "truckle" shape, flat, or deep, whether of 10 lb. or 100 lb. weight, are "Cheddars."

The distinguishing characteristics of the system are:—

1. The use of heat slowly to raise the temperature of the milk to about 80° Fahr. previous to the addition of rennet.

2. The *limited* use of a cutting instrument in the first stage of whey separation.

3. The use to as large an extent as possible of an instrument which will *split* or *break* the curd into small fragments.

4. The application of heat to raise the temperature of the curd and whey, after *breaking*, to from 95° to 100°, for the purpose of encouraging the growth of the lactic

* "Practical Dairy Husbandry," p. 271.

ferment, of hardening the curd, and completing the separation of the whey from it; the former being stirred, during that time and after the desired temperature is reached, in the hot whey by a *blunt* instrument until the required hardness and freedom from whey is obtained.

5. The removal of the whey in a *sweet* condition, about half an hour from the time the stirring ceases.

6. The developing of lactic acid in the curd by piling and occasionally covering it to preserve its warmth.

7. The thorough draining of the whey from the curd, and the cooling of the latter before grinding.

8. The division of the curd into small particles before pressing.

9. The mixing of salt with the curd, at the rate of about 1 lb. of the former to 56 lb. of the latter.

For the purpose of illustrating and enlarging upon these leading points of the system, we will here describe the process, as performed in Mr. Harding's dairy until the close of his useful career. His practice has been generally chosen by writers on dairying when a description of the system has been required.

The evening's milk is poured by the milker through a fine strainer into the cheese-tub. There is no previous cooling of the milk, though, doubtless, where that is done much danger of souring is avoided during hot weather; but into the space beneath the tub cold water is introduced, and the milk cooled down thoroughly. Mr. Harding fully recognised the necessity for a pure and sweet material from which to manufacture his cheese. By reducing the temperature to 55°, or lower, during the summer, the preservation of the milk under fair conditions was secured; this can be done if a stream of water of a quarter of an inch diameter is available.

Here let us say a word about the cream rising on the night's milk. Without going into the theory of the question, we may say that the cream of some specimens of milk rises faster than that of others, and is less easily stirred in again;

but while the difference between them on this account is marked, it is certain that, with either, to be able to prevent its rising is a great advantage. A small water-wheel gently moving a wooden float, technically called an "agitator," is used with success, to prevent the rising of the cream, in large cheeseries which are abreast of the times. At Marksbury nothing of the sort was used in the old days; the cream was skimmed off, poured through the strainer with the morning's milk, and thoroughly stirred in. But the advantage is on the side of "agitation."

When the morning's milk had been run into the tub, hot water from the boiler was turned on, and the whole mass heated to from 80° to 82°. The higher temperature is necessary with small quantities of milk in cold weather, and in draughty, ill-constructed dairies 84° is not too high in the early and late parts of the season.

The rennet and sour whey were then added to the milk. The former, as made at Marksbury, was reliable in its action and pure. Salt brine was made which would float an egg, and to every gallon of this was added four vells, a half-ounce of saltpetre, and half a lemon sliced, which soaked in the brine for a month, at which time the liquid was ready for use. A half-pint of this would, with the use of sour whey, coagulate 100 gallons of milk in sixty minutes or less. Prepared rennet has now largely superseded that made at the farm.

Concerning the use of sour whey various opinions prevail, but experience has shown that a curd produced without it, a larger quantity of rennet being used, is not so firm and manageable as that produced by a less quantity of rennet and a limited amount of whey. The acidity in the curd after scalding is more rapidly developed when it is used, and few things tend more to render a cheese soapy and tasteless than very slow acid development. At the same time, we may remark that great judgment is required in the use of sour whey in coagulating milk; to exceed the necessary quantity is risky. This varies with circumstances;

in a warm dairy the variation is less than in a cold room. In the former the use of from a quart in warm weather to three quarts in the colder parts of the season to every fifty gallons of milk is sufficient; but very few accurate calculations have so far been made on the question of quantity. The figures given are from the practice at Marksbury, and it has not yet been found necessary to deviate much from them.

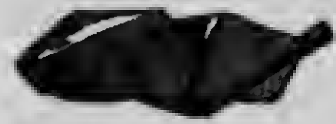
The use of sour whey has now, however, been almost wholly supplanted by "pure cultures" of the lactic bacillus, which, indeed, is much better in all respects, and more reliable. The pure cultures are mixed with the milk.

If annatto is used, the proper measure should be mixed in a bowl of milk, poured into the mass, and carefully stirred in. This stirring should continue for five minutes or so after the rennet and "pure cultures" have been added to the milk, in order that the coagulation and colour may be uniform, and that no cream may rise before the curd begins to form.

Instruments for "Breaking."—One of the leading principles of the Cheddar system is that the process of "breaking," as it is technically called and hereafter described, shall as far as possible be performed with *blunt* instruments, which, in passing through the curd, shall cause it to split. But the limited use of *cutting* implements is at present requisite because no *blunt* instrument has yet been introduced which will divide the curd into blocks of a workable size and shape. When the curd is "ready to cut," the curd-knife is passed through it first lengthwise and then crosswise of the milk vat, leaving the mass in blocks of 6 or 8 inches square. Then the "skimming-dish," so named because it is used for skimming cream as well as for breaking curd, is called into the work; the manner of handling it requires careful description. The


Skimming-Dish

blade is passed edgewise into the contents of the tub, and then drawn gently upwards, allowing the block of curd to split in its grain, as shown in the next figure, and when that is done, carefully drawn out edgewise, and the operation repeated until the mass is reduced, by as little cutting as possible, into lumps of 4 or 5 inches in thickness. This part of the process is performed slowly, but with gradually increasing rapidity, the condition of the curd and whey indicating to the trained maker the necessary speed.



Section of Curd, showing Splitting

To persons who have never used it the skimming-dish appears awkward, and likely so to bruise the curd as to cause loss. But such a notion is erroneous; there is nothing yet invented which, taking its place, will do its work so well.

Now the use of cutting instruments is left off, and the "breaker" comes into requisition. This consists of a bent wooden handle, through the lower part of which some nine or ten brass rods of $\frac{1}{8}$th of an inch diameter are inserted at about $1\frac{1}{2}$ inches apart, their ends being fastened into two strips of hard wood, the edges and ends of which are carefully rounded off. In fact, the implement is thoroughly adapted to the work of curd-splitting or *breaking*.

Breaker in Breaking

But there have been introduced into many dairies implements similar in form to the shovel-breaker just described, but yet differing from it in the most important point, viz. the shape of the rods and side-strips, which are made to *cut* or *tear* the curd instead of *splitting* it. Sections of the various sorts of rods used in the construction of

A B C

Breaker Wires

breakers are given in the figure on p. 348, where A is the wire of the Cheddar shovel-breaker, B the *diamond* wire, and C the *cutting* blade. The "American" method pursued in transatlantic dairies and factories has, as one of its leading characteristics, the use of cutting instruments, and the factory curd-knives have many blades, about half an inch apart, so as to cut the curd into small cubes at the outset.

The chief objection raised against the round wire breaker is that it "bruises" the curd. This may be true of it when in the hands of ignorant and careless makers, but if properly handled no more loss of butter and casein passing off with the whey need be incurred than is consistent with the production of the finest cheese, and the whey may always be clear.

In "breaking," the breaker should be held in the position shown in the figure on p. 348 during the early part of the process, and moved slowly, the speed increasing gradually. Care should be taken to *break* evenly throughout the mass, and as a result the whey should at any time be so clear as to reflect the face and bust of the operator. This rule is simple but sufficient.

Scalding.—When the curd is reduced to lumps of the size of large peas, "scalding" commences. The hot water is again applied between the two skins of the tub or vat, the breaker turned over in the hands, being held as here shown, and the curd stirred until the correct temperature is gained. In old-style dairies the curd is allowed to settle, and a quantity of whey drawn off and heated in a pail placed in the boiler. The custom of "slip scalding," or raising the temperature by pouring into the tub two pails of whey, one at a rather earlier and the other at a later stage of the process than that at which the heat is applied by hot water or steam, was followed up to about 1870, and then dropped.

Breaker in Scalding

In scalding (as in heating for coagulation), a higher temperature is necessary in cold than in warm weather, in a draughty dairy than in one properly constructed, with small than with large quantities of milk; the range, however, lies between 97° and 100°, and it is seldom necessary to go above or below it in home-dairy practice. When this temperature has been reached, the hot water, or steam, should be turned off, and the stirring continued until the curd feels "shotty," or is hard enough to roll between the fingers without adhesion, and the whey pressed from it is clear; then the *breaker* is withdrawn, and the curd allowed to sink to the bottom of the tub. As the curd often enters into this condition suddenly, being apparently far from it one time and within a very few minutes afterwards found to be hard, it cannot be too carefully watched. While scalding, great care must be taken to prevent any curd lodging on the bottom of the tub, where the heat will cause it to adhere and become lumpy; the motion of the breaker must not, however, be violent. And here let us remark, that from the first cutting until the scalding and subsequent stirring are completed, the process must not cease for a moment, except for whey-heating under the old style of management. The Cheddar method does not admit of cheese-making and domestic work being done alternately by the maker; the entire attention of one person is required throughout the earlier half of the work, and the cheese should be the chief consideration until it is in press.

Drawing off the Whey.—At this stage of the process the curd is allowed to remain under the whey for half an hour, when the latter is drawn off, particles of curd not being allowed to pass off with it. For this purpose a simple syphon and a cylindrical strainer is the best arrangement known. The strainer is placed in the tub, close to the side, the syphon filled by immersing it in the whey, and then, the ends being held tightly in the hands to prevent the contents running out, the shorter arm is adroitly put into the whey, which then begins to flow from the longer arm, and continues to do so until almost all has been drawn from the tub, leaving the curd undisturbed. The shorter arm of the syphon should, when resting on the side of the tub, reach to within half an inch of the bottom of the strainer, which should be eight or more inches in diameter, and as deep as the tub. When these are not used, the whey is drawn through the tap, care being taken to prevent any curd being carried with it.

When this has been done, the curd is piled in a compact heap, and, if the weather is cold, covered by a cloth, or cloths, to enable it to retain warmth and develop acidity. This cannot be done too quickly; the longer the time it occupies, the colder will be the curd, and cold checks the development of acid.

In from twenty to thirty minutes the curd is cut into several pieces and re-piled, those parts most exposed before being now turned inwards, and all packed closely together. To decide when curd is sufficiently acid is difficult to an untrained maker, some dairymen using a hot iron, to which the curd adheres, and from which it draws out in fine threads when a certain amount of acid is present, others trusting to their experience. The hot-iron test is simple, and at the same time reliable.

Drying.—When sufficiently acid, the pile of curd is cut into three or four lumps and spread over the bottom of the tub, and there left for ten or fifteen minutes; then, divided into smaller lumps, again spread abroad; after another short interval torn into pieces of 3 or 4 inches square and 2 inches or less thick, and spread upon boards or in a cooler, this being a gradual method of drying, the windows opened if the weather is fairly warm, and rapid cooling induced. It will require once turning; and when the surface has become dry, the temperature about 60°, and a tinge of brown appears, it is ready to grind.

Salting, Pressing, and Curing.—As on an average a pound of cheese is made from a gallon of milk, we may take the number of gallons of milk as the basis for salting.

The salt should be thoroughly mixed with the curd when ground, at the rate of 1 lb. to 56 gallons of milk, and too pure or too fine a salt can hardly be used. The proportion may be less of salt in summer, and greater in autumn, because in autumn the milk is richer.

The cheese remains in press until the day after making; it is then taken out and bandaged (if this has not already been done), turned, and again put under pressure.

After the second day under pressure, the cheese will be ready for removal to the curing-room, and we will follow it thither. It is only curd yet, and the process of mellowing down into a ripe, clean-flavoured, and appetising article of food, fit for the table, has yet to come. Here may be stored perfect and well-pressed curd, promising to become all that we could wish—a credit to the maker, the desire of the dealer, and a source of gastronomic pleasure to the consumer; and here it may by over-heating acquire a sharp, strong, and unpleasant taste; or by the temperature being kept too low may become soapy and characterless in flavour; here, in fact, it may be spoilt by crass neglect.

Cheese cannot be cured perfectly in ill-constructed, draughty, or damp rooms, which are too cold in winter and too warm in summer, without any artificial means of warming the contained air and keeping the temperature at a desirable point, and in which the thermometer shows variations of many degrees. We have seen a modern dairy the walls of which were mildewed, and the cheese in which was furred with fungoid growth, and this in the county of Somerset, the home of the Cheddar system; and we have reason to know that a large number besides in the county and country were more or less unfit for the purpose for which they are intended. Mr. Harding found from personal observation that newly made Cheddars give out moisture at the rate of 2 lb. per ton in twenty-four hours, and accounted for the lack of character in and uniformity of much of the cheese made late in the season by want of artificial heat and proper curing-rooms, the evaporation of the moisture being slow, from the low temperature of the surrounding air. Subsequent experience establishes the correctness of his belief. Let us then say what has already been so often said, that if the cheese is to be of first quality we must store it in a proper room with a correct and uniform temperature. The room should be so constructed that the air it contains should be affected as little as possible by that outside. Ventilators are useful, though they must be more generally closed than open. Warmth should be obtained by the use of a heating apparatus; pipes connected with a boiler that is very small will warm a large cheese-room admirably, though where no hot-water system is in use a slow-combustion stove will, though inferior, answer the purpose fairly well. But neither must be situated very near the cheese-shelves.

The best temperature for the curing of Cheddar cheeses is from 60° to 65°, in which, if well made, they will ripen and be ready for sale in three months or less from the date of making; while in a cold room the same cheeses require twice as much time, and a correspondingly large amount of storing space will be needed. The cheese should be turned over every day until it is a month old, and afterwards not less than once in two days. The bandages may be stripped from large cheeses at the end of five or six weeks, and from thin ones of less than 50 lb. weight at a month from the time they are made. It is an advantage to have the date of manufacture marked on each cheese.

"Half-Cream" and "Skim" Cheeses.—In some cases it may appear desirable to make "half-cream" or "skim" cheese, and no description of the system would be complete which did not include a few remarks on the manufacture of the two latter, and on the points in which the process of making each differs from that of whole-milk cheese.

"Half-creams" are made from the evening's milk *skimmed* and the morning's meal of whole milk, mixed, and "skims" from two meals of *skimmed* milk. The routine of the work is the same with both; the differences are of time, condition and temperature. In making these goods there is great danger of producing too hard a curd; this, it will be readily seen, is greater with skimmed than with half-skimmed milk. The maker should be careful to cut the curd rather earlier than is usual with whole milk, as a tender curd is more necessary. In scalding, the heat should not be lowered, but the curd needs less stirring and more careful watching than in making full-cream cheese. The acidity should be hastened, and all the subsequent work done as quickly as possible, as the curd will cool and dry rapidly. It should be put to press at not less than 65°, and cured in a room the atmosphere of which stands at about the same temperature.

Treatment of Sour and Tainted Milk.—A few remarks upon the treatment of sour and tainted milk under the Cheddar system will perhaps be useful. Many makers have both, but especially the former, to contend with occasionally, and want to make the best of a misfortune. It is certain that we cannot make a prime article from either, but with care and proper management an eatable cheese can be produced.

Experience has shown that sour milk cannot be made up too quickly. A loss of solids will be the result, but of two evils we must choose the lesser; so when the curd is firm enough, cut and *break* it, remembering that the tendency to become tough is proportionate to the sourness of the milk, and that if this part of the work is not quickly dispatched the lumps of curd will become unbreakable before they are sufficiently small—a condition of things to be avoided if possible. At no time in a cheese-maker's experience is the minute division of the curd in breaking more necessary than when he has sour milk to convert into cheese. Scald high—say 100° to 102°—and carefully watch for the hardening of the curd during the stirring, which will occupy but a short time. Let the curd lie under the whey the usual half-hour, or the lactic acid will be too much checked;

but after the whey has been drawn off, expose it to the air a short time, then pile, though not so closely as is usual with good cheese, and when the sourness is checked by the exposure, pile as with the curd of whole milk. Place it abroad, when torn, upon a sloping surface where it can drain itself, and dry it thoroughly before grinding. Use more salt than would be required for a curd made from sweet milk—say 1 lb. to 50 gallons of milk—and put at first under less than ordinary pressure.

"Tainted" milk is not so common in England as in America, where "floating curds" made from it are a terror to the cheese-makers. We have had personal experience in handling such milk, and know that it may be successfully treated. The great checkmate of taint is lactic acid, which should be introduced by means of a "pure culture" of the lactic bacillus, and developed by high scalding and close piling. The curd should then be dried as rapidly and ground as finely as possible. If stirred too long after scalding, the cheese will be hard and liable to crumble.

A "pure culture" of the lactic bacillus is nowadays obtainable from the leading Dairy Schools, such as that at Kingston, near Nottingham. This remarkable revelation of dairy science is best of all calculated to checkmate any ferment from a different bacillus which may have got into the milk. As a matter of simple fact, indeed, this pure culture of the one bacillus is now a real necessity in the production of fine cheese of any sort, and more particularly perhaps in respect to Cheddar cheese, though hardly if at all less so in respect to Cheshire, Lancashire, Stilton, and other kinds.

Elsewhere in this book the subject of lactic bacteria is discussed at some length, in regard to the making of cheese and the souring of milk.

Cheshire Cheese.—For a very long period the county of Chester has been famous for its cheese. Many hundreds of years ago Cheshire cheese had obtained a reputation that was barely approached by that of the cheese of any other county but Somerset; and in recent centuries its fame has spread to many lands, in some of which imitations of it have been and are still being made. Cheshire cheese is also made in adjoining counties, more particularly in Shropshire and Staffordshire, where the same geological formation prevails, and, indeed, where in some cases it does not. There can be no doubt that the properties peculiar to Cheshire cheese, whether it is made in Cheshire or in adjoining counties, are in some not unimportant measure owing to the New Red Sandstone, and to the boulder clay by which it is accompanied, from which the soil of that part of the country has been derived in the course of ages. Cheshire is also famous on account of its salt deposits, and it is presumable that the saline element counts for something in the agricultural products of the county. It is sufficiently clear that the soil contains some property or properties which influence the character of the herbage, and that the herbage gives to the milk produced from it, and to the cheese that is made from the milk, a characteristic flavour that can only in part be imitated in other districts and countries.

In the olden times the shape and size of Cheshire cheese were features peculiar to it and to the Cheddar cheese of the period, but other distinctive properties of the Cheshire were not closely shared by any other kind of cheese. Modern progress in cheese-making, however, enables almost any kind of cheese to be made almost anywhere to-day with remarkable success. The lactic bacillus is a wonderful leveller-upwards of character-types in cheese.

So far as shape and size are concerned, the depth is commonly greater than the diameter, and each cheese will weigh 40 to 80 or 100 lbs. The weight, however, depends in a great measure on the number of cows whose milk can be devoted to a single cheese; in small dairies the cheese, while still retaining the orthodox Cheshire shape, will necessarily be small in size.

It is seldom on the Cheshire system that the cheese is made oftener than once a day, and that in the morning.

The evening's milk has, therefore, to be kept through the night, and mixed with the morning's before the cheese-making commences. For a long period it has been customary to keep the milk overnight in pans or coolers of one kind or another, in which it may rest in small quantities and shallow; and in the case of small dairies it has been not uncommon to keep it a day and a half, until there was enough to make a cheese. Longer than this, especially in hot weather, it is not advisable to keep it for cheese-making purposes. But, whether it be kept one night o.. · or as long as two nights in some cases, a milk-room specially adapted and kept for the purpose is a highly necessary convenience. After standing the twelve or more hours, as the case may be, some of the cream is usually skimmed for butter-making, more of it being taken off as the cheese-making season approaches its close. Up to midsummer little or no cream is taken off, but after that period the milk is supposed to bear a little skimming.

In modern times it has become common not to put the milk in small pans to cool, but to put it immediately after milking into a properly constructed vat, which has an inner and an outer shell, with a space between them.

Milk-Vats. — The modern Cheshire milk-vat has an inner and an outer shell, the one of stout tin and the other of wood or galvanised sheet-iron, well bound together and water-tight. Its inside horizontal measurement is 7 feet by 2 feet 10 inches.

In this vat the milk is cooled overnight, and coagulated the following morning. In the evening the space between the two shells is filled with cold water, which is changed a time or two, until the milk is cool enough. In cases where it can be done, a small stream of cold water is kept running through—in at one end and out at the other—until the milk is cool enough; in hot weather the stream is kept running all night, so that the milk is not only cooled at the onset, but kept cool all through the night; and there can be no doubt about the advantage of cooling milk in this manner in warm weather, in stirring it whilst it is cooling, so that its heat and odour may both escape the more freely, and in keeping it through the entire night—by means of the stream of water—at a temperature which will prevent its souring or tainting, but not its ripening.

It is not advisable to cool the milk too much; under ordinary circumstances of weather 60° Fahr. will be found quite low enough, and some do not cool it below 65°. A good deal depends, however, on the milk-room; if it is a cool, well-ventilated room there is less need of cooling the milk below 65° than if the room is a warm one and ill-adapted to the purpose, because in the former case the milk will go on cooling until it meets the temperature of the room, whereas in the latter case it will grow warmer until it meets the temperature of the room. In very hot weather it is well to cool it down to 60°, or even to 55° if possible before leaving it for the night.

When the evening's milk is skimmed on the following morning, a portion of it, if it has been kept in pans, is warmed in a kettle of some sort; if it has been kept in the vat it is all warmed together by putting hot water or steam in the space that was previously occupied by cold water. This warming up of the evening's milk is usually done before the morning's is added to it; but if the evening's milk is found to be about 65° there is not much, if any, need to heat it, for the new milk added to it will generally bring the temperature up to the point which, according to the fancy of the dairymaid, is considered best for adding the rennet and for coagulation. This, however, has in the past been a haphazard sort of system, depending for uniformity on the mere judgment of the dairymaid, the test being her hand or finger. In modern times thermometers have come into general use, and accuracy is thus obtained; but this does not appear to be a matter of much consequence, because authorities differ so widely in their opinions as to the temperature at which it is best to set the milk for coagulation, so that uniformity obtained by using a simple scientific

Milk in Jacketed Vat, ready for Renneting

Curd Mill, showing Ground Curd in the Vat

instrument appears to be a matter of indifference. One authority (White) places it at 70° to 75°, another (Aston) at 88° to 94°; but the use of a thermometer will enable each individual cheese-maker to secure on all days alike a uniform temperature; what that temperature may be will still depend on the fancy of the maker. More or less annatto for colouring is added to the milk at the same time as the rennet; the quantity used will depend on the season of the year or on the fancy of the maker. If in summer, less of it is used, because the flowers among the grass in the fields are supposed to give enough colour to the cheese. Flowers, perhaps, have an effect in colouring both cheese and butter, but the tint of both depends chiefly on the time which has elapsed since the cows calved; the longer it is since they calved the paler grows the milk, so that as winter approaches it is found necessary to use more artificial colouring-matter, in order that the later-made cheese may not be paler than that of the summer.


Curd-Breaker

"Breaking."—Sufficient rennet is used to coagulate the milk in fifty to sixty minutes. When sufficiently advanced, the coagulum is carefully broken down by the aid of a curd-breaker, which we illustrate. This breaker is made of tin, the handle being of wood; the little squares seen in the figure are formed of strips of tin set edgewise, and intersecting each other so as to form meshes of about an inch square. The operation of breaking is at first performed very slowly and carefully, and in the course of a quarter of an hour or so the curd in the bottom of the vat is raised with a skimmer, gently broken up by hand, and intermixed with the rest, during which, where a doubleshelled vat is used, hot water is poured into the space to raise the temperature, and the process of breaking with the tin breaker is resumed and continued for some ten or fifteen minutes longer. The curd then settles to the bottom, and is gathered towards the upper end of the vat, while the whey is removed by means of a siphon, a ladle, or a whey-plug.

It has aforetime b en usual to have a special curd-drainer, a rather shallow apparatus, built of wood throughout, and standing on four legs, the sizes varying to meet the needs of large, or small, or medium dairies. But the modern milk-vat dispenses with the need of a special drainer. As the whey runs off at the lower end the curd is gathered towards the upper end of the vat, and two racks, together 4 feet long, and in width equal to the inside measurement of the vat, are placed in its lower end, which is at liberty, the curd being then at the other end. A cloth is spread on the racks, and the curd placed on the cloth, exactly as in the case of the special drainer, the only practical difference being the saving both in the cost of the drainer and of the room that it would occupy in the dairy.

Vat with Curd in it

Grinding and Salting. — The process through which the curd next passes is that of grinding it in the curd-mill. Before grinding begins the curd is weighed, and immediately after grinding the proper amount of salt is mixed with it—about $3\frac{1}{2}$ to $4\frac{1}{2}$ lb. of salt per cwt. of curd, according to the fancy of the dairymaid. In some cases a portion of the salt is applied earlier than this—when the curd is placed on the racks to drain—and the balance at the time of grinding; in yet other cases a little salt is put in the milk at the time of setting it for coagulation, a little more perhaps before the grinding, and the remainder after grinding. In highly approved methods the curd, after being ground and put into the cheese-vat, is placed in an oven, which has been erected for the purpose, and not under a press as is the custom in other parts of the kingdom. The figure on page 360 represents the vat of freshly ground curd as it is placed in the oven; A is the wooden cheese-vat, B the cylinder of perforated tin, and C C the skewers that are inserted to help out the whey. When the vat is removed from the oven, the curd will generally be found to have settled down a good deal, and a narrower cylinder of tin then replaces the wider one.

The oven in question is sometimes, in order to economise heat, placed in the inner wall dividing the kitchen from the dairy, so that the kitchen fire serves to heat the cheese-oven without any additional expenditure of fuel. The curd is put loosely in the vat, and without any pressure at all is placed on a shelf in the oven, where it usually remains until the following morning only. Sometimes there are two or three cheeses in the oven at once. The warmth of the oven helps the remainder of the whey to leave the curd, and skewers are inserted through the mass of the curd in a lateral direction through holes in the side of the cheese-vat, in order to facilitate still further the escape of the whey. The warmth of the oven is regulated according to the weather, about 65° to 70° or so, and this in most instances, where the curd is but lightly salted, or not salted at all, promotes a gentle acidity in the curd; during the night the curd settles down in the vat into a tolerably compact mass. The curd sometimes remains in the oven longer than the following morning, in which event it is taken out, turned over, placed in a dry cloth, in the vat, and replaced in the oven. Much depends on the curd in the oven becoming impregnated with lactic acid to a sufficient degree.

Cheese Presses.—When the cheeses are finally taken from the oven they are placed in the lever-press, providing there is a vacancy for them ; but as it sometimes happens that these large cheeses have to remain in press a week, or even longer, those coming out of the oven have to wait their turn to go into press, unless ample press room is provided to meet all requirements.

In some dairies a few stands are provided for the cheese in case any of them have to wait before going under press, and as the stands are on wheels they are very convenient for conveying the heavy cheeses from one part of the dairy to another.

In the Drying-Room.—During the time the cheeses are in press they are daily turned and dry-clothed, and when finally taken out of press are scalded with hot water ; after the scalding they are greased all over to prevent cracking of the skin, and they are next swathed in stout bandages to preserve them in correct cylindrical shape during the subsequent drying. Lastly, they are taken upstairs to the cheese-room, or drying-room, where they are turned over at intervals until they are sold to go away.

The drying-room, or cheese-room, as it is most generally called, is commonly the one immediately over the kitchen or general living-room of the farmer's household, in which case it obtains a good deal of the necessary warmth from below, and this means the saving of coal above. Many farmers have hot-water pipes laid round by the wall on the floor of the cheese-room, and when properly laid they are on the whole the best means of warming the room. Others, again—and these are the most numerous—have only a stove in the cheese-room. Though this is a useful heat-producer, yet it is objectionable on the ground of unequal distribution of the heat produced, and because it makes the air too dry for ripening cheese in the best way.

Ripening.—The time required to ripen Cheshire cheese varies with the method of making and with the season of the year ; generally from two to four months will suffice.

Cheese in Presses

It
th
of
m

sy
rip
th
th
fro
sm
An
an
is p
fro
the

mal
the
the
whe
is re

in r
mak
gone
save
Such
the
prev
habi

It does not necessarily follow that the bigger the cheese the longer it will be in ripening; this depends on the method of making, and on what use has been, or has not been, made of the lactic bacillus.

Yet it may be stated that, on the ordinary farm-house system of making, the larger cheese will be the longer in ripening; at the same time, however, it is true that when the curd is properly warmed and acidified, as described in the earlier part of the present chapter, the cheese made from it will ripen as soon as, or even quicker than, a much smaller one that has been made without such manipulation. And in many cases, particularly where the curd is placed in an oven for a time, the ripening of the large Cheshire cheeses is promoted with a like result, though in a different manner from that which is at once the glory and the strength of the famous Cheddar method.

It cannot be too strongly urged on the notice of cheese-makers that a proper amount of warmth is as essential to the ripening of cheese as to the ripening of fruit, and that the warmth should be judiciously applied from the time when the curd is precipitated in the vat until the cheese is ready for the market.

Looking to quick returns, many Cheshire cheese-makers in recent times have, it is averred, got into the habit of making early-ripening cheese, and not a few of them have gone too far in that direction. This would matter nothing, save that an early-ripening is not a long-keeping cheese. Such cheese should always be sold just before it is ripe; the farmer cannot venture to hold it until better prices prevail, as the old-time farmers of the county were in the habit of doing, commonly much to their profit.

CHAPTER XIX

CHEESE-MAKING (*continued*)

DERBYSHIRE, GLOUCESTER, STILTON, AND OTHER BRITISH CHEESES

THOUGH it has long held in our own country a good position among the more popular of English cheeses, the several merits of typical Derbyshire cheese are of a somewhat less pronounced type than those of Cheshire, Cheddar, or Stilton, and it has not, in the sense they have, obtained a world-wide reputation. It has long been a favourite cheese in several districts of the United Kingdom, but it has not ever secured an extended popularity in foreign countries. It is true that none of our kinds of cheese has ever been extensively exported in recent times, for we cannot spare them, and we import largely instead; but our Stiltons and Cheddars and Cheshires are well known in polite circles in many of the cities of Europe.

The essential character of Derby cheese is that of a middle-class cheese; it is not in any sense a fancy cheese, as the Stilton and the Slipcote and many of the Continental cheeses are, but it is a good substantial article of food; it does not appeal to the suffrages of the "upper ten," and its consumption has been mainly confined to the middle and the lower classes of the people, and to special districts within the limits of the British Isles. Yet a first-class Derby will compare not unfavourably with a first-class cheese of most other English makes.

The method on which Derby cheese is made is less complicated than that of most other kinds; the appliances in use are fewer and simpler, and the dairy premises are usually of a more primitive character. It is not usual for the cheese to be made oftener than once a day, though we have known cases where careful dairymaids have made it twice a day during the whole of the summer; these have considered, and with truth, that cheese is all the better if made from milk that is quite fresh and sweet, which is not always the case when it is twelve or fourteen hours old in warm weather; and on this method the cheese has the further advantage of retaining all the cream of the milk. This, however, has been found to be, or has been supposed to be, a disadvantage on land that has been highly farmed: full-milk cheese has been found very liable to crack and heave, and be generally unmanageable; and dairymaids have been driven for relief to the dubious and unsatisfactory expedient of skimming a portion of the milk. This was about as reasonable as was the old-time expedient of bleeding a man for toothache! The scientific cure for this state of things in cheese-making is not far to seek.

The old-fashioned circular tin or brass "cheese-kettle" is generally used in Derbyshire farm-houses, and the cheese is usually made in the ordinary kitchen of the house; it is seldom that a room is provided specially, and the equipment generally is inferior to what we find in certain other districts; nevertheless, great improvements in these matters have been brought about in modern times. Though we have seen in use within a recent period various dairy utensils of wood, and even a cheese-tub of the same material—hence the name—wood is now almost wholly discarded, and tin, or brass; or glazed earthenware, as the case may be, has taken its place. The vessel in which the milk is coagulated is generally of tin, though sometimes of brass; the milking-pails are no longer of wood, but of tin, unless in very conservative establishments; and the pans in which the milk is set to cream are of glazed earthenware or of tin.

The Curd-Mill.—The curd-mill commonly used in Derbyshire is the double-roller one seen on page 366; the rollers are of wood, and the iron studs are set round them spirally in parallel lines, and are so arranged that those of one roller do not clash with those of the other; while at each side they work through iron racks, which clear them of curd. These double-roller mills are supposed to crush the curd less than the single-roller ones, though they break it up fine enough. Before the introduction of curd-mills the curd was always broken by hand, or "crimmed," in local parlance, before it was vatted preparatory to being put under the stone press; and this operation of hand-breaking, though it was laborious, did the least possible amount of harm to the curd in the way of crushing it and setting some of the solids at liberty. When curd has been ground in a mill, and is again put under pressure, the whey flowing from it is charged with particles of casein, and hitherto no system has been invented by which this loss to the cheese can be prevented where a curd-mill is used at all.


Double Roller Curd-Mill

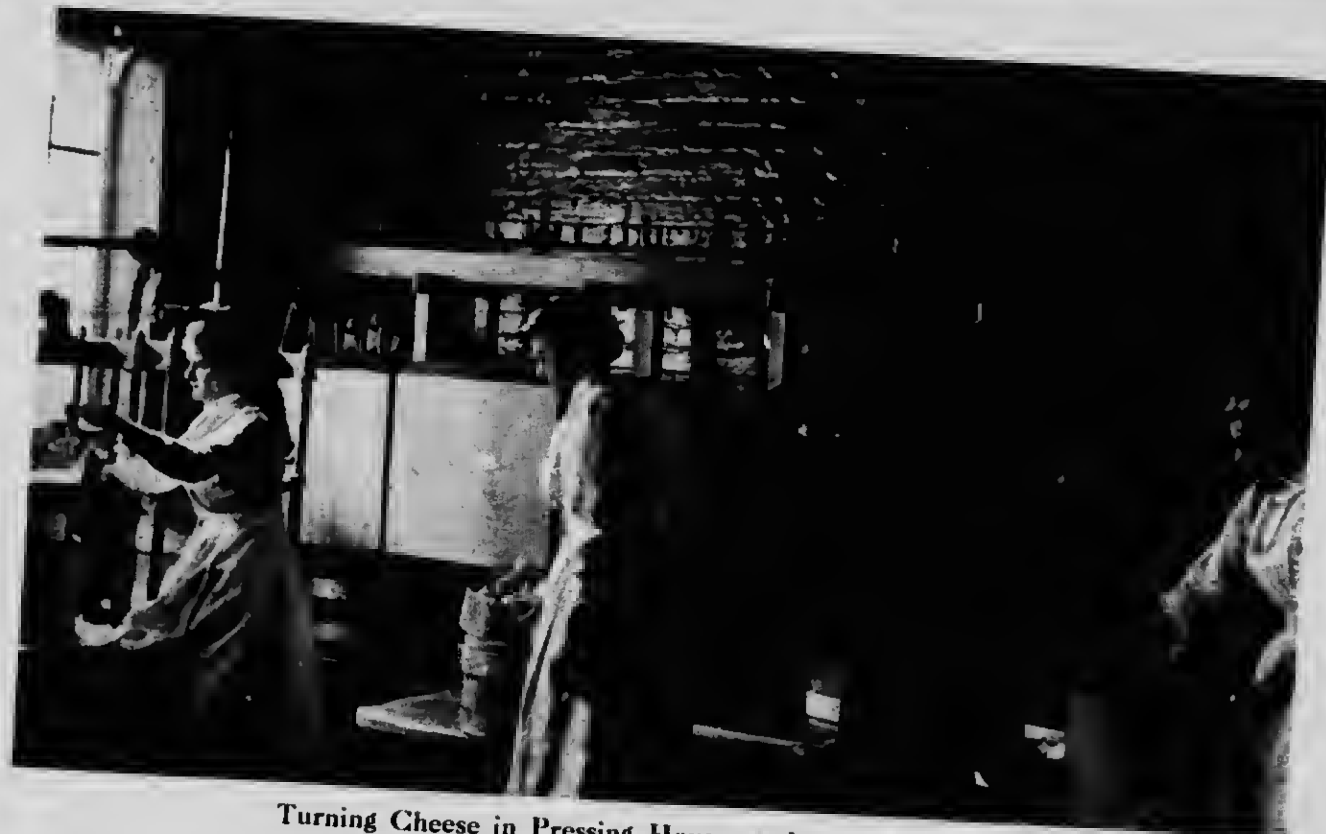
The Lever Press.—One of the most useful improvements in dairy utensils was the invention of the lever press, and it immediately superseded all other kinds in up-to-date dairies; many a farmer's wife, weary with the labour and untidiness of old-fashioned cheese-making, has rejoiced in the acquisition of a lever press, and dairymaids have regarded it as a godsend, relieving them as it did of a great portion of the labour. A light, handy press, of simple lever action, is commonly used in large dairies, instead of the wooden screw press, for expressing the whey in the early stages after the curd has been broken down; and in small dairies, where only one or two cheeses per diem are made, it is also used for all the subsequent pressing to which the cheeses are subjected. In large dairies, however, a larger lever press, that is compound in action, is used for the later stages of pressing. It is a very strong implement, exceedingly simple and easy to work, and thoroughly efficient in all respects. Having two fixed upright bars on either side, the cheeses are, as a rule, pressed quite evenly, whether there be two or half a dozen of them, and the amount of pressure can be regulated with the greatest ease and to any reasonable proportion. That anyone should still use the old stone presses seems odd, but habit is strong in old folk.

The Process described.—Where cheese is made only once a day—and this is the case in probably 99 per cent. of the dairies of the country—the evening's milk is sieved, as a rule, into the ordinary cheese-kettle; in warm weather it is cooled as well as circumstances admit of, stirred about to facilitate the escape of the warmth and the odour peculiar to new milk, and placed in the coolest part of the premises until morning. A portion of the cream that has risen during the night, and sometimes the whole of it, is then skimmed, after which the morning's milk is mixed with the evening's, and the whole mass is raised or lowered, as the case may be, to 80°,—raised by heating up a portion of the evening's milk that has been skimmed, lowered by standing a pail of cold water in the morning's milk for a time. It is, however, seldom that the temperature requires lowering, even in hot weather, provided the evening's milk has been fairly well cooled, and in cool weather it almost invariably requires warming up. If the evening's milk is at about 65°, the morning's, which is at about 95°, will bring it up to about the desired temperature with little or no trouble of artificial warming.

The rennet is added when the thermometer in the milk indicates 80°, and sufficient of it is used to coagulate the milk in about one hour. When the coagulum is firm enough, the curd-breaker is very gently used for about ten minutes, the curd being now and then turned gently about by hand, so that the breaker may act more efficiently throughout the whole of it. The breaking is a delicate operation: if it is hurriedly done, the whey will be white with detached particles of curd; if it is done carefully, and not too early, the whey will be green, and there will be scarcely any loss of curd. When the curd is considered to be broken into pieces small enough—say half an inch square—it is allowed to settle for a time, during which the green whey comes out of it freely, the whey coming upwards, the curd settling downwards in the kettle. As soon as the great bulk of the whey has thus become separated from the curd, it is ladled off, and the curd is wrapped in a cloth, put into the cheese-vat, and placed under pressure of some sort to express the remainder of the whey, or as much of it as can be conveniently got out at this stage of the process.

Whilst the curd is going through this preliminary stage of pressing, it is cut across the middle several times with a knife, the outsides are trimmed off and piled up on the top, and it is placed again in press. This process is repeated as often as may be deemed necessary to get out nearly all of the whey. The curd is then passed through the mill, vatted, and placed under heavier pressure than before, so as to be firmly moulded into the form required, and to get out the rest of the whey. This process of pressing generally lasts two or three days, during which the cheeses are turned over and dry-clothed two or three times a day.

How the Derbyshire System differs from Others.—The chief difference between the Derbyshire and most other systems lies in the period at which acidity is developed and salt is applied to the cheese. In the Cheshire and the Cheddar systems acidity is developed before the cheese goes to press, and the salt is applied to the curd immediately after the latter is milled; in the Derbyshire system the acidity develops after the cheese goes to press,



Turning Cheese in Pressing House, and putting in Press

and the salt is applied the following evening or morning, as the case may be, and to the outside only of the cheese. And this is an important difference, involving a fundamental principle. We have seen that heat is not applied to the curd after coagulation on the Derbyshire plan, that the whey is dipped off as early as possible, and that the curd is vatted whilst perfectly sweet. This is exactly what is meant by a "sweet-curd process"; and it is the converse of any process in which acidity is admitted, by any means whatever, at or before this stage. But mark the sequel: though the curd is vatted whilst it is perfectly sweet, an uncertain amount of acid will probably develop, because no salt is applied, as a rule, for six to eighteen hours afterwards. By withholding the salt for some hours the young cheese will begin to sour, if not too cold, whereas if the salt has been mixed with the sweet curd no appreciable acidity occurs. The better way by far is, however, to develop acidity before the cheese goes to press, and then you are sure it is there. In the other way it is not at all sure to develop at all; and this explains the many failures there are in home cheese-making.

Much depends on the state of the milk from which the cheese is made, as to whether the acid shall develop quickly or slowly; and on the salting, as to whether it shall develop at all. If the milk is already ripening, the curd will acidify at an early date, say in the course of the afternoon; if the milk is perfectly sweet, the acid will be some time longer forming in the curd. The proper time, then, at which to apply the salt to the outside of the cheese, as in the Derbyshire system, will depend on the skill with which the dairymaid detects the ripening of the milk; or, if the milk is perfectly sweet, on her judgment as to the time when sufficient acid shall have developed in the newly formed cheese. But the skill and judgment here indicated are somewhat rare to be met with, though they are in truth not very difficult to acquire.

The Derbyshire system is, as we have said, essentially a sweet-curd system ; that is to say, the whey is dipped sweet, the curd is vatted before any perceptible acid has formed, and no salt is applied for many hours afterwards, and then only on the outside ; but this system has been improved on with advantage in at least one case that we are well enough acquainted with. Some years ago, Mr. George Sheldon, a well and widely known dairy farmer in the Peak of Derbyshire, near Yolgrave, effected a striking improvement in the condition and quality of his cheese by the very simple expedient of keeping over a portion of unsalted curd—about 5 per cent. of the whole—and mixing it with the following day's cheese. The kept curd, exposed to the air, became sensibly acid during the night, and when it was intermixed with the fresh curd of the following day it imparted just the right amount of ferment to produce a perfect cheese. This discovery of merit in acid curd was entirely fortuitous in this instance, and independent of all others. The farm in question had always previously produced cheese that was scarcely more than a good second-class article, but the first year that the plan was adopted of keeping over a portion of curd, the whole dairy—from the milk of forty-five dairy cows of Shorthorn breed—was sold for 87s. per cwt., which was 15s. or 20s. more than it would have commanded under the old system.

This deponent happens to stand in the familiar relationship of son to the above-named Peakland farmer, and is familiar with this interesting episode in dairying.

There is now much less cheese made in Derbyshire than there was thirty years ago. The Midland Railway runs through the heart of the county, and a very large traffic in milk has been developed to supply the needs of London, Manchester, Sheffield, and other large towns; and as the climate and soil of the county are excellently adapted to the raising of stock, some farmers make butter instead of cheese, and rear a number of calves on the skim-milk. Thus the volume of Derbyshire cheese-making has been greatly diminished within recent times.

Not only the accommodation for making the cheese, but also that for storing it after it is made is, as a rule, poor enough in Derbyshire farm-houses. In many cases the cheese-room is over the kitchen, and no heat is provided beyond that which the kitchen fire supplies,—an intermittent heat at the best. In summer the heat would be too great and in winter too little,—constantly varying, in fact. In the more advanced cases, coke-burning stoves are used, and in yet others a system of hot-water pipes is laid down in the cheese-room, round by the walls and near to the floor. This, though more expensive to begin with than a stove, is a much more effectual way of securing an even temperature all over the room; and it is a kind of temperature that causes the cheese to ripen fast enough without drying too much, and without so much cracking of the crust as a stove produces. Heat from a stove is not the best for curing cheese, inasmuch as it dries the air, and causes the too-rapid evaporation of moisture from the cheese. This fault does not appertain to the hot-water pipes.

Gloucester Cheese.—Single and double Gloucester cheeses have been famous for a long period, giving to the Vale of Berkeley a reputation that has penetrated into many lands; but Gloucester cheese is no longer celebrated as it once was. This is in part owing to the enormous importations of foreign cheese into this country, whereby many good old traditions relating to English cheese-making have been somewhat rudely dispelled, and in part it is owing to the great extension of the milk trade with London and other cities. Double Gloucesters may indeed be almost regarded as a thing of the past, for they are now made only to a small extent; but single Gloucesters continue to be made in some farm-houses. They are each about 16 inches in diameter, the double Gloucester being between 4 and 5 inches thick and weighing about 24 lb., while the single Gloucester is between 2 and 3 inches thick, and weighs about 15 lb.; the distinction between them is one of thickness chiefly, and has not always reference to quality. The following are average analyses of double and single Gloucester cheese, four samples of each; they may or may not be generally applicable to Gloucester cheeses.

DOUBLE GLOUCESTER

Water ..	35·70
Butter ..	28·45
* Casein ..	28·08
Milk-sugar, lactic acid, etc.	3·26
† Mineral matters (ash)	4·51
	100·00

SINGLE GLOUCESTER

Water ..	32·27
Butter ..	30·40
‡ Casein ..	27·57
‖ Milk-sugar, lactic acid, etc.	5·66
Mineral matters (ash)	4·10
	100·00

* Containing nitrogen, 4·50.
† Containing common salt, 1·43.
‡ Containing nitrogen, 4·41.
‖ Containing common salt, 1·20.

If we take the smaller quantity of water and the larger of butter as tests of comparative quality, the single is obviously a richer cheese than tho double Gloucester; quality is, however, a matter which depends not on richness alone, but on condition and degree of ripeness.

Under the general system cheese is made twice a day, from fresh milk each time. In other cases "half-coward" cheese is made; this means cheese made in part of skim-milk. It is made once a day only, from the morning's milk fresh and the evening's skimmed, the two kinds mixed together. The milk in any case is warmed up to 80°—in some cases to 85°—at which point the colouring (if any) and the rennet are added to it, and coagulation is far enough advanced in about an hour. When as much whey as possible has been got out, the curd is milled, and put to press. The next and two or three following mornings the cheese is taken out of press, turned, and salted on the outside. This is the best way of salting such cheese; but in other cases the curd, after having been under pressure for some hours, has salt scattered over it at the rate of about 2½ to 3 per cent., and is afterwards rebroken, refilled into the vat, and a gradually increasing pressure brought to bear on it. During the pressing period, which lasts nearly a week, the cheeses are daily taken out of press and wrapped in dry cloths—a plan that is common to most of our old systems of cheese-making.

The characteristics of Gloucester cheese of good quality are sharp, well-defined edges, and no bulging anywhere; a clear yellow hue around the edges, and a well-developed blue mould rising through the paint on the sides; a smooth, close, firm, and waxy texture rather than a loose and open one; a mild, though rich flavour; and a somewhat tough and solid skin, destitute of cracks, that will, when the cheeses are ripe, bear a man's weight without giving way underneath the foot; this, indeed, is the standard test of firmness and solidity.

A remarkable custom of painting the cheese has existed in Gloucestershire for a long period—a custom more nearly akin to Dutch practices than is found elsewhere in England. About a month after they leave the press the cheeses are scraped and painted over with Indian red or Spanish brown, or a mixture of both with small beer, to give them a characteristic tint, on account of which they have long been supposed to be more acceptable in the London markets. This, of course, is a mere fancy, but it is established by the practice of many generations of cheese-makers. In cheese-making, whether it be applied to the outside or to the inside of the cheese, and especially in the latter case, we should be glad to see artificial colouring matter dispensed with. Good cheese needs no adventitious colouring.

Leicester Cheese.—The finest qualities of what is known as Leicester cheese are generally admitted to be, with the exception of double-cream Stilton, the best cheese produced anywhere. Stilton, however, is a double-cream cheese, and as such is not a fair competitor; made in Leicestershire, and in various other counties nowadays, it is known to the world by the name of the district and not by that of the county in which it was originally made, and in this respect it resembles the true Cheddar cheese. But "Leicester cheese" has long borne a foremost reputation, and the finest samples of it have often commanded from 10s. to 20s. per cwt. more than the best ordinary cheese made in any other county in the kingdom.

With regard to the making of Leicester cheese, a farmer of the county, of wide experience, wrote to us as follows:—"There is no regular course to be laid down, as almost every dairymaid has her own method, scarcely two carrying out in detail exactly the same system; the milk from different farms, owing to some difference in the herbage, requires different treatment both as regards the heat of putting the milk together and also the curing, some dairies requiring more salting than others. My idea is that a true and successful make of cheese depends on putting the milk together at its proper temperature, extracting all the whey, and well curing without over-salting, yet with all these being properly carried out it does not follow that fine cheese is the result; this depends on the herbage from which the milk is produced."

The usual method of making Leicester cheese is as follows:—In spring and autumn the temperature of the milk when set for coagulation is 80° to 84°, but in summer not higher than 76° to 78°, and sufficient rennet is added to cause coagulation in about an hour and a quarter, more or less. The curd is then slowly and carefully broken down, so as not to bruise it and liberate the butter, and after the curd has had time to settle down to the bottom of the vat a process that generally takes about twenty minutes, the whey is either ladled off or run through a tap in the bottom of the cheese-pan,—if it has a tap; in very cold weather the whey and curd are in some cases heated up to 80° or

84°, after the curd is broken. The curd is then gathered into a cloth, is pressed and broken several times until the whey is removed, and before it is finally vatted for press from 2 to 4 ozs. of salt are mixed with the curd of each 40-lb. cheese, in order to make sure that it is cured. The cheese is after a time turned and dry-clothed, and when it has been twenty-four hours in press is well salted on the outside, a process that is repeated each day for four or five days; the cheese is then well washed in warm whey or greasy water, and put on the shelf to dry. The ripening usually takes six or eight months, and a fine-quality, well-made Leicester cheese improves by keeping twelve months.

The quality of a fine Leicester cheese is always very superior; the flavour is rich, clean, full and nutty; the texture is mellow, not close or dry, flaky rather than waxy, and fairly moist; it is a very "meaty" cheese, and rich, and the flavour left on the palate after tasting it is very agreeable; in diameter it varies from 16 to 20 inches, and it is usually 4 to 5 inches thick. The excellence of the cheese does not rest on any uncommon richness in butter, for in this respect it is not superior to most other kinds of English cheese, but on some occult property communicated to it by the peculiar herbage of the county; there is a fullness of flavour about it, a meatiness, a warmth and wealth of quality, that reminds us of fruit that is produced from a rich soil and ripened in a genial climate.

In reply to the question, "What kind of land do you consider most suitable for making finest Leicester cheese?" one large dairy-farmer writes to us: "Low-lying land, having a cold marly subsoil, and showing a growth of rushes in the furrows." And another says: "It is a known fact that cold grass land, *showing a few rushes*, generally produces the finest cheese."

It has no borrowed qualities, no peculiarities attained by a special system of manufacture or of ripening; it is a plain and substantial article, thoroughly English in character, and undoubtedly superior to every other kind of cheese similarly produced. It may be said, however, that South Derbyshire cheese—the best of it—approaches very closely to fine Leicestershire. Again, a fine Peak country cheese, made on limestone land, need not shrink from comparison with the others.

Stilton.—In some respects the most famous of our different kinds of cheese, prized highly among the "upper ten" and by epicures everywhere, unique in shape, in flavour, and in quality, Stilton is yet one of the most modern of English cheeses. Not much over one hundred and thirty years old, it has attained a celebrity, at once singular and extensive, that is not enjoyed by any other kind of cheese made in this country or elsewhere.

In Marshall's "Rural Economy," published in 1790, it is said:—"Mrs. Paulet, the first maker of Stilton cheese, being a relation or an acquaintance of the well-known Cooper Thornhill, who kept the 'Bell' Inn at Stilton, on the Great North Road from London to Edinburgh, furnished his house with cream cheese which, being of a singularly fine quality, was coveted by his customers, and through the assistance of Mrs. P. they were gratified at the expense of half-a-crown a pound; but where the cheese was made was not for some time publicly known, hence it obtained, of course, the name of Stilton cheese. At length, however, the place of produce was discovered, and the art of making it learnt by other dairywomen of the neighbourhood. Dalby first took the lead, but it is now made in most villages about Melton Mowbray; and in Rutlandshire many tons are made every year, and the sale is no longer confined to Stilton."

In Pitt's "Agriculture of the County of Leicester," published in 1809, the author speaks as follows of Stilton cheese:—"This is, I believe, the richest and highest-priced thick cheese of British manufacture; it is made in most of the villages about Melton Mowbray, and sold at the principal inns in the county, to accommodate their customers. The price, like other cheese, is subject to fluctuation, but seldom, I believe, so low as 1s. per lb. or more than 1s. 6d. The first cheese of this kind is said to have been made by Mrs. Paulet, of Wymondham."

The following is given as the best receipt for making it at that period :—"Take the milk of seven cows and the cream of the same number; heat a gallon of water scalding hot, and pour it upon three or four handfuls of marigold flowers that have been bruised a little; then strain it into a tub to your milk, and put some rennet to it, but not too much, to make it hard; put the curd into a sieve to drain—it must not be broken at all, but as the whey runs from it tie it up in a cloth, and let it stand half an hour or more; then pour cold water upon it, enough to cover it, and let it stand half an hour more; then put half of it into a vat 6 inches deep, and break the top of it a little to make it join with the other; then put the other half to it, and lay a half-hundredweight upon it, and let it stand half an hour; then turn it and put it into the press, and turn it into clean cloths every hour the day it is made; the next morning salt it, and let it lie in salt a night and a day; keep it swathed tight till it begins to dry and coat, and keep it covered with a dry cloth a great while. The best time to make it is in August."

Modern Methods of making Stilton.—The following are the details of modern Stilton cheese-making, as stated by a practical maker :—

1. To make a fine rich Stilton, suitable land must be found on which to graze the cows; and to be suitable it must be rich *old* pasture, such as will keep them strong, full of milk, and healthy, without extraneous help in the form of cake, corn, grains, or roots, all of which tend to spoil either the flavour or the quality of the cheese.

2. There are only the months of May, June, July, August and September in which really fine Stiltons can be made, and in wet seasons the making should not commence before the middle of May.

3. Suitable vessels must be procured to "put the milk

together" in, to drain the curd, to "make the cheese up in," etc.—cans, cheese-pan, curd-drainer, strainers, hoops, stand-drainers, shelves, etc.

4. The cows must be milked at fixed intervals, that is, at 5 a.m. and 5 p.m., *regularly*; this is important, as it is considered necessary to the production of cheese even in size.

5. The night's milk, being brought home, is put into a "lead" to stand all night; when the morning's milk comes in it is put into the cheese-pan, and into it is put the cream of the night's milk, and both are stirred up together; when the mass has got to its proper temperature, 83°, rennet made from calves' stomachs is poured into it, the quantity of the latter being governed by the quantity of the milk in the pan; if the quantity and strength of the rennet are right, the curd will "come," ready for the second process, in one hour.

6. The curd is then broken up very little, and left to stand, say, for ten minutes; it is next put into "leads," covered with cloth strainers, to allow the whey to drain away gradually, and as it drains the ends of the strainer cloth are gradually brought together and tied closer and closer, until the curd becomes tolerably firm and dry; it is next placed in a large tin strainer, and is cut into square pieces. In this form it remains until, in the opinion of the maker, it is ready to put into the hoops.

7. Before being put in the hoops it is broken into small pieces; then it is put in, first a layer of curd and then a sprinkling of salt, until the hoop is full (care being taken that the salt does not get to the ends or sides of the cheese), and it is lightly pressed down in the hoop. Too much or too little salt is equally injurious to the cheese, and a knowledge of the right quantity to use can only be acquired by experience.

8. When in the hoop it is placed on the shelves of what is called the "drainer," on clean dry cloths, and is turned "other end down" two or three times a day. This process

The Hartington Stilton Cheese Factory: Bringing in the Milk

goes
the h
show
occup
and v
9.
bound
of the
the cl
wet an
as thr
This
cases,
10
taken
cheese
later
at an
" mite
shelf t
and a
of the
which
The
centur
lb., and
district
the Le
in man
other c
deal of
only, a
pasture
have th
not the
hard an
not ripe

goes on until the curd is sufficiently compact to turn out of the hoop, which is generally at the time when the cheese shows signs of being smooth on the surface. The time occupied in this process depends entirely on the temperature, and varies from four to eighteen days, and perhaps longer.

9. After being taken from the hoops the cheeses are bound up in linen cloths that are broader than the height of the cheese, and long enough to go round it in each case; the cloths are attached with "cheese-pins," and as they get wet are repeatedly changed for dry ones—sometimes as often as thrice a day, until the coat of the cheese begins to form. This process requires much labour and attention in many cases, for on it depends the form and shape of the cheese.

10. When the cheeses are ready, the binders are finally taken off; the cheeses are then placed on shelves in the cheese-room, and are for a time turned over twice a day; later on, once a day will suffice. The room should be kept at an even temperature. When the cheeses show signs of "miteing" they should be daily brushed and changed from shelf to shelf; the brushing opens the pores of the cheese and admits the dry air, thus promoting the development of the fungus called "blue mould" (*Penicillium glaucum*), which is so highly prized in Stilton cheese.

The demand for Stilton cheese three-quarters of a century ago was so great that it sold readily at 1s. 2d. per lb., and it was made in many places in the Melton Mowbray district. It is still made at the present day very largely in the Leicester district, and so-called Stiltons are being made in many cheese-making districts in England, and in various other countries. The consequence is that there is a great deal of cheese sold that is Stilton in name and appearance only, and produced far enough away from the grand old pastures of Leicestershire. Many of these putative Stiltons have the brittleness but not the softness, the mouldiness but not the rich and buttery ripeness of the real ones; they are hard and unyielding, not mellow and plastic, and they do not ripen so generously as the true Stilton. Nor is this by any means always owing to faults in making, but chiefly to the lack of double cream, and to the absence of certain peculiar properties which, some persons say, are not to be found elsewhere than in the Stilton district.

A Stilton Cheesery in Derbyshire.—More than a third of a century ago the Duke of Devonshire had a factory built at Hartington for the making of Derbyshire cheese, and for the good of his tenantry around; and a quarter of a century later the whole establishment was taken over by Mr. J. M. Nuttall for the making of Stilton cheese. Under Mr. Nuttall's capable control the new line of work has been an ever-growing business. Milk produced on farms within about three miles or so is bought under contract for each season beginning with April and ending with September. Grass-fed milk is best for Stilton, and fodder-fed milk is turned into Derbyshire cheese unless it is wanted for the milk trade at a paying price. For the season of 1911 the quantity of milk received was 136,482 gallons, and the number of Stilton cheeses made was 8,074. Of these cheeses more than three-fourths were sold and gone before December came in, and the rest bespoken for the most part. This result is a tribute to the popularity of Hartington Stiltons. During the season the whey was used, with corn *ad lib.*, in fattening more than 200 well-favoured pigs, all young, plump, and of medium weights.

The making of imitation Stiltons in other districts and countries has kept down the price of all kinds but the very best, and these are generally secured for customers to whom price is a consideration of secondary importance. A true Stilton, well made and thoroughly ripe, is not always mouldy inside when it is cut, but it is always so mellow that it will spread on the bread and melt on the tongue as if it were so much butter. The cheese most nearly resembling it, according to our taste, is a really good Cotherstone, but there is no cheese made in any other place or country that can be compared, without suffering in the comparison, to a fine old Stilton—a double cream Stilton.

The Hartington Stilton Cheese Factory

fac
eve
and
Che
hav
any
cou
che
Son
tise
cou
rega
evei
chee
doul
far
its c
or w
bran
D
butt
made
parts
adop
until
very
this
veiny
of goo
veiny
by son
cheese
princi
many
larity
day,

Southern Counties.—One of the most interesting facts connected with English dairy-farming is that in almost every county is found a different system of cheese-making, and in some counties there are several systems in vogue. Cheshire and Derbyshire are, perhaps, the only counties having a system peculiar to themselves in which there is any approach to uniformity of method throughout either county respectively. Even the famous Cheddar system of cheese-making does not prevail throughout the whole of Somersetshire, though it is the most general system practised, and it has established itself more or less in most other counties in the kingdom where cheese-making can be regarded in any sense as a special feature. Somerset, however, has a world-wide reputation on account of its Cheddar cheese-making; Dorset is famous for its butter; single and double Gloucesters have made their native county known far and wide; and Devon is everywhere celebrated for its cream; but with these exceptions few of the southern or western counties are specially famous for any particular branch of dairying.

Dorset.—Dorset is chiefly known on account of its butter; there is, however, a considerable quantity of cheese made in the county, some of which is very good. In some parts of the county the Cheddar practice is wholly or partially adopted; in others the milk is skimmed time after time until nearly every particle of cream is got out of it, and very poor cheese is made from what is left in the milk—this is the "all skim" cheese. But there are the "blue veiny" and "double Dorset" cheeses, and these are usually of good, sometimes of excellent quality. A really good "blue veiny" Dorset resembles a ripe Stilton in appearance, and by some it is preferred to Stilton. The system of making the cheese has not changed in any material sense, so far as the principle is concerned, but the methods employed are in many cases carried out with more care, system and regularity than they formerly were. The cheese is made once a day, generally speaking; but where butter is the leading product, and the milk stands a longer or shorter time to cream, the cheese is a matter of minor importance, and is not always made daily. There are no special features in the process to call for remark, and Dorset cheese-making has not been formulated into a system and promulgated as a guide for other counties.

Wiltshire.—The principal dairying district in Wiltshire is on the western side of the county, bordering on Somerset and Gloucester, and running along from Warminster, by Trowbridge and Chippenham, to Swindon, over a fairly level tract of country, some ten or twelve miles in width and forty or fifty in length. From this district a large quantity of milk is sent daily to London. Where cheese is made in farm-houses in Wilts, it is usual to make it once a day only, and that in the morning. The evening's milk, after being denuded of a portion of its cream for butter-making, is mixed with the morning's, and the two together are, if necessary, raised to 80°, at which temperature the rennet is added in sufficient quantity to coagulate the milk in about an hour. The curd-breaker, similar to that in use elsewhere, is then used very gently. When the breaking is done the curd and the whey are heated up together to 90° or so, according to the weather, and kept in motion by the breaker. The curd then remains at rest until it is firm enough to handle, when it is taken out of the whey and put to press; it remains in press for some twenty minutes, during which the remaining whey is escaping from it, and it is then taken out of press, passed through an ordinary curd-mill, and salted at the rate of about 2 lb. of salt per 112 lb. of curd. The press vats are commonly turned out of a solid block of wood, the bottom pierced with holes for the escape of the whey. The following day the cheese is taken out of the press, salted on the outside, swathed in a dry cloth, and put back to press; this process is repeated a time or two on succeeding days, after which the cheese remains in press for about a week, but receives no more salt, and is then removed to the cheese-room, where it ripens.

The Wilts "truckles" are cheeses that have obtained a certain reputation. They are usually about 9 inches deep and the same in diameter, and are not uncommonly called "loaves." August is considered a favourable month for making them, but in some dairies they are made all the year round. They are very apt to bulge out at the sides if they are not skilfully made; and as very few people know how to make really good ones, they are mostly made in the autumn months, as there is less probability of their losing shape at that period of the year. It is considered necessary, in making these cheese, that the curd should be quite sweet, and this is the chief cause of the liability to go out of shape in ripening, because the sweeter the curd the more the fermentation in the cheese as it ripens. Before vatting the curd it is made as dry as possible; that is to say, all the whey is got out of it; it is then thoroughly crumbled, firmly pressed into the vat by the hands, and usually remains in press four or five days, being turned every day and repeatedly salted on the outside. These cheeses are then taken to the cheese-room, bandaged for a time to maintain the shape, and are ready for the table in about twelve months.

In some of the southern counties, it is a common practice for the farmers to let the cows for the season to a dairyman, who pays a stated sum per cow, and makes the best he can of the bargain. The dairyman and his family usually milk the cows, and the season terminates at a given period. In other cases the farmer hires a dairyman to do all the work connected with the dairy, paying a given sum per cow per week or for the season, and retaining to himself the control of the products of the dairy, the manager being responsible only for the proper management of the cheese- and butter-making.

Dairying in the North.—None of the counties north of Derbyshire, Cheshire and Lancashire have obtained a special or distinctive reputation in either cheese- or butter-making. Much good cheese and butter are made in the northern half of England, but it contains no district or county that is famous on account of its cheese in the sense that Cheshire, Leicestershire, and Somersetshire are, nor is there one whose reputation for butter is equal to that of Dorset.

In the vale of the Tees, in Yorkshire, Cotherstone cheese is made, and it is highly esteemed in its native county, beyond which its reputation has not far extended; that reputation is, in fact, to a great extent a borrowed one, for the cheese is an imitation of Stilton, and, though it possesses various merits of its own, it sometimes resembles Stilton very closely indeed. Similar attempts to imitate Stilton cheese have been made in various parts of the country, but they have not all met with encouraging success. Minor differences in milk, which at present are not well understood, are believed to cause variations in cheese, even though the same process of manufacture be employed; it is not that the milk is poorer, or that less skill is used in making the cheese, but that some property is absent which prevents absolute fidelity of imitation.

The dairying of Wensleydale, a district in the North Riding of Yorkshire, was thus described by the late Mr. W. Livesey :—" The cows, when in the old pasture land, are milked in the fields, standing most quietly during the operation. Thus the animals have never to be driven to and from shippons, as in Lancashire. The milk is carried to the farmhouse in a way I have never seen elsewhere. Here they have large tin cans, or 'kits,' called 'budgets,' of various sizes, generally holding from 4 to 6 gallons; they are much the same shape as some cans used in carrying milk by rail, except that one side is made concave in place of convex, so as to fit the back of the carrier of the milk, who has it fixed by strong leather straps, exactly after the plan of a soldier's knapsack.* The milk is thus carried various distances, just as the pastures or meadows are relatively situate to the farm-house. Some are distant above a mile.

*In Switzerland the use of such milk-kits, very similar to those in Wensleydale, is widespread.

To a stranger it is a novel sight, morning and evening, to see the men flitting about with their 'budgets' on their backs, and more singular still to see a few females laden with them, for the thrifty, hard-working women shoulder their loads like men, and show what they can do in the dairy line.

"There are two modes of making cheese here, which are still distinguished by 'the new way' and the 'old' one; though the 'new' has been now practised for about twenty years. This 'new' method is the simplest and shortest one I have ever seen. Whether it would answer in cheese of larger size I cannot tell; I doubt if it would. The small cheeses here made after the 'new' mode (those I have seen) are of good quality. I ought to state that the largest cheese made here is less than 20 lb. weight; the bulk I have noticed vary from 10 lb. to 15 lb. each; some are as small as 4 lb. and 5 lb., for cheeses are made here from a dairy of five, four, or three cows, and sometimes even from one. These small cheeses are not deep, like the little 'truckles' of Wiltshire, but *flat*-shaped, except where they copy the *very deep* Stiltons. Generally the dairy consists of seven to ten cows, but a few run up from sixteen to twenty cows. So wedded are the people to small-sized cheese that in the largest dairies they will make the milk into three cheeses per day, where in Lancashire it would be made into one. At a farm I called at, where seven cows were kept, two cheeses per day were made. They do not use a large cheese-tub, as in Lancashire, for curdling the milk; this is done in the 'cheese-kettle.' The 'kettle' is a large brass or copper pan, exactly like those used in Lancashire for heating the whey. In some few cases the kettle is of tin.

"The night's milk is passed through the sieve into the kettle, where it remains until morning, when it is placed upon the fire to heat. When got to the proper temperature it is removed and placed upon the floor, and the morning's milk is run through the sieve into the kettle, mixing with the heated night's milk. In the large dairies, where the kettle will not hold all the milk, a small tub is also used, and there two persons can be employed in making the cheese at the same time. It is strange what various provincial terms are used for the same article; for instance, what is generally known as a 'vell' is here called a 'keslop,' and in Lancashire a 'bagskin.' Again, while the rennet is known in the latter county as 'steep,' here it is called 'prezzur'! I once took an intelligent Scotch farmer to one of our choicest Lancashire dairies, and after he had thoroughly questioned the maker as to the various processes, he exclaimed, 'Oh, my, my! it's aw done b' the rule o' thumb!' In other words, *all by guess-work*. Here they say they 'mak um b' th' greap,' which, explained, means by the feel—testing the heat of the milk and the state of the curds by the hand. The 'prezzur' is made either every day or alternate days, by cutting a piece from off two or three 'keslops,' and letting it stand about twenty-four hours in cold water which has been previously boiled. It is made in a pint mug or cup, and its strength is, of course, *guessed at*.

"The 'new' mode of making is shortly as follows: The night's milk being heated in the 'kettle,' and the morning's milk added to it, the pint of 'prezzur' is poured into it and well mixed. It then stands from about half an hour to three-quarters to coagulate. It is then very gently broken up by the hand into very small pieces. At some farms a breaker is used made of wire crossed as in a riddle, something like the Lancashire breaker; but the shape is circular, and they are of very small size. They have not an upright handle, but a part of the outer wire rim is drawn out and bent, so as to form a short handle. In the breaking by the hand the movement is, of course, *upwards*, but by the breaker it is downwards. The breaking, which occupies about *an hour*, being over, the whey is removed by ladling it off. Then the curds are placed in a circular tin about 11 inches across and about 4 inches deep, the sides and bottom of which are very full of perforated holes about the size of the bore of a large quill. The tin full of curds is then left to drain for about three hours, when it is reversed and left for three more hours; then its contents are transferred to the cheese-vat, put to press, and kept there for nearly twenty-four hours, after which it is floated in 'pickle' for three days, just the same as the system of 'bringing' in Lancashire. I got the maker to test for several days the temperature at different stages, with the following results:—

Heat before curdling	95° to 98°
Heat after adding hot whey	94° to 97°
Heat when vatting	64° to 69°

The maker stated that in summer the temperature at curdling was kept lower than at this date (October 20), it being, in the warm weather, set to coagulate at the same heat as the milk stood when brought from the cow. The pickles or brines are made on the customary plan in Lancashire—boiling the salt in water, the liquid when cold being made the strength that an egg will float in it. A little dry salt is placed on the top of each cheese as it floats in the pickle, and this, melting, gets mixed, and so keeps up the strength of the pickle to the original standard. All these cheeses are slightly coloured by the use of cake annatto. The climate here is low in temperature, with a very large rainfall, and, the cheese-rooms not being heated, the cheese is kept colder than in any other county in England or Scotland where I have travelled. Up to fog-time the cheeses are kept a week in the cool room, where they are pickled, and then removed upstairs to ripen; after the period named they are, in some places, kept for a short time upon a shelf which is suspended from the ceiling of the kitchen and about the middle of the apartment.

"Now for the 'old' mode, at which I assisted in making a cheese from the milk of five cows. The night's milk being heated in the 'kettle,' the morning's milk—which stood at 82° before it was poured out of the 'budget'—was added, when the whole contents of the kettle were 102°. The maker 'b' th' greap' found it was too hot, and so added some cold water, remarking, 'You see the cheese will be no poorer, for this [the water] will all go into the whey.' This reduced the milk to 100°. A pint of 'prezzur,' together with the piece of 'keslop' which had been used in making it, were put into the milk, which was well stirred to secure a thorough mixing. It was covered over with the wooden lid of the 'kettle,' and left to stand thirty-five minutes, the temperature of the place being 40°. When beginning to break up the curd with the hand, I found the contents of the 'kettle' had got down from 100° to 89°. The breaking-up occupied half an hour, when the maker, having previously put a pan of whey upon the fire to heat, poured it upon the broken-up curds, and brought up the heat again to 100°. She remarked that at this cold season of the year it was needful to keep up the heat of the curds higher than in summer; otherwise, in place of feeling 'sharp,' they got to be pasty, and stuck in the curd-mill.

"The broken-up curds remained to settle for about three-quarters of an hour, when they stood at 90°, and the whey was removed in the manner before named. The curds, which were then at 82°, were put into a cheese-vat, which was lined with a dry cloth. After standing for about half an hour to drain in the cheese-press, with a light weight applied, the mass of curd had got down to 65°. It was then cut up into small lumps, and replaced in the vat with a dry cloth, where it was again placed to drain, and this process was afterwards once again repeated, about two hours having been occupied from the time the curds were first put in the vat. At length the mass of curds was cut up and ground in the curd-mill, the heat of the ground curd being 55°. They were finally vatted into a Stilton-shaped vat, and placed in the cheese-press, remaining there for nearly twenty-four hours. At the expiration of that period the cheese has a stout calico bandage stitched upon it, when it is put into pickle, where it remains three days. When taken out of pickle it is not washed either in cold or warm water, but simply wiped dry with a cloth. On a subsequent day I had the curiosity to weigh the milk and weigh the cheese produced from it after it came out of the press; the weight of the milk was 91½ lb., that of the cheese 10 lb. 14 oz.

"This result agrees, I may point out, with those of many tests. I may quote one Derbyshire cheese-factory. In May, June, July and August the weight required for 1 lb. of cheese ranged from 10 lb. 4 oz. to 10 lb. 1 oz.; in September, 9 lb. 8 oz.; and October, 8 lb. 10 oz. Another maker on the 'old' mode, but who makes them the ordinary shape (not deep, as the Stilton shape), lets the curdling of milk occupy nearly, and sometimes quite, an hour, and the time from breaking up to putting it to drain in vat alone another hour; and she lets the draining and cutting up and redraining of curds occupy four to five hours. Though the cheeses are only about 12 lb. weight, she presses them for forty-eight hours, and keeps them in pickle three days. The temperature at which she operates now (October 20) is as follows: Settling to coagulate, 98°; commencing to break up, 90°; placing to drain, 80°; final vatting after grinding, 60°. It will be noticed that no hot whey was used by this maker. Though the Wensleydale cheeses are so small, and the ordinary shape rather thin, yet most makers keep them in the press for forty-eight hours. I find that a very great majority of the dairies are made on the 'old' method and of the flat shape."

In the adjoining county of Lancashire, cheese-making is an important but not a very prominent branch of agricultural industry; the immense population of the county provides a constant demand for fresh milk and butter, so that although a large number of cows are kept in the county the milk of but a comparatively small proportion of them is used in cheese-making. But in the fertile district known as the "Fylde" country, lying north of the Ribble and adjacent to the sea, a good deal of cheese is wont to be made.

Lancashire Cheese.*—The foundation of success in

* By Miss Knowles, Chief Teacher of Cheese-making, Lancashire County Council Farm, Hutton, Preston.

making Lancashire cheese—as in most hard varieties—lies in the condition of the mixed milk when the rennet is added, not only with regard to quality and purity of flavour, etc., but more especially to its ripeness or amount of lactic acid present. The acidity should not be perceptible either to taste or smell. From 19 to 20 per cent. of acid is desirable.

Where the cheese-maker has the control of the milk from the time it is drawn, the most satisfactory results are obtained by carefully and systematically regulating the temperature and setting of the evening's milk, with a view to finding it just ripe enough next morning. A fall of temperature during the night to 60° or 62° F. usually works well, although some milks require to be higher, and others lower in temperature.

Much depends on (1) quantity of milk and depth of setting; (2) temperature of dairy and rate of cooling milk; (3) quality and nature of the milk.

Generally speaking, the night's milk should be cooled in summer to 68°—72° F. directly it is drawn; then during the later months, when the dairy is colder and the supply of milk usually less, natural cooling is all that is required—i.e. the milk is strained into the vat and left to cool gradually. If winter cheeses are made, deeper setting is to be recommended.

Excellent cheeses can be made by having the night's milk cooled more efficiently, and then getting the acidity by means of a "starter" added to the mixed milk in the morning; but this method, unless carried out either by trained or experienced workers, is liable to give results which are far from satisfactory.

The evening's milk is sieved into the vat, and aerated well by stirring; the temperature both of the dairy and the milk is taken at a later hour at night. In the morning the temperature is again noted, then the cream, in summer, is well stirred in among the milk from which it has risen. In cold weather, or when the cream is thick, it is skimmed off, heated to 110° F., and strained into the vat again; then the new milk is added, and the temperature regulated.

Temperature of Renneting.—The temperature of renneting is about 80° F. in summer, rising gradually to 86° F. or so in the colder months of the year, when, as a rule, the supply of milk is reduced in quantity but increased in quality, and the dairy is cooler; where, however, the dairy is heated and the supply of milk is kept up, little variation in the temperature of renneting is necessary.

Once the maker has grasped the idea of what consistency and type of finished curd is required, it is desirable to regulate the renneting temperature with a view to obtaining such a curd. There is in this system no scalding or heating of the curd after cutting, hence careful attention is given to the temperature of the milk when rennet is added. Too high a temperature causes the curd to be tough or hard, with probable loss of mellow quality and of open texture in the cheese. On the other hand, too low a temperature gives too soft a curd, which is difficult to dry without loss of solid constituents—fat and casein.

Sufficient rennet should be used to produce a perfect coagulation in fifty to sixty minutes; one drachm to two and a half gallons of milk is commonly used. The rennet is diluted with water to assist in its equal distribution, and then is well mixed with the milk.

When the curd is ready to cut, it splits clearly over the finger, is fairly elastic, and considerably softer than what is reckoned necessary in a Cheddar curd at the same stage.

As the object of cutting the curd is simply to facilitate the removal of the whey without any heating of the curd, one need only use the vertical knife for the purpose of cutting the curd. For all that, however, there is no reason of much consequence why the horizontal knife may not be used in addition.

The cutting of the curd is carried out carefully and somewhat slowly at first, the knife being drawn alternate ways of the vat, until the curd is in cubes of about the size of small beans. The vat is then covered over with a cloth, after the curd has been loosened from the sides by hand. The acidity of the whey at this stage is ·13 to ·135 per cent.

Pitching.—The curd is left to "pitch" or "settle" in the whey for twenty minutes, or until the acidity is ·14. During pitching the curd sinks considerably in the whey, and becomes firmer; then the whey is drawn off. Dealing with a very large quantity of milk the acidity at this point may be rather less, and for small lots of milk rather more.

Draining or Drawing off Whey.—The whey should be drawn off with the least possible bruising of the curd; during the process it should become clearer and greener in appearance.

Working with the cylindrical vat, which is mostly used in Lancashire, the weight of the curd in itself is sufficient to force out the moisture. About one-third the circumference of the cylinder consists of a perforated lid; when this is fixed on, the whole revolves bodily inside the outer casing of the vat, through which the whey passes. During draining this cylinder is turned half-way over, first to the right and then to the left, thus throwing the curd into a sloping position and giving pressure. With either a round or square open vat a canvas cloth is placed over the curd when the sieve is put in, and racks to fit the vat are then put on; later on, as the still exuding whey is being drawn off, weights are added, and increased as the curd becomes firmer.

The curd is lifted with a shovel from the sides to the centre of the vat, and re-pressed several times during draining. As soon as the curd is firm enough to lift by hand when cut into squares, it is transferred to a lever press or drainer. The acidity of whey at this stage is ·15 per cent.

Drying the Curd.—The complete drying of the curd is accomplished by means of pressure, combined with the breaking of the curd and a slight increase of acidity. The pressure is applied gradually; every twenty minutes the curd is opened out and either cut or broken into pieces about 3 to 4 inches square, then covered over and pressed again. These breakings are repeated from three to five times, the actual number depending upon the quantity of curd in the drainer and its condition when first put in. When the curd is dry, it is somewhat short and tender in texture and practically sweet to taste and smell. The acidity of the whey when draining from it usually shows from ·2 to ·24 per cent.

Practical observation is necessary to determine the proper dryness of the curd. If the acidity is developing too quickly during drying, the time between the breakings should be shortened, and the pressure put on sooner and more heavily. If it is too sweet, rather longer may be allowed, but it is not advisable unduly to prolong the drying period, even if short of acidity, as the curd is liable to become "hard." It is better to rectify the deficiency either by putting less new curd into the cheese, or, when dry, to open out to cool and acidify for some time before grinding. In that case what is left over for old curd should be kept warmer than usual.

Method of Acidifying Curd.—One particular quality possessed by Lancashire cheese is a remarkable mellowness, and a consequent capacity for being a good "toaster." This is partly brought about by what may be termed a system of natural acidification of the curd.

After being made as described the curd is cut into blocks, put into mugs or tins, and kept in a room heated to about 60° F.—the first day's curd for forty-eight hours, and the next for twenty-four hours. This is called "old curd." The curd ripens naturally; during the process there is a gradual reduction of temperature and an increase of acidity, especially in the first twenty-four hours.

During ripening the curd is left standing in whatever whey drains from it after being put into the mug. The acidity of the drainings from the two-days-old curd is usually about 1·55 per cent., the temperature of the curd being about 60° F. The whey from the one-day-old curd shows about 1·3 per cent. acidity, and the temperature is about 62° F.

The condition of each curd, after being passed through the mill, may be described as follows :—

Two-days-old curd is soft and mellow, yet granular, with a clean, acid, slightly cheesy smell.

One-day-old curd is much firmer and rather harsh to the touch, and distinctly sour.

On the third day these two curds are added to the new that has been made that day. A full-sized Lancashire cheese is about 50 lb. of curd, made in a mould 14 inches in diameter.

A good combination of acidities, with proportions of curd to use in making up the cheese, is :—

17 lb.	.. Two-days-old curd ..	acidity	1·55 per cent.
17 lb.	.. One-day-old curd ..	"	1·3 "
17 lb.	.. New curd ..	"	·22–·24 "

Grinding and Salting.—All the three curds are passed through the mill twice, thoroughly mixed in a vat, and salted in the proportion of 1 oz. salt to 3½ lb. of curd.

A simple method of mixing for small quantities is to pass all three lots of curd through the mill at the same time, together with the salt, allowing the curd to fall into the mould after the second grinding. In regular working, a part of each day's new curd is kept over, thus giving daily supplies of "old curd." Cheeses are then made up every day, the maker balancing the acidities and proportions of curd as much as possible.

Variations in Old Curd.—It is almost impossible to ensure the daily acidities of the different curds being as stated. This difficulty is overcome, and uniformity of product obtained, by varying the proportions of curd when making up the cheese according to the ripeness of it. For example, if the acidity of the two-days-old curd is, say, 1·65 per cent. and the one-day normal, then the new should either be made up sweeter, or else a larger proportion of it added to the cheese. The curds must also contain moisture corresponding to the acidity.

Moulding and Pressing.—The curd is put into moulds at from 68° to 70° F., and filled in loosely. The cheese is then left in the dairy or press-room (temperature about 60°) until the evening, when it is turned into a muslin cloth, put back into the mould, but not pressed until the next morning. Almost all the moisture has gone from the cheese before it is pressed at all, so that the main object in pressing is to form a crust and shape the cheese. For this, twenty-four hours' pressing is sufficient, although a longer time may be given.

From 15 to 20 cwt. pressure is applied to the cheese in the early morning, then in two or three hours it is turned into a fresh cloth, reversed in the mould, and put back to press with 20 to 30 cwt. pressure, for about two hours, or until the coat is formed. A muslin bandage, made to fit the cheese, is then put on, each end of the cheese being greased and covered with a circle of the muslin.

The cheese is again pressed with weights from 8 to 15 cwt. until the next morning, when it is turned out of the mould, dated, and kept in the dairy for a day or two until the coat and bandage are quite dry.

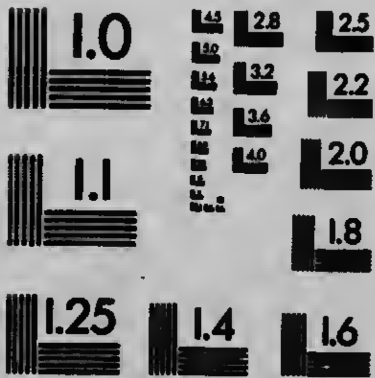
Finishing and Ripening.—As soon as dry the cheese is well greased all over with hot whey butter or lard. This prevents cracking and improves the appearance of the cheese. It is then taken to the ripening-room. During ripening the cheese should be turned every day, and rubbed over with a cloth occasionally. The temperature of the room should be as near 60° F. as possible. Lancashire cheese made as described is ripe enough for sale in a month's time, but will keep quite good for several months longer. If intended to be kept it is best to transfer it to a colder room. The time occupied in making the cheese is usually :—

Coagulation	50 to 60 minutes.
Pitching	20 to 30 ,,
Draining	50 to 60 ,,
Drying	1½ to 2 hours.

Or between 4 and 5 hours altogether.

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



APPLIED IMAGE Inc
1653 East Main Street
Rochester, New York 14609 USA
(716) 482 - 0300 - Phone
(716) 288 - 5989 - Fax

Scotland.—The broad lines on which Scottish dairy-farming is conducted differ in few if any respects from the systems in vogue in various parts of England and Wales, and we shall therefore have no need to enter at length into a description of them; it is sufficient to say that the Cheddar system introduced by Mr. Harding in the middle of last century has displaced most of the old systems of cheese-making. Scottish Cheddars, in fact, are possessed of a reputation equal to that of Cheddars made anywhere else. It may be said, indeed, that until the Cheddar system was established there, Scotland had not made any reputation to speak of as a cheese-producing country.

Messrs. C. F. Doane, M.S., and H. W. Lawson, M.S., M.D., American authorities, have compiled an interesting pamphlet called "Varieties of Cheese," in which nearly two hundred and fifty kinds of cheese are tabulated. Most of these are "soft cheese" of one kind or another, and some of them clearly resemble others so closely as to be identical except in name. But in any case there must be about two hundred different and distinct kinds of cheese made on this mundane spheroid.

CHAPTER XX

SOFT CHEESES

THE type of cheese that is characteristic of England is known generically as "hard" cheese, to distinguish it from another type called "soft" cheese, which is characteristic of Continental countries, more especially of France and Germany. Amongst the most famous of hard cheeses are the Cheddar and the Cheshire in this country, the Parmesan in Italy, and the Emmenthaler or Gruyère in Switzerland. The salient difference between hard and soft, so far as process of making is concerned, is that hard cheese undergoes pressure—for the most part heavy pressure—and that soft cheese does not. As a sequel thereto, the texture and solidity of the ripened cheeses differ much between the two sorts; but still the difference is in gradations which sometimes are not easily distinguishable between them. Certain soft cheeses really deserve the name, whilst others do not; and certain hard cheeses—to wit, the Leicestershire and the Lancashire—are so mellow and even free in texture as not to deserve the name of "hard" cheese.

We do not make any soft cheeses in this country that will compare with the famous Camembert cheese of France—a delicious cheese which with the Brie and the Roquefort constitute the triple crown of dairy products in that favoured country. The nearest we have—a long way different—is the little Rutlandshire cheese known by the name of Slipcote. This cheese is ripe when its skin, as in the case of the Camembert, will slip about on an inside which is of the consistency of treacle. But it is in the flavour that the Slipcote is so dissimilar from the Camembert. The colour, too, is disparate, and this is owing to the special and peculiar fungoid growth which must necessarily occur on Camembert cheeses, or they would not be Camemberts. Indeed, it is of root importance that, in the case of Camemberts, as in the case of all other kinds of soft cheeses, the special fungi that are necessary to develop the flavour for which these cheeses are prized must be present; failing their presence, the cheeses—whatever they may have been intended to become—will develop (or degenerate) into nondescript articles of food for which no one will cultivate a taste.

Several years ago, at one of our dairy schools, an effort was made to produce Camembert cheese, and with but ill success in the beginning. How to make it, so far as mere manipulation was concerned, was thoroughly understood, from the cow-shed to the curing-room. But the one thing needful above all others was wanting, viz. the fungus which, growing on the outside of French Camemberts, gives to the cheese its piquant and attractive flavour. Then the question of supplying the deficiency in this particular and indispensable thing suggested itself in this way: Can the fungus be promoted at will, anywhere? Well, yes; why not? For it was known that many curing-rooms in France were highly valued on account of long usage. This very quality of antiquity was a guarantee that such rooms were impregnated throughout—walls, ceiling, atmosphere—with the germs of fungi that were always ready to take possession of new cheeses that were daily brought into these finishing schools.

These fungi are aerobic, and apparently promote the ripening and flavouring from the surface to the inside. The ripening is mainly due to unorganised ferments or enzymes which are already in the milk before it is coagulated. In this it is the lactic ferment which, in almost all kinds of cheese, plays the predominant part. It is difficult, if indeed possible at all, to determine how far these fungi assist in the ripening, but in any case there is reason to infer that in developing a flavour—be it what it may—they occupy the chief place.

Camembert Fungi.—It was decided to test the theory that the peculiar flavouring and ripening were owing to germs or spores which the cheese-room at the dairy school did clearly not possess, but which there was ample reason to believe the well-known *chambres de fromage* in France do possess—a possession, indeed, which endowed them with an intrinsic money value.

A considerable number of Camembert cheeses were brought over from France, and were broken into fragments that were laid about the room on shelves, benches, window sills, and any other available places, in order that the spores might be liberated, and so impregnate the atmosphere of the place.

In a few days' time it was obvious that the spores had permeated the atmosphere, for they had taken possession of the raw, curdy cheeses, and in due time the true ripening was in progress,—a theory verified, a fact accomplished. There was no further difficulty in producing, with all the fidelity practicable in another land, a famous French tit-bit cheese from the milk of cows in England! Here was a new demonstration of the *entente cordiale*; for is not such imitation a flattering compliment?

It is consonant with this phase in the subject to remark that amongst English dairyers of old time it was an axiom that a newly built, or even a newly plastered cheese-room—one, or both together—was bad for ripening the cheese. The best ripening-room of long ago—long since mistakenly done away with—was under a thick roof of thatch, the lowest coat of which was a century old, or possibly two, with eaves projecting a couple of feet or more, a paradise for swallows to nest in! Through these thatched house-coverings of our forefathers, ancient non-conductors as they were, no winter's frost could penetrate, no summer's sun intrude. With windows carefully blinded, the only light inside was twilight in the day, and flies were outwitted all the time. The air of these rooms was redolent of ripening cheese which, having become sufficiently vaccinated in the making, so to say, with the undeniably necessary lactic acid bacillus for its ripening, took on an early tint of blue that was partly green, and deepened into a colour as the weeks crawled by. This blue mould on the outside—and inside, too—of most kinds of hard cheese that are well ripened is the *Penicillium glaucum*—the "blue-veiny" which is so much liked by English connoisseurs of cheese. Elsewhere—in France, in Germany, we ken not where beside—it is mostly a brown mould (the *Cladothrix dichotoma* of the bacteriologists); and other moulds of that ilk contribute a variety of tints and flavours to various soft cheeses on the Continent of Europe.

It is to one or other of these moulds that distinctive tints appear which should always be, and are, associated with well-made cheeses such as Stilton, Gorgonzola, Roquefort, Camembert, Brie, and so on; and to the same fungi in each and either case are attributable the attractive and singular flavours which constitute the special charm of those "tasty" items of food.

The British race have not, so far, developed any popular fancy for soft cheeses, even of French types; and certainly not for those of Germany, many of which are remarkable from several points of view. It is, however, not unlikely that the latter may possess some as yet not ascertained but potential merits from a pathological standpoint,—that is to say, as counter-irritants. But, so far as hard cheese is concerned, it may be taken that it is more consonant to the natural bent of our people.

Cream Cheese.—Cream cheese is the only one of all the soft cheeses that may be said to be known more or less well in every parish of England and Wales, and perhaps also in Scotland and Ireland, and in the rest of the British Isles. And this cream cheese is as essentially British as any other, and has its own unique individuality. But it has nowhere made itself predominant over the ordinary

Students in a Dairy School making Cream Cheese

I
e
f

—
is
ar
be
pr
in
di
fa
ho
Da
wh

qua
witl
to t
tabl
all-i
or o
is o
quali
class
2

hard cheese of any given county as a food. Indeed, it is less a food than a delicacy and a relish, but as such it is unsurpassed and unsurpassable in the regard of persons who have refined tastes in respect of soft cheeses.

However piquant and appetising the Continental soft cheeses may be, even the best of them—the Camembert—is not to be named at the same time as a fine English cream cheese for quality and for delicacy of flavour. Indeed, there is not in this wide world another kind of cheese equal in quality to a first-class cream cheese—not even a first-class Stilton—for it is made from cream alone, a distinction which, we believe, cannot be claimed for any other cheese here or elsewhere. At the same time, it is simpler and easier to make than any other can be said to be on ordinary farm-house lines.

Notwithstanding the simplicity of its making, however—perhaps, indeed, because of that very simplicity—there is nothing worth calling uniformity of method in the process, and it does not appear that any widespread effort has ever been made to establish a uniform system, beyond what printers' ink has done in that direction. The obvious and inevitable result all along has been that a lamentable diversity in quality and flavour is found to prevail. This fault is, however, diminishing, slowly perhaps, but we may hope surely, as an achievement of the Press, the British Dairy Farmers' Association, and the excellent dairy schools which are at work in various dairying counties.

It is still the case, think hopefully as we may, that the quality of the different makes of cream cheeses one meets with differs to an extent that borders on the incredible to those who know nothing about the cheese except on the table. This is a fact much to be deplored, for quality is all-important in respect to food which is at the same time, or ought to be, a delicacy and a treat in gastronomy. It is of serious importance, too, this common disparity in quality, because it discourages the consumption of this class of cheese, as, in fact, it also does in respect to all other kinds of cheese. It should be unnecessary to say that "quality" means proportion of butter-fat in a cheese. Condition is not in itself quality in that way, though it is a factor which should always be good—not bad, not even intermediate. The whole thing lies in a nutshell; what the public want in these things are quality, condition, complexion! And if these are there in good form, the question of price becomes to some extent subordinate.

But there has always been prevalent in dairying communities generally an unaccountable heedlessness about improvement of cheese-making. Such, at least, has apparently been the case up to the time when associated cheese-making stirred up the dry bones in the pastures of rural England forty years ago, since which time an era of progress and reform has been and still is upon us. In this prevalent search after betterment in dairying, the making of cream cheese has not been overlooked. It has for years been quite inexcusable that bad cheese should be found anywhere, and the fact that it is so found, and frequently, is to be attributed to the happy-go-lucky self-satisfaction which is so little a rarity in rural life.

We have often known good and even delicious cream cheeses to be occasionally made in the simplest way in farm-houses, by just putting a pint or so of good thick cream—cream that was merely beginning to thicken with the lactic ferment—into a piece of fine muslin and either hanging the parcel up to drain or putting it into a small wooden box that had many perforations through bottom and sides. No simpler than this can any process be; and it will be a success if the cream is all right. This is probably the oldest as it is almost certainly the simplest method extant in the making of cream cheese. And, given a clean, cool dairy, and good milk to raise cream from, it may confidently, so far as the product goes, prove about as good as any other system, though possibly not equally reliable in all seasons of the year.

Various Qualities.—There are various qualities of cream cheese in this country, here and there. The best of them may contain 40 to 50 per cent. of butter fat; the poorest of them are on an equality with ordinary soft cheese, and no better, perhaps no worse. The disparity lies in the proportions of casein and of butter left in the cheese.

Sweet Cream Cheese.—There are cream cheeses to be eaten fresh and sweet, and others for consumption when more or less acidified. For the former sort the cream is drained after twelve hours' rising, and is sent to market when it is firm enough to keep its form and shape squarely preserved. These cheeses are not ripened then, and are wanted by customers who like the dainty freshness of a sweet cream cheese.

Ripened Cream Cheese.—But where it is the custom to make the cheeses and to ripen them, the cream need not be so fresh, because incipient acidity is fermentation which sooner or later—generally in a very few days—ripens the drained cream. This incipient acidity was spontaneous until recently, and still is in many dairies, and it comes from the absorption by the cream, during its rising, of the lactic bacillus which is deposited upon it from the air.

Using a "Starter."—In advanced dairies nowadays, however, the great services rendered by well-regulated lactic ferments have been extended to the ripening of cream cheese, much to its well-being in due reason. In this process a "starter"—a preparation made from a pure culture of *Bacilli acidi lactici*—is mixed into the cream when the latter is at a temperature of about 60° Fahr. The quantity of "starter" to be used in a gallon of cream will depend on the potency of the ferment, but usually the proportion will be about 10 to 12 per cent. This will hasten the ripening and the firming or solidifying of the cheese, and will develop a piquant acid flavour which is admitted to improve the cheese as a food and a relish, and which may be claimed to be valuable as an internal corrective by those who like it. This latter merit cannot be claimed, save in a very modified degree, for the sweet cream cheese. And the difference between the two sorts, whatever it may amount to, is owing to the developed lactic ferment in the ripened cheese. A too early use of the "starter" will tend to coagulate whatever casein there may be in the cream, some of which might drain away with discharging moisture if time were given for it to do so; and so far as this may be true, the cheese is less rich in proportion of butter-fat when the starter is used at an early stage—a too early stage. It is on this basis, indeed, in one way or another, that cream cheeses having a comparatively large proportion of casein and a relatively small one of butter-fat are produced.

Richest Cream Cheese.—If the richest quality of cream cheese is being made, the cream is skimmed off with the least possible quantity of skim-milk in it; and it may be pasteurised if desirable and cooled in pails in running water down to about 60° Fahr., after which it may lie at rest for twelve hours, or longer still in a dairy which is exceptionally cool, but whose air is still impregnated with the lactic bacillus to some reasonable extent, and with no other bacilli intruding were it only within the limit of possibility to exclude them. In any case, indeed, it must be understood that bacteria, bacilli, microbes, germs—call them what you will—of some kind or other (possibly of several kinds) will be found in cream when it is skimmed, and the great desideratum is to include the one right kind—the lactic bacillus—and to exclude all interlopers, so far as may be practicable. There is one way of doing this—viz. to pasteurise the cream and, when it has cooled down to about 60° Fahr., to employ a "starter." In this way we start with a clean slate, so far as fermentative germs are concerned.

When the cream is sufficiently ripened it will be put to drain in a fine linen cloth, in order to get rid of such mere moisture as would be superfluous in a cream cheese, and this moisture drains away in the form of skim-milk, providing the cream up to this point has been correctly manipulated. The edges of the cloth will be brought together and overlapped, a board put on the cloth, and on the board a weight to expedite the outflow of the skim-milk. The weight if too heavy at first may cause not skim-milk only but actual cream to exude from the cloth. Later on, when the cream is becoming thicker, a heavier weight than the first—say 7 lb., or two weights adding up to 7 lb.—may be put on the board. In a few hours' time—say three or four—the cream will be ready to put into moulds that will form it into bricks for market, chiefly in what are understood to be quarter-pound or half-pound bricks.

Sweet cream cheeses are for early consumption, for after three or four days they are no longer fresh and sweet. They are, of course, delicious delicacies whilst still fresh. Ripened cheeses are, however, on the contrary, all the better for keeping a week or longer, according to the season of the year. The lactic ferment is a preservative, for it checkmates other ferments that promote decomposition in cheese of most kinds. Sufficient testimony is available to show that such is the case.

What is called "single-cream cheese" is made from cream which contains a much smaller proportion of butter-fat than that which is made into double-cream cheese. In quality, as denoted by proportion of butter-fat, this single-cream cheese is just an ordinary cheese, made from "full" milk but containing a much larger proportion of casein than the other; whilst the "double" variety is made from the richest cream obtainable—cream, for instance, from Channel Islands cattle—or from other cream that is skimmed within twelve hours of "setting," or from a separator which is regulated to take only the best of the cream.

Cream Globules.—It will be understood that the butter-fat globules in milk vary greatly in size, and the largest are themselves infinitely small. Dr. Fleischmann has calculated that a pint of milk contains more than forty thousand millions of them! Yet for all that they are not crowded, though closely associated, for it has been ascertained that between each two of them, in fresh milk, there is room for another to pass. The difference in average size of globules has been found to be as follows :—

In a surface drop	$\frac{1}{3150}$ of an inch.	
In a drop below	$\frac{1}{6640}$	,,
In one still lower	$\frac{1}{8300}$	,,

If these different qualities all rose to the surface about the same time in pan-setting of milk, there would be no chance of obtaining really rich cream for the making of "double" cream cheese. But they do not all rise with equal celerity, and this because they are not equally buoyant, and this again because they are not equal in size. The largest globules rise fastest and first, the medium ones next, and so on. It is the largest globules that produce what our American kinsmen called "gilt-edged butter"—a charming name !—away back in the last century, and it is such cream that is needed to make "double-cream" cheese. The churnability of this best quality of cream is much superior to that of weak cream whose globules are smaller than those of the better cream. It is obvious, therefore, that the breed of cows whose milk is more uniform as to the size of its globules than that of another breed, is the better breed of the two for butter-making, though it does not necessarily follow that way in respect to cheese-making. There are no other breeds quite equal to the Jerseys, the Guernseys, and the Devons for butter-making purposes, all points considered, and therefore for highest quality cream cheese, though we have other breeds of high merit,—to wit, the Red Polls and the Kerries, and two or three others not far behind.

Uniformity of quality and character, of flavour and looks, is of first-rate importance in cream cheese as in every other product of the dairy, and therefore regularity and system in dairy work are imperative necessaries if success is to be won and held. There can be no real ground to suppose that we in England, particularly in the Southern and the Midland Counties, cannot make French types of soft cheese successfully. It is all a question of "know how," as people say in the United States of America, because the French dairyers have no superiority of cattle or of soil, or even of climate, compared with what we enjoy, for cheese-making purposes. And he would speak with prejudice who were to declare that our English types of hard cheese cannot be creditably reproduced in France.

But with respect to soft cheese in England, even of our own specialised cream cheese—which is an intrinsically better article from a nutritive point of view than any cheese made in France or anywhere else, as a distinctive national production—the whole thing turns on the public demand for that class of cheese. With a small and variable market, production must be cautiously pursued.

Less than for hard cheese is the dairy accommodation needed for soft cheese-making. Old premises, if sanitary or susceptible of being made so, and especially if they have dry walls thick enough to keep out the heat of summer and the cold of winter, can readily and inexpensively be converted into dairy rooms for soft cheese-making. Failing such premises, the best of dairies can be run up quickly and at a light cost, of framework and matchboards; an inner lining of boards leaving a three-inch space between the outer and inner skins of the building. Three rooms are all that will be necessary, providing they are not too small—one as a making room, one as a preliminary ripening room, and a room in which the ripening is perfected. This latter room should have its floor a few feet below the level of the ground outside, in order to secure the coolness and dampness that are necessary in the advanced stages of ripening. Two rooms, indeed, with a cool and fairly damp cellar under one of them, might be easily and cheaply constructed. Temperature and humidity of the air of these rooms must need be different in either one from both the others, and all new beginners should have become trained to conditions the observance of which is necessary to success.

Small Holders and Soft Cheeses.—An agrarian transformation scene occupies at the present time some portions of the great and complex stage on which our national life in the Shires is being played. It is an amplification of Mr. Jesse Collings' famous "three-acres-and-a-cow" proposal, than which nothing more practical has hitherto been advocated. The difficulty chiefly incidental to small holdings where a cow is kept—or two or more cows—is so to utilise the milk as to avoid preventable loss of income. There is no room for loss on a small holding.

It would seem probable, therefore, that the small holder's wife may take up an important part in the management, if only she has had the necessary training. She may look after the wants of the cow, and turn the milk into marketable products, greatly reduced in weight and bulk as compared with the lacteal fluid itself. She may, for instance, turn it into soft cheeses, which will win plenty of custom and keep it, if only the cheeses are well managed and of uniform quality and condition. For this to be accomplished successfully a preliminary apprenticeship to such dairy work is undeniably a *sine qua non*, but anything approaching expensive dairy accommodation is not at all necessary however pleasant an equipment it may be. For all that, however, the retail disposal of milk at 4d. a quart may not easily be bettered as a source of money-making, if only there are customers in plenty around. But in milk-selling, as also in selling soft cheeses, continuity of supply is a point which demands serious and ample consideration.

Bath Cheese.—An erstwhile popular soft cheese in Bath no longer than twenty years ago lost the stimulating demand for it that formerly existed in that city of fashion, and simply became a lost art, a defunct industry. It was called a cream cheese, but it was not a cream cheese in the true sense of the word, as it is understood—and correctly so—in the current parlance of the dairy. It was simply a full-milk cheese, save when there was a demand for cream cheese, in which event the milk was skimmed and the cream was made into a soft cheese. What became of the skim-milk annals do not relate.

An effort is again being made to revive the old Bath cheese made from unskimmed milk, and it is to be hoped that success will follow. In these full-milk soft cheeses the whole foundation of popularity lies in the ripening. The cheese is a good thing in itself, but it must necessarily be appetising and winning on the tongue, if it is to captivate the fancy of the public and keep it. This the Bath cheese of old failed to do, but whether the fancy was lost through lack of skill in making the cheese, there is no record available to inform us. Well acidified by the lactic bacillus, this soft cheese could not fail of being useful not only as an appetising food, but as an intestinal corrective—a mild imitation, so far as the lactic ferment went, of the famous *Yoghourt* of Eastern Europe. The souring of milk or of cheese by means of lactic bacilli provides us with perhaps the simplest and best of medicines in Nature's glorious pharmacopœia.

Slipcote Cheese.—Perhaps we have only one other old-time established soft cheese to claim as an indigenous product of the English dairy, and that is the little Slipcote cheese of Rutlandshire. Yet have there been and still are sporadic cases of soft cheeses for local or family use being made; but none of these appear to have emerged from provincial obscurity. The Wissenden Slipcote has made a modest name for itself, and is regarded as a pleasant relish in the way of food.

This cheese is made from whole-milk, and is therefore not a cream cheese. The milk is coagulated by rennet in the usual way, and the coagulum is put into a strainer lined with a cloth, and it remains there, the moisture draining out of it the while, until it is nearly dry. Then enough of the curd to form one small cheese is taken from the mass, and placed in the bottom of a small dessert-plate, where it drains still more. When firm enough the little circular cheese is placed between cabbage leaves, which are changed daily until the cheese is ripe. This ripening takes three days or a week, more or less, according to the weather. The maturity of the cheese—its fitness to be eaten—is indicated by the interior turning into a treacle-like liquid, and then it is that its coat or skin becomes loose and exhibits symptoms of slipping off; hence the name, "Slipcote" cheese. More than any other English cheese the Slipcote is Continental in character; for all that, it is an original and not an imitation.

Camembert Cheese.—The most popular soft cheese in France is Camembert, as many people think; and France is, *par excellence*, the premier country of the world for soft cheeses. Ergo: Camembert is the most popular of soft cheeses, at all events on the Continent of Europe. We can hardly think, however, that it will ever become so in England, even as a home-made article. The gastronomic idiosyncrasy of Englishmen is, so far, overwhelmingly in favour of the hard cheeses to which they have been accustomed from time immemorial, and we may venture to say that it is only because of superior quality in our own cream cheese that our countrymen make an exception in favour of this one national soft cheese. And now it may be averred that when we buy a first-rate cream cheese—a cheese which to all intents and purposes is actually a cream cheese and not merely a soft cheese—we may seek in vain for any other cheese, made in this or in any other country, that will be equal to it in quality,—that is to say, in butter-fat proportion. And it may further be maintained that a fresh cream cheese cannot be surpassed or even equalled by any other kind in delicacy and purity of flavour and aroma, whilst a ripe one has a piquant acidity which serves to make the richness of the cheese only the more pronounced, just as a modicum of salt emphasises the flavour of butter, or of beef or mutton.

Camembert cheese is a relish which is greatly and deservedly appreciated, but its flavour borders perilously close on that of decomposition. It is not long at the zenith of toothsomeness, and will become repellent if kept unconsumed a day or two longer than it ought to be. It is also a "Slipcote" cheese, for it is only the inside and lesser half of it that is eatable, the crust being thick and covered with reddish fungi whose enzymes develop the singular flavour for which the soft and sticky inside is famous. The great waste of crust, from which it is difficult to detach all of the interior edible part of the cheese—crust which ought to be food but is not—makes the rest a somewhat expensive morsel. In this respect the English cream cheese may claim a great advantage, so far as economy goes, because there is not a scrap of it but what can be eaten with enjoyment. The Camembert is not a cheese that is rich in butter-fat, as cream cheese is, or Stilton, for it is commonly enough made in part of skim-milk, and at best is no more than a full-milk cheese. This attractive cheese, indeed, does not rest its claims to appreciation on intrinsic merit, but on a seductive and adventitious flavour which is really but an early indication of approaching putrefaction. For all that, however, a Camembert cheese in the pip of perfection is a relish for the gods! So, at least, think our good friends in France.

Milk that has been cooled and warmed again is considered unsuitable for Camembert of the best class. It is, therefore, received warm from the cow, sieved into wooden tubs with tightly fitting lids, and renneted at a temperature of 80° Fahr., or a little higher in cool weather. Rennet of a reliable and standard make is used in order that uniformity may result. Satisfactory coagulation is brought about by $\frac{1}{2}$ c.c. of rennet per gallon of milk in two to two and a half hours. Rennet is mixed with six times its own volume of water, so as to secure its even distribution throughout the milk, which for a time is carefully stirred in order to prevent the rising of cream until such time that it cannot rise in the thickening milk. This precaution is taken because the mould which grows on the crust of the cheese cannot do so satisfactorily if the cream appears thereon.

It is a practice not uncommon in Camembert dairies to utilise whatever separated milk there may be available where a portion of the milk produced is used for the making of butter, and the separated milk of one dairyer who makes butter only may be used by a near neighbour who makes nothing but cheese. But whenever separated milk is so employed in making Camembert, it must be fresh and sweet, also warm and free from froth.

Whenever in a new place it is desired to commence making Camembert cheese, the rooms, walls and atmosphere must need be impregnated with the bacilli of the ferments and moulds without whose co-operation true Camembert cheese cannot be produced. This all-important impregnation of premises may the more effectually and easily be promoted by impregnating the milk as well with a portion of the inner portion of a cheese that is well on its way to become ripe. Once the rooms become permeated with the indispensable germs, the process of inoculation on the outside of young cheeses becomes natural and automatic without further preparation.

The tender coagulum having become ripe, so to speak, is ladled out into hoops in which the cheeses are formed, and which have been dipped into hot water. These hoops are small cylinders whose height and diameter are alike 4½ inches. The incipient cheeses are left in the hoops until the following morning, when they have drained themselves down to about two-thirds their former thickness. The hoops are then filled up with new curd, the surface of the old curd having first been broken up with a wooden spatula in order that the two curds may become so firmly attached that they will not be liable to separate as the cheese ripens, or afterwards.

Draining is continued by having the hoops standing on straw mats, which recline upon a draining table whose surface has an incline and is also grooved. A temperature of about 65° Fahr. is considered suitable at this stage. The cheeses should drain freely, failing in which they do not ripen satisfactorily. When the cheeses have shrunk in the hoops and are loose around the circumference, they are turned upside down, still within the hoops, and are placed upon fresh, dry mats. But if the draining is too rapid, this results from the milk being scarcely as fresh as it ought to be. The salting takes place when the cheeses are loose in the hoops, first on one side, and then on the other when it has been turned uppermost, and this is followed by salt being well rubbed in around the circumference. Placed on ribbed shelves in the making-room, and turned twice daily, the cheeses after a time show a fine, white hairy growth, evenly distributed, and are then taken to a ripening-room whose temperature is 10 degrees below that of the making-room. Under correct conditions the mould will grow rather quickly, and will ere long assume a blue tint. When this occurs the cheeses are taken into a cave, if one is available; if not, then into a cellar—which, after all, is a distinction without a difference; but in either case the temperature should range about 50° Fahr., and be maintained at that if possible. Here the white fungoid growth is checked, and a reddish-brown growth spreads over the crust of the cheese; and the characteristic flavour of the cheese depends on the development of this subsequent growth. Indeed, this growth is of first importance. Any other growths than those herewith cited are sure indications of inferior and unacceptable cheese.

All of the interior portion of a successful Camembert is softened, mellowed, wholly changed in appearance and flavour. A layer of curd—not mellowed—in the centre is an indication of imperfect ripening. This layer is hard and, like the crust, not eatable, or at least not at all attractive. The ripening of Camembert, like that of all other kinds of cheese, is a process of digestion leading on to decomposition, and the kind of digestion in any cheese depends, so far as we can make out, on the nature of the bacterial ferment which secures the chance of fulfilling its life history, its destiny, in the *corpus* of the cheese. In the Camembert flavour is first and richness away behind as a consideration with those who eat most of it; and as this flavour is not inherent in the cheese, it has to be artificially obtained from a source which in itself is purely natural, viz. a fungus, which communicates the flavour.

The Camembert is a cheese that will soon go to the bad if not consumed at the zenith of its ripeness. This tendency to early decomposition, which in all soft cheeses of its class is unavoidable, constitutes a disability that will probably not improve its chances of becoming generally popular with dairyers in England as a product designed to be profitable.

Brie.—Between Camembert and Brie there is much similarity of character, the chief fundamental difference being that of flavour ; and this, in the one cheese, is evolved by means of moulds and ferments different from those which perform a corresponding work in the other, and yet of the same class or genus. This difference reveals an artificial adaptation of natural means in order to bring about a different variety of the same article, namely, cheese. There are some two hundred or more varieties of cheese known to science in the world, the bulk of which are technically classed as soft cheeses.

As a cheese, the Brie has a history much more ancient than that of the Camembert. The latter is said to have been originated in 1791, whilst the former was a recognised article of food quite five hundred years ago. Both are held in high esteem in France, and each has naturally its partisans who sing the praises of their favourite. The Brie, always larger than the Camembert, is made in different sizes, but the method or system on which they are made is practically the same in both. Some of the Brie cheeses are about 15 inches in diameter, and all of them thin and flat, varying from 2 to 3 inches. The best qualities of both kinds of cheese are made from warm milk fresh from the cows, and other qualities, more or less inferior, are made in part from skimmed or separated milk.

Pont l'Évêque.—The Pont l'Évêque, so far as the histories of both are known, is a still more ancient production than the Brie. It is said that this cheese was made in the valley of Ange, from which was derived its early name of Angelot. The chief centre of this particular dairy industry in this age is Pont l'Évêque, and hence the name of the cheese in our time. The industry is a highly important one, and the demand for the cheese is very considerable. Even in England, whose people have a taste for hard cheese which appears to be hereditary and congenital, as it were, there seems to be a growing consumption of it. This kind of cheese is being made to some small extent in several of the dairy schools as a technical and tuitional subject in the course through which students are called upon to pass.

Of this cheese there are three qualities on the market, as, indeed, there are three or more of any other sort of cheese —with this difference: in respect to this Angelot cheese there are three qualities designedly, whilst in respect to other cheeses the lower qualities are caused by want of success on the maker's part. The first quality is made from whole milk, with more or less of added cream; the second from whole milk, without adventitious enrichment; and the third, from skimmed or separated milk. Naturally, there would be only one quality were there no demand for the others. But let us remember that under certain soft-curd systems it is possible to give to skim-milk cheese an apparent mellowness which is apparent rather than actual, and which is not nutritious as a really good-quality cheese would be. As a matter of fact, indeed, it is undeniable that each kind of cheese is valuable as a nourishing food exactly in proportion to its own intrinsic quality and to the skill with which that quality has been conserved in the making.

The making of Pont l'Évêque is more difficult than that of Brie or of Camembert cheese, and is also very different. The merely mechanical process is as simple as one could expect in any cheese whose milk has to be coagulated with rennet. The difficulty is accentuated by the necessity of keeping the curd free from perceptible acidity during the early part of the process. To secure this, the milk to be manipulated must—as nearly as may be practicable—be perfectly fresh and new from the cow, as also must the cream be when such additional quality is introduced. In which case a separator is indispensable.

The milk is sieved into wooden tubs, the usual capacity of which suffices for coagulating about five gallons of milk. Should its temperature have fallen below 90° Fahr., it should be restored to that degree, and to a higher one in cool weather. Rennet of a reliable quality, and therefore of a standard brand, is used to the extent of one dram (mixed with six times its volume of water) to each two gallons of the milk in the tub. It is considered a wise precaution, in order to develop softness in the curd, to add a quart of boiling water to each tub containing five gallons of milk, at the time the rennet is introduced or before. The quantity of rennet employed is relatively large, because, first, the coagulation should be sufficiently advanced in about half an hour or so, and, second, because the subsequent ripening and mellowing is performed by the enzymes of the rennet. This, indeed, is also the case with "hard" cheeses to a considerable extent. But it will have been noted that Brie and Camembert cheeses are for the most part ripened by the enzymes of the fungi which, be they what they may, respectively take possession of the exterior of those different cheeses.

When the coagulum has reached the correct stage, it is cut vertically and horizontally into cubes of about an inch square,—cut, indeed, in any direction that will be most effective for the purpose. The curd is then ladled out into a cloth resting on a circular hoop or form, which in turn stands upon a draining table. During this part of the process, which should be expeditiously performed, the curd must not be allowed to lose any appreciable part of its warmth. All the curd having been lifted, the corners of the cloth may be gathered, but not tied up, leaving the curd still offering a large surface, which facilitates the exodus of the liquid portion of the milk, the whey. The temperature is maintained by the use of cloths that are dry and warm.

The object of all this is to get all the undesirable liquid out of the curd. No "starter" is used in the milk, and all lactic ferment is discouraged. The curd is therefore fresh and sweet to taste and smell when the time arrives—say in half an hour or so—for getting the curd ready for putting it into the moulds. Here comes the critical moment, for the success or otherwise of the whole process depends on the maker deciding correctly on the right state of the curd for moulding. It will have shrunk to about one-third to one-fourth of its bulk when it was milk, and is now partly broken or crimmed with the fingers, and placed into moulds or hoops which are in couples on straw mats that rest on boards. The cheeses weigh when ripe about one pound each, and are either square or oblong with rounded corners, and about an inch and a quarter in thickness.

Some five or six weeks in ripening, these Pont l'Évêque cheeses are a sufficiently ordinary product of the dairy, quite distinctly differentiated from Brie and Camembert, alike in process of making and in method of ripening, as well as in the creamy texture of the last-named cheeses, and in peculiar and pronounced flavour more than in any other particular. The time for salting is when the cheeses have an odour resembling that of yeast, and when they are inclined to be oily on the crust. This odour of yeast is peculiar, because no yeast fungus is allowed to propagate itself on the rind of the cheese. And, indeed, in order to prevent the formation of mould of any kind, the cheeses are from time to time washed in a weak brine, and in addition thereto they are lightly covered with dry salt.

Gervais Cheese.—One of the popular cheeses made in France, and not unknown in England, is perhaps the least of all the small fry of soft cheeses in France; namely, the Gervais. It is popular because it is of higher quality than the general run of soft cheeses, yet not equal to our own cream cheese, which, indeed, is unequalled in that respect whenever it is really what its name denotes. The Gervais is made of new milk to which cream is added. It is a diminutive product of the dairy, being about 2½ inches high and less than 2 inches in diameter. Two quarts of warm milk direct from the cow and one quart of cream—the two thoroughly stirred together for pretty nigh a quarter of an hour—are needed for a dozen Gervais cheeses. The rennet is added when the mixed milk and cream are at a temperature of about 40° Fahr. This temperature must not be allowed to fall during the process of coagulation. This comparatively very low temperature employed in the process causes the coagulation to be correspondingly delayed, and the coagulum is seldom fit for ladling inside of twelve hours. When ready for it the curd is ladled into a cloth whose corners are tied together and hung up to drain, as is commonly the case with cream cheese. When sufficiently drained and firm the curd is salted preparatory to filling it into the moulds. This variety of cheese is usually eaten whilst it is fresh, yet it will keep well for several days when it is needed to suit the taste of persons who prefer that the inherent flavour of the cheese should have sensibly developed before it is laid on the tongue.

These four French cheeses are the only ones at all likely to take even a moderate root in England, in the regard of dairy folk and of the public.

CHAPTER XXI

CLOTTED CREAM

A VERY favourable niche in the favour of persons who love gastronomy has long been occupied by the "clotted cream" of Devonshire, and deservedly so occupied. In former times this scalded cream was a speciality of Devon and Cornwall, but especially of the former, and hence the name of "Devonshire Clotted Cream," which has long been and still is so attractive and so descriptive a name and a trade-mark. So useful, indeed, has been the name in the sale of the article, that clotted cream is now being and long has been made in many places besides the two most southerly and westerly counties of England. It may be fairly surmised and taken for granted that the climatic conditions of these two counties are ideally perfect for the production of cream; in their way supplementary to the "red ruby cattle" of that favoured region, which themselves are in the front rank of such breeds as give the richest milk in the bovine world. The Jerseys, the Guernseys, and the winsome little Kerry cows of Ireland would, in the two counties named, find themselves in suitable environment.

Be that as it may, the epicurean delight known as Devonshire cream—be it made in Devonshire or in Cornwall, or in any other of the southerly dairy counties—has long held the suffrage of persons who love and live to eat luxurious and dainty food. It is very rich in butter-fat, which is perhaps the most attractive and useful of all kinds of fatty products in nature, and as such it is excellent as warmth-producing food. The proportion of butter-fat—which is understood to be the most complex natural fat known to science—in clotted cream is from 50 per cent. upwards.

This fat, owing to its animal origin and its complex composition, is more easily digested than any other. In clotted or scalded cream it is in a fine state of emulsion, and for that reason as well as for its easy digestibility it is nowadays being widely recommended to invalids by eminent medical men. In this way it is to some not inconsiderable extent displacing cod liver oil in medical cases to which it is suitable; and these are many.

It is considered that the milk of Channel Islands cattle is desirable for making clotted cream, and no doubt need be entertained about its being the best of all for the object in question, just as it is the best of all for butter-making. It is, however, all the same true that the milk of at all events any British breed of cows—even that of Shorthorns, which are certainly not the best in the bunch—will yield very satisfactory clotted cream. As a matter of fact, clotted cream originated from Devon cows—not Channel Islanders—but then it must be borne in mind that Devons yield very rich milk, both as to quality and tint.

How it is made.—It may be stated that clotted cream of the best kind cannot be satisfactorily made from "separated cream." The act of passing through a centrifugal separator appears to deprive cream not of any of its richness in butter-fat, but of some of its viscosity or adhesiveness, and so far makes it unfit to produce the finest type of clotted cream—unfits it in some hidden way for the process employed in the scalding and clotting of cream. This deprivation, however, on the other hand, may be taken to improve the cream for churning into butter. This, indeed, is seen in the improved churnability of separated cream as compared with cream obtained from open pans.

Be that as it may, clotted cream is made by obtaining cream from milk fresh from cows and put into open pans for the time necessary in cream-raising on that system—say twelve hours or less in summer, and twenty-four hours or more in winter. The time required for raising cream in winter has no need to be prolonged to a full day, or even an hour or two longer. It is all a question of temperature in the dairy, which is susceptible of arrangement to any needed point. The natural raising of cream, on milk at rest in pans, may be expedited or delayed at will by regulation of temperature of the milk, to begin with, and of the dairy in which it is set to rest in pans.

The pans considered most suitable for the purpose are about 15 inches in diameter and 7 inches deep, the sides sloping downwards and inwards until the bottom is 11 inches in diameter. The best pans so far invented for ordinary cream-raising are those of sheet iron enamelled white inside. When these are in possession of milk they are allowed to remain on shelves undisturbed until the cream is ready to be skimmed. This is in ordinary cream raising, as in that for clotting. The pans may indeed be of strong tin, or of glass, or of porcelain, as well as of sheet iron enamelled. It is a question of greatest suitability and durability where scalding is an indispensable part of the process. Enamelled pans may or may not be suitable for the trying ordeal which pans have to pass through in the scalding part of the process. Glass and porcelain are perilously brittle, and even enamelled pans need to be carefully used; for if they are tumbled about the enamel is apt to chip off in flakes, leaving iron exposed in dark and ugly patches.

But in the clotting process the cream is not skimmed off at this stage. Instead of that the pans are very carefully carried—in order not to disturb the thin layer of risen cream on the surface—to the stove or stoves where the scalding takes place. The scalding stoves are designed to support the pans and to steam them underneath. This steaming is the crux of the whole process, for the flavour of the clotted cream—a point of delicacy and of much esteem—depends on the care and skill of the dairymaid at this stage, but in any case the steaming or scalding should proceed at a moderate rate,—that which experience has found to be the best, and which is not difficult to learn.

Whether the heating by steam be adopted, or setting the pans in a hot-water bath at a given temperature that is understood to be the best for the purpose, is a matter more of fancy and custom than of necessity. But in either case the pans should be supported in such positions as will admit of either steam or hot water playing freely over the surface of sides and bottom of the milk-pans. All points considered, it may be said that a hot-water bath is preferable to the dry heat of a kitchen range, or even of steam. An apparatus for the purpose—a stove with a pan or hot water as part of its construction—is used in the more up-to-date dairies. In this case the hot water is drawn off when the scalding has gone far enough, and cold water takes its place without any disturbance of the milk-pan.

When the scalded milk and cream are cold enough, the clotted cream is taken off in a condition ready for the market. Rapid cooling after scalding, especially in summer, prolongs the time during which the clotted cream will remain fresh and sweet, and is therefore important.

Fresh milk, and rich withal, is needed, and a cool dairy room for the milk-pans whilst the cream is rising. Failing fresh milk for cream-raising, there will be some form or other of fermentation—haply only lactic—and this prejudices the flavour of the cream that is developed by scalding.

Of Shorthorn milk about eight quarts will be required, and of Jersey, Guernsey or Devon cows' milk about six to seven quarts. But the quality of milk varies somewhat in different cows of any given breed, more so, no doubt, amongst a composite breed, such as the Shorthorn is understood to be, than amongst ancient breeds whose blood has not been diluted by any outside alloy. Differences in quantity rather than in quality of milk will occur amongst aboriginal breeds.

Mr. C. W. Walker Tisdale, a well-known dairying authority, tells of certain essentials in the process of making Devonshire cream. Rich milk is best for this purpose, because its cream is not dilatory in rising to the surface. Into setting pans that have been scalded to rid them of bacilli, and of dirt if any, the milk is sieved, and remains at rest, about six inches in depth, until the cream has risen —a period of some twelve to twenty-four hours, according to the season of the year and the temperature of the dairy. The broad pans containing milk and cream together, though not intermingled, are steadily carried to hot-water stoves elsewhere, and are both scalded there.

This is a highly important phase, and a high-class product, possessing the characteristic flavour which this part of the process bestows upon it, depends on the care and skill devoted to the work.

Milk that is tainted from any source, whether vegetable or animal, cannot be so manipulated in the dairy as to produce the best quality of Devonshire cream. The condition of the food supplied to the cows, and the pathological state of the cows themselves, must be above suspicion.

CHAPTER XXII

CO-OPERATIVE DAIRYING IN ENGLAND

A GREAT transformation scene in the domain of English dairying was in progress during the last thirty years of the nineteenth century. It is in progress yet, though the rate, perhaps, is slower, for the whole of it is not at present accomplished. Possibly the greater part of it is before us, representing conditions greatly different from the old ones. But of this we can make no certainty, for we know not what changes the future may have in store. To those persons, however, who remember well the dairying that was prevalent in the Shires in the 'sixties of the last century, the great changes that have taken place are sufficiently obvious. The almost unvarying custom at that remote period was the making of cheese and butter, one or both, on every dairy farm in the country, and in the great majority of instances with very primitive accommodation, and with appliances which are now regarded as very decidedly archaic in character, in construction, and in convenience. This state of things might conceivably have been prevalent still but for the rapid development of American competition in cheese which took place at that time. The unsuspecting security in which our dairy farmers had been slumbering for centuries received a shock from the effects of which we may doubt if it has even now recovered, in respect, at all events, to those who felt it at the onset. For this competition was as "a bolt out of the blue" in those far-off days, alike in its gravity and suddenness and in the commotion which it created amongst our people.

American and Canadian Cheese.—American competition in cheese, whose condition and quality compared favourably with middle- and lower-class English cheese, soon became a big affair. It increased much more rapidly in those early days, at all events, than our own urban demand for country milk, and the immediate result was that the lower grades of English cheese—of which the quantity was enormous—went down twenty or thirty per cent. in price. This effectually woke up the makers of such cheese—and their name was legion. A genuine and wide-spread alarm and dread arose in respect to this transatlantic cheese. America, we knew, was a vast country, with enormous possibilities for the production of cheese, once it was seen that a profitable market existed for it in England. This market was soon a realised fact, and, with characteristic energy and impetuosity, our American kinsmen laid themselves out to fill the market. Then it was that our farmers became thoroughly awake to the dangers which loomed up in front, and they began to think of what they must do to meet the changed state of affairs.

On July 1st, 1868, on the motion of Lord Vernon, the Council of the Royal Agricultural Society instructed the secretary to obtain information as to the means by which the Americans were enabled to deluge our markets with cheese whose quality was superior to that of a large portion of the cheese made in this country. Mr. H. M. Jenkins' report did not appear in the Society's *Journal* until the spring of 1870; but meanwhile the subject had been discussed far and wide, especially in Derbyshire, at farmers' clubs and elsewhere, and was in the mouths of farmers everywhere. The project of adopting the system of associated or co-operative cheese-making, which had answered so well in the United States, took concrete form at the annual meeting of the Derbyshire Agricultural Society, held in the county town on the day before Christmas Day, 1869. A committee was appointed to investigate the subject and to report on the desirability or otherwise of giving to the American system a fair trial in this country. On the 18th of the following February the Society met to receive the committee's report, which was favourable to a full and fair trial of the system.

But no one here knew anything beyond hearsay about the practical working of the so-called "cheese factories" in the United States. The subject filled the air, but there had been no object-lesson in these islands. Farmers in this country are proverbially self-contained and conservative in their habits of thought, or were so then. They knew, to their terror, that American cheese was ousting their own from our markets, but they were unable to translate American methods into English practice. To risk their milk in a co-operative concern which they had never seen at work was a matter which caused them grave doubts and fears. They dared not try to do well, for fear of doing ill. The difficulty involved in this want of faith was at length removed by the establishment of a guarantee fund to secure timid farmers against loss in the experiment.

Origin of the Derby Cheese Factory. — The nobility and gentry of the county came forward liberally in support of the fund, and it was decided that it should be made available to cover, if necessary, any deficiency which might arise in a period not exceeding three years. In this time, it was thought, the system would either be so far a proved success that it could be safely left to its own resources, or it would be a declared failure and must needs be abandoned; hence the guarantors became liable for three years. And in order that no misunderstanding might arise as to the distribution of any portion of the fund that might be used, and as to the point at which it could be fairly thought the fund might be justly drawn upon, it was decided to pay the contributors 6½d. per gallon for all the milk they sent to the factory, and this quite independently of the price the cheese might sell for, and quite irrespective of any drop that might occur in the cheese markets of the period for which the fund was made available; the milk, it was arranged, should be paid for monthly.

A suitable building was secured in the town of Derby, and an American cheesemaker brought over. A new committee was appointed by the guarantors to arrange about the buildings, to order the required plant, to assist the American manager in the general arrangements, and to carry on the work of the season. The establishment of a substantial guarantee fund, and the commencement of active preparations, had already created great interest in the project throughout the country, and matters generally were beginning to wear a brighter and more encouraging aspect. Much of the more open opposition in the neighbourhood had been silenced; some enemies of the project had become friends, others had become neutral, others again remained enemies still; and throughout the length and breadth of the dairying districts of the country the result was being looked forward to with feelings in which hope and anger, confident belief and persistent opposition, were curiously jumbled up together. The chief opposition, all the more dangerous because it was exercised privately, came from the cheese factors. They saw, or fancied they saw, in the movement a principle of co-operation that would interfere with their mode of doing business, and they did all the harm they could to the new venture. But, as Mr. H. M. Jenkins wittily and tersely stated the case in 1871 before the Society of Arts: "It is far better for the farmer to have a factory for his bank than a factor for his banker." And so the thing went on.

The Longford Factory.—It was at first proposed that only one factory should be started, at all events for the first year; but as the interest grew, and encouragement extended, it was considered only fair to the system itself, to say nothing of the desirability of proving conclusively its success or failure at as early a date as possible, that there should be two factories, one in the town and the other in the country.

The Hon. E. K. W. Coke, of Longford, who from the first had been one of the warmest friends of the movement, and Mr. Newton, of Etwall, also a warm supporter, now came forward, and each of them not only offered to put up the new building at his own expense, but to place it at the disposal of the committee rent free for the first year; and on their part the committee undertook to refund 40 per cent. of the outlay if, at the end of three years, the system should be found to be unsuccessful; and the money for this purpose was proposed to be raised by, if necessary, a further call on the guarantors. As, however, the offers of both gentlemen could not be accepted, a vote of the committee was taken. The majority was in favour of the Longford location, and, the proposed conditions having been accepted by all parties concerned, the building of the Longford factory was immediately commenced.

This was the first cheese factory, as such, ever built in the British Isles; and as the season was advancing before it was finally decided on, it was built of wood, chiefly with a view to saving time. It is, however, no longer used for its original purpose, but rather as a convenient depot for milk which is sent therefrom to distant cities and towns.

The decision to have two factories instead of one, and these situated at a distance of ten miles from each other, made two things necessary; first, that a second cheese-maker should be sent for, because one man could not manage two factories so far apart: secondly, that the managing committee should be divided as to superintendence of matters of detail at each factory separately, still remaining one committee in all matters of a general character touching the interests of the movement.

The Derby factory was a building that had for some years been used as a cheese warehouse, and so far as the upper rooms were concerned was well adapted to its new purpose; the lower room only required adapting to the plant that was placed in it, hence there was little delay in getting all things ready for a start. But on the 8th of April the first milk was received and the first cheese made in an English cheese factory—in the year 1870.

Early Experience of the Factories.—During the first year the committees worked under great difficulties. Everything was new and strange, and many alterations were required to make matters work smoothly. Happily, that which at the onset would have proved the greatest difficulty of all—the finding of money to pay the milk-suppliers' monthly dues—was removed by the guarantee fund. But the amount of opposition brought to bear against the movement was, for a long time, very great; and as much of this was of a secret character it was the more difficult to contend with. In the first year's Report of the Joint Committees of Management the following words occur: "Your committee cannot but regret that an experiment made entirely upon public grounds, and purely in the public interest, should have been viewed in its outset with so much uncalled-for and unworthy suspicion. This feeling, however, your committee is gratified to say, is fast passing away." And again: "An item acting prejudicially on the balance-sheet is the cost incurred in disposing of the cheese in a distant market, caused in some measure by the extraordinary and unexpected jealousy and dislike with which the movement was viewed by some factors of considerable influence in the trade." These quoted words indicate clearly enough the extraneous and gratuitous difficulties with which the committees had to contend.

Before the price to be paid for the milk was settled, the committee, "after collecting the experience of intelligent holders of large dairies, spread over a wide field of inquiry, found the well-nigh unanimous opinion to be that on ordinary dairy-farms, and in ordinary cheese-making seasons, and taking the average yield of cheese for the entire season, namely, embracing the poor and the rich curd-yielding periods of the season, a pound of cheese could not be produced on the old system of farm-house dairying from a less quantity of milk than 1 gallon 1½ pints. Assuming this experience of the cheese-yielding powers of the milk to be correct, and also that your committee working in the same district could not work at a less percentage, it follows that at the cost price of the milk alone (viz. 6¼d. per gallon) a cwt. of 120 lb. of cheese would stand at 77s. 6d., exclusive of whatever might prove to be the cost of labour and materials used in the manufacture. Assuming that these, under the factory system, could not be covered for a less sum than 4s. per cwt., it would follow that your committee would be under the obligation of realising from the products of the milk an amount equivalent to 81s. 6d. per cwt. of 120 lb., or of being obliged to fall back heavily on the guarantee fund. Now, inasmuch as the average price of the entire make of Derbyshire cheese has ruled for the past season at 72s. 6d. per cwt. (the exceptional dairies realising 80s. and upwards being an insignificant percentage of the entire make), your committee had no little anxiety (buying milk on such terms) lest they should be unable to sell the produce at prices so much in advance of Derbyshire rates as to cover the large amount of money expended in the purchase of milk; and they feel much gratified that they have been enabled to do so."

The committee attributed their being able to cover the large outlay in milk, besides cost of manufacture, without any material aid from the guarantee fund, chiefly to the following causes:—

1. That in working up milk in such large quantities, and on the Cheddar system, a larger yield of curd is extracted from the milk than is obtained under the ordinary private dairy system.

2. The saving in cost of labour, which, being spread over so large a production, is capable of being reduced to the minimum.

3. The advantage, from buying them in bulk, of obtaining materials on the best terms.

4. The material reduction under this system in waste and loss of curd, as compared with the same quantity of milk made into cheese in small dairies.

5. The absence of loss by cheese cracking and heaving,

which places a large percentage of an ordinary dairy in the infirmary instead of in the market.

6. The general rule, applicable to cheese-making as to every other class of manufacture, that an article can be produced at less cost in bulk than in small quantities.

In the system first tried in the English factories the required acidity was wholly developed in the whey and curd before any of the former was removed, and not, as now, *started* in the whey and curd together, and afterwards *completed* in the curd alone. During the time when acidity was developing in the whey and curd the latter was repeatedly stirred up by hand, in order to prevent its packing together at the bottom of the vat; the object was to keep the particles loose, so that they would easily swim out with the whey into the dry-vat, and when there would permit the whey to quickly escape. So the curd particles were like so many grains of wheat in size and appearance, and though their tendency was to adhere together in a mass, because of the acidity which prevailed among them, they were kept in a loose state after they were got into the dry-vat, partly to obviate grinding and partly to enable the salt to be evenly mixed with them. After the salt was thoroughly mixed with the curd, the press-vats were filled and placed in the powerful screw-presses; a light pressure was at first applied, and afterwards a heavier one, until the cheeses were compactly formed. The press-vat was a cylinder of galvanised wrought-iron without ends; the necessary bottom was formed by the board on which it rested when in the press, and the top consisted of a "follower," which fitted inside the hoop, and sank as the cheese became more compact.

Changes in the System.—The experience of the first year proved to those in charge of the experiment that the American system, as introduced into this country, required considerable alterations to adapt it to our needs. Whilst the co-operative system in general, and the labour-saving appliances in detail, which were the salient features of this new departure in English dairying, were found to be admirably suited to bring about the end in view, it was considered indispensable to the future prosperity of the system that "every possible trace of the American type of cheese" should be eradicated, and that under an English maker our own Derbyshire system should be copied as closely as possible, and that our slower and more careful process should be supplemented by the advantages of machinery, the concentration of labour, and the general economy of manufacture which the factory system supplied. This, however, was not a chango that could be perfected by bringing into the factories the Derbyshire method pure and simple; there were various unexpected difficulties cropping up here and there in the process of adaptation, and these involved the production of some faulty cheese. The difficulties were, however, gradually and one by one surmounted, and the committee "had the satisfaction of seeing the admirable method and the best points of the American machinery and system fully and successfully applied to the manufacture of Derbyshire cheese in two Derbyshire cheese factories."

But the cheese now produced in the factories, though flat and thin, and weighing the regulation 30 lb. apiece, was not really Derbyshire cheese in character. The Derbyshire system, indeed, being essentially a sweet-curd system, cannot well be practised in factories, unless many more lever-presses and certain other appliances are provided than are found to be required in the American or in the Cheddar systems; hence it came to pass that one or two of the salient features of the Cheddar method must needs be incorporated. The experiments made in dropping the American and adopting the Derbyshire, and again in grafting on the Derbyshire certain leading features of the Cheddar system, were inevitably accompanied with difficulties and disappointments which could only be surmounted by "indomitable and untiring perseverance, based upon a firm conviction of the soundness and ultimate victory of the system." These qualities were present in no common degree among the members of the committee.

The second season was one of hard work and much anxiety, but the result was satisfactory to those on whom it had depended. Before the third season (1872) began, the milk-suppliers, who for the two previous seasons would patronise the system only on condition that they were shielded from risk by a guarantee of 6½d. per gallon for all milk supplied, had become familiar with the working, and were so satisfied with the results of the system that they voluntarily relieved the guarantors from all risk in the third and last season for which the guarantee fund was available, assumed the responsibility themselves, undertook the entire management of the factories, formed themselves into local and independent committees, each dealing with its own factory separately, and became dairy associations on a purely co-operative basis. This was, of course, the result which must obviously follow the introduction of the system if it turned out a success, and the sooner the result was arrived at the better for the system.

The season of 1872 had its difficulties, for the cows of most of the contributing dairies were afflicted with foot-and-mouth disease, which seriously reduced the quantity of milk. The quantity of cheese sold from the Longford factory in the season of 1872 was over 82 tons, at an average price of 74s. 10½d. per cwt. The whey and butter sold paid the working expenses, with the exception of about £52, and the contributors received a net price of 74s. 3d. per cwt. of 120 lb. The quantity of milk delivered was 211,338 imperial gallons, on which a net dividend of 6¾d. and 6/7ths of a farthing was paid. The average quantity of milk required to make 1 lb. of "green" cheese was 9 lb. 13 oz., the shrinkage of weight during ripening was about 10 per cent., and the total cost of manufacture was 6s. 0½d. per cwt. of the cheese.

The quantity of cheese sold at the Derby factory in its third year was over 49 tons, and the average price realised

74s. 7d. per cwt.; the total cost of manufacture, 7s. 1½d. per cwt. of the cheese; and the dividend paid on the milk, within a fraction of 6¾d. per gallon.

Notwithstanding various drawbacks, the year 1872 (the third season of the two factories) was one which added credit to the factory system, for, after paying all expenses, a higher price per gallon of milk was paid than when the guarantee fund was in force, and this in spite of the price of cheese having declined several shillings per cwt. This result was highly creditable to the skill, the industry, and the perseverance of the respective committees, as it was an encouragement for the future.

The objects of the promoters were (1) to place the making of the cheese of the county in the hands of skilled men, who, having charge of the milk of several hundreds of cows, could be paid at the rate which skilled and intelligent workmanship properly commands; (2) to relieve farmers' households of the sloppy untidiness, and their wives and daughters of the toil and anxiety, which are inseparable from home cheese-making; (3) to reduce the cost of making the cheese; (4) to raise the average quality of the cheese production of the land; (5) to introduce into farming the beneficent principle of co-operation; (6) to break the power of the "middle men"; (7) to obviate dependence on incompetent dairymaids; (8) to increase the profits derivable from dairy-farming; and (9) to promote a healthy emulation, to create a feeling of mutual interdependence, to encourage a freer intercourse, and to introduce habits of system, inquiry, calculation, regularity and order among the farming circles of the country. That great good was within the reach of such means as these no one can deny, and that the means themselves were thoroughly practical is equally beyond the need of argument; the reasons why all the expected good has not been brought about we will presently inquire into.

Extension of the Factory System.—Meanwhile other factories were being built. The success of the system had been demonstrated to the whole country, and in districts where cheese-making accommodation in farm-houses was of an inferior character, or where dairymaids were scarce, high-waged, and incompetent, farmers became anxious to have factories to which they could send their milk. Windley and Etwell were the first to follow, then the Holms, Hope Dale, Ivonbrook Grange, besides factories in Cheshire, in Somersetshire, and in Scotland. This was while the enthusiasm which had been aroused was in full bloom. The Holms factory was the first to be built and equipped by dairy-farmers for their own and their neighbours' use; but the Hope Dale factory, we believe, was the first one *built* on a purely co-operative principle, each milk-supplier contributing capital on a *pro rata* scale according to the number of cows whose milk he intended to send to the factory. The results of the first year's working of the Holms factory compared favourably with that of the best home-made dairies of the district for that year, and were greatly superior to the average results of home cheese-making in that part of the country.

But after the period to which the foregoing paragraphs refer cheese everywhere declined rapidly in price; in the years 1876 to 1879 inclusive we may rate the average decline to amount to about £25 per ton, and it was on the inferior qualities of cheese that the greatest decline had taken place.

It has been frequently said that the fact of cheese factories not having become so numerous in the country as it was predicted they would is a proof that the system is a failure. This may be dismissed as beside the mark. One of the principal reasons—nay, the chief of them—why factories have not so multiplied in number is the enormous expansion in recent years of the milk trade to the towns and cities. In numerous districts where factories were in contemplation this expansion has operated to prevent their establishment; and in others where they have been established it will, perhaps, in time disestablish them. This, however, we may not regret; for the milk trade, properly conducted, will out-profit cheese-making almost anywhere, if only a railway is near enough, and is reasonable in its freights.

Utilisation of Surplus Milk.—Soon after the introduction of these co-operative "cheeseries," as we may term them, a new occupation was found for some of them that were conveniently situated for the purpose. The trade in country milk developed rapidly at that time or soon afterwards, but the demand was found to fluctuate suddenly at times, especially in the summer months. Something was wanted as a sort of safety-valve for the escape from the market of surplus milk during the period when fluctuations were likely to occur. And hence it came to pass that certain so-called cheese factories were used to regulate the milk trade, as a "governor" regulates the rate of speed of an engine. Whenever the market for milk fell off, more cheese was to be made at the cheeseries, which lent themselves in that way to the milk trade. Large dealers in milk found it necessary to maintain a cheesery as a depot where farmers could deliver their milk, and from which just so much milk as the urban demand called for could be sent each day, the surplus being made into cheese. In this way serious losses from surplus milk in London, once almost unavoidable, do not now so often occur. The telegraph wire has been the instant means of communication between urban demand and country supply of milk. Without railways the milk trade, as we know it now, would have remained an impossible achievement. Without the telegraph wire it could not be conducted without loss.

Cheese-making in Factories.—The first requisite at a cheese factory is a constant supply of clean, cold water; without it no cheesery manager can be uniformly successful. It must be cold for cooling the milk in hot weather, when cooling is indispensable, and it must be clean for washing utensils. During the heat of summer its temperature should not be above 55°, and, this secured, the rest of the year will take care of itself. Enough running water to fill

Cream Ripening Vats in a Co-operative "Faetory"

C

a
ch

is
He
dir
cor
dep
his
for
it c
easi
a la
has
expe
sigh
the

T
mete
The
more
its sp
and t
and i
of its
has a
1·000
water.
compo
milk-fa
not to
a certa
and wa
milk.
the ligh
skimme
beyond

a pipe whose diameter is 1½ inch will be ample to supply a cheesery of 500 cows.

One of the most important parts of a manager's duty is to watch closely the milk he receives into the cheesery. He is perfectly justified in rejecting any of it that is sour, dirty, skimmed, diluted, or otherwise impure and out of condition. His success, in fact, will in a great measure depend on his vigilance in these matters, assuming that all his milk-suppliers are not strictly careful and conscientious; for no one can make good cheese from milk that is not what it ought to be. He cannot, it is true, detect skim milk as easily as he can sour or dirty milk; nor can he, even with a lactometer, decide absolutely whether or not the milk has been diluted with water; but carefully acquired experience will enable him to detect, by his faculties of sight and smell, and without the aid of scientific instruments, the more flagrant cases of carelessness and adulteration.

The Lactometer.—The lactometer is simply a hydrometer applied to milk, and it indicates only specific gravities. The more casein, milk-sugar, and mineral matters—the more solids, that is—there are in milk the greater will be its specific gravity or density, other things being equal, and the higher will be the indication on the lactometer; and it is on account of these constituents—not on account of its cream—that milk is heavier than water. Pure milk has a specific gravity of about 1·032, that of water being 1·000; milk is therefore about 3 per cent. heavier than water. Now the fats of milk, of which cream is chiefly composed, are lighter than water, the specific gravity of milk-fat being 0·9, and of water 1·0; cream, however, is not to this extent lighter than water, because it contains a certain amount of milk-solids. But in any case cream and water are each 3 per cent., or upwards, lighter than milk. Skimmed milk is heavier than pure milk, because the lighter fats have been taken out of it. But if this skimmed milk be again charged with cream to an extent beyond its natural quantity its specific gravity will be brought nearer that of water than it was before the milk was skimmed, and sufficient cream may be put into it to reduce the specific gravity even below that of water, because cream is lighter than water.

That portion of milk called "strippings," which is the small quantity of milk that a cow usually lets down a short time after she has been milked, is known to be richer than ordinary milk in fats, and its specific gravity is lower than that of ordinary milk. The specific gravity of "strippings" is sometimes found to be as low as 1·020, when the proportion of cream is unusually large, and 1·025 is not by any means uncommon. If ordinary milk is found to have a specific gravity of 1·025, instead of its normal 1·032, it is reasonable to suppose one of two things; either that it is exceptionally rich in cream, or that it has been diluted with 15 or 20 per cent. of water. Hence it follows that specific gravity is not by any means an absolutely reliable test of the purity of milk, for while it can be raised by abstracting the cream it can be lowered again by putting in some water; and, as cream is lighter than water, a smaller quantity of water put in than of cream taken out will suffice to restore to the milk the specific gravity it had before it was skimmed. Hence it is one of the simplest things in the world to cheat a lactometer.

Cream Gauges.—In simply testing the relative percentages of cream in various samples of milk a set of simple glass cream-gauges, as seen in our figure, with graduated marks upon them similar to those on the cream gauges in the figure, will be found sufficient for practical purposes. A quicker determination of cream may be made by a centrifugal cream extractor. The percentage of cream is, however, no infallible sign that milk has or has not been skimmed, because the proportion of cream in pure milk

Cream Gauges

varies greatly and depends on many causes. The food the cow eats, the kind of land she grazes on, the weather, the period of the year, the breed of the cow, the state of health she is in, and her general treatment, are all causes which affect the quantity of cream in milk. And there are other causes which are not at present understood, because the proportion of cream in a cow's milk will be found to vary greatly on successive days, though she has been kept on the same food, and the weather and her health have, for anything we can tell, remained unchanged.

Different kinds of land, equally valuable perhaps from an agricultural point of view, will produce milks that differ in richness; one kind of land will produce a large quantity of milk somewhat inferior in quality, and another kind a smaller quantity of milk of a superior quality, while yet another kind of land that is richer and stronger than either of the others will produce a large quantity of milk of very good quality. One sample of milk, therefore, that contains a smaller proportion of cream than another sample against which it has been tested must not be hastily condemned as having been denuded of a portion of its cream, for if they were tested together a week later it is sometimes possible their positions in the cream gauge might be reversed. Still, as the table on page 440 shows, the variations in cream in different samples of milk, tested on the same days and produced in the same district, though on different sorts of land, are found to bear some kind of relationship, and for the most part to rise and fall together in somewhat irregular unison. The tests were made at one of the Derbyshire cheese factories, and they may be accepted as presenting a trustworthy picture of the true state of things. The leading feature of the records is, however, the continual fluctuation that is going on. The samples in each case were taken from milk that was believed to be perfectly genuine, and from the mixed milk of the number of cows mentioned in the margin.

The least percentage of cream is found in July, and this is probably owing to the heat of the weather preventing the milk from cooling as much as it ought to do if the cream is to rise perfectly. Cream rises best, though not quickest, in a slowly falling temperature, and the longer the temperature continues falling the more completely the cream will rise; so that the smaller quantity of cream indicated in the hottest month may be owing in part to the cause we

VARIATIONS IN CREAM

	No. of Cows.	June.			July.		August.		September.				Oct.	November	
		E. 6	E. 12	E. 27	E. 24	M. 26	M. 21	E. 29	E. 8	M. 13	M. 17	E. 29	M. 18	M. 6	M. 15
		%	%	%	%	%	%	%	%	%	%	%	%	%	%
1	18	10	8	8	9	8	14	9½	13½	9½	10	11½	11½	13½	11½
2	10	9	8	8	8	8	9	9	12½	9	9½	11	9½	11½	11½
3	24	10	10	9	8	8	9	9½	12	9	8½	11½	11	14	13½
4	9	10	11	11	10	10	15	11	14	9½	10½	10½	9½	13½	13
5	24	7	8	8	8	8	9	7½	11½	7	8	10	11	13	12½
6	30	10	9	9	8	8	10	9	11½	7	8	11	9½	10	11½

M., Morning; E., Evening.

have stated, and in part to the milk being actually poorer in fats on account of the cows drinking more and eating less than when the weather is cooler.

Notwithstanding these fluctuations in quality, it is the duty of the manager to test repeatedly various samples of milk against each other in the manner illustrated by the accompanying specimen table, and it is no less the duty of milk-suppliers not only not to impoverish their milk by any means—either skimming off cream or putting in water—but also to be very particular about keeping scrupulously clean every vessel that comes in contact with the milk. Careless members of an association do injury to others besides themselves, or it would not be necessary to make complaint against them. It is useless for nineteen milk-suppliers to be very particular as to cleanliness, if the twentieth is careless; the one will undo the good the nineteen have done. One lot of dirty or sour milk will taint all the milk it is mixed with, and the cheese of twenty people is spoiled through the culpable negligence of one person. But however blamable such carelessness may be, it is less so than that of skimming the milk and then sending it to the factory as pure milk, for not only is skimmed milk more or less acid in hot weather, by reason of standing whilst the cream was rising, but the taking off a portion of the cream is a direct act of petty larceny committed against the association.

Importance of Cooling and Aerating.—We have referred at length to the questions of purity and quality of milk, because they are of first-rate consequence in factory cheese-making; and we have spoken plainly as to the duties of milk-suppliers and factory managers, because plenary success is impossible if these preliminary duties are neglected. We also consider it to be an important thing that the milk, before being sent off to the cheesery, especially in hot weather, should be aerated—well stirred about, to let the gases and odours escape out of it—and at all events partially cooled. In cold weather there is less need for these precautions, though aeration is at all times a good thing, wherever it can be done in a pure atmosphere. But if the milk is neither cooled nor aerated, and the weather is hot, it arrives at the factory in a condition more or less unfit for cheese-making, and seeds of destruction that cannot afterwards be removed in the cheesery are already sown in it.

Arrived at the factory, the milk is poured into a can that stands on a weighing machine, both of which are raised high enough to admit of the milk running down tin pipes direct into the milk-vats, and so obviating all lifting of the milk after it is weighed; and in order to do this the carts are stood upon raised ground outside whilst they are being unloaded.

The cheese is made once a day, except in very hot and bad-keeping weather, when a zealous manager will make it twice a day if he has reason to think the evening's milk will hardly keep sweet till morning. This, however, does not very often occur, and need be no more than mentioned. The normal routine is to receive the evening's milk into the milk-vats, dividing it pretty equally amongst them; to keep it cool and in motion, so that it may remain sweet and the cream may not rise; and when the morning's milk arrives, to mix up the two together. There are two objects kept in view in dividing the evening's milk equally among the vats: souring is more surely prevented by having the milk distributed over as large a vat surface as possible, and it is advisable to have the evening's and morning's milk mixed together as evenly as may be convenient.

The vats are not always the same size, but they are usually capable of holding about 500 gallons each, being 14 feet long by 48 inches wide, and 20 inches deep. They are made of stout tin of the best quality, and are enclosed in and supported by a stout outer case of red deal or pine, between which and the tin is a space under the bottom and around the sides and ends. During the night a stream of cold water runs through the vats, in at one end and out at the other, filling the space between the tin and the wood, and thus cooling the milk which the vats contain. And the water is made to perform a second duty, for as it issues from the other end of the vat it is conducted by an india-rubber tube to a small water-wheel that is sunk in the floor close by. To this wheel the agitators are attached, and the water, gradually filling the buckets that are on the periphery of the wheel, at length causes half a revolution, which, by crank and lever overhead, stirs the agitators that float on the surface of the milk. The agitators are simply wooden rakes, and these, pushed to and fro by the intermittent action of the water-wheel, move the milk every half-minute or so, and thus prevent the rising of the cream.

In this manner the milk is soon cooled down to about 65°, provided the water is cool enough for the purpose; below 60° it is not considered advisable to cool milk for cheese-making purposes, and if it has been delivered in good condition at the cheesery it may safely be allowed to remain at a temperature of 60° to 65°, even in very warm weather. But if it is cooled below 60° it seems to be deprived of some property that it does not regain; the curd from it is dull as might be expected, and the cheese appears to ripen after the manner of fruit on the wrong side of a wall.

Whilst the milk is being cooled another important process is going on, for the agitators, whose chief office is supposed to be that of preventing the rising of the cream, perform the equally important though less obvious duty of aerating and deodorising the milk, thus enabling it to throw off the heat and odour and cowy smell peculiar to new milk. This aeration ought, however, to be performed before the milk leaves the farmstead, for the longer the odour and warmth are retained in the milk the quicker will it decay. Milk obtained from heated cows that have been tormented by the attacks of flies, or have been hurriedly driven on a hot summer's day, is already in a state of heat and ferment which are the forerunners of decomposition; it is therefore by far the best that milk should be at all events partially aerated and cooled immediately after it is drawn from the cow throughout the hot weather of summer and autumn, or it will acquire a taint that cannot afterwards be entirely got rid of; and milk is liable to become tainted if it is put into closely lidded cans and jolted in a farm cart over a mile or two of rough roads on its way to the factory. It is, of course, less necessary to take these precautions with the morning's milk than with the evening's. The former is made while the cows are cool and tranquil in the night and when the flies are at rest, the latter is made in the heat of the day; the former is made up into cheese soon after it arrives at the factory, and the latter has to wait twelve or fourteen hours in the milk-vats.

"Ripening" of Milk.—The "ripening" of milk for cheese-making, especially of evening's milk which has been cooled and aerated according to the description already given, is a point whose importance is now appreciated and understood. This ripening is the more necessary in respect to periods of the year when the nights are so cold that the temperature of the milk falls to 50° or below, and remains so during the night. This milk, kept for twelve or fourteen hours at a low temperature, does not ripen like milk at 60°, and cheese made from it without ripening is wanting in mellowness. The remedy is to warm up the evening's milk early next morning to 78° or 80°, and allow it to remain at that temperature two or three hours to ripen. This temperature will promote the development of lactic acid, which a low temperature through the night has kept in abeyance. It is well, indeed, to mix morning's and evening's milk together, and let them remain at the high temperature mentioned until both are equally ripe together. This course has been followed with satisfactory results for thirty years and more in various places. Previously the value—nay, the necessity—of ripening cold milk was not understood.

The above precautions are unnecessary in the summer and early autumn months, and the ordinary course is then as follows:—When the morning's milk arrives at the factory it is weighed and run into the vats, where the evening's milk is waiting to receive it; and when sufficient of it has gone into the vat that is farthest away from the weighing-can the tin pipe is shortened to adapt it to the next vat. Steam is then turned under vat No. 1, occupying the space that has been filled with a stream of cold water through the night, and the milk in the vat is raised to a temperature of 78° to 82°, according to the weather, and the rennet is mixed with it. The heating of the milk at this stage and the cooling of it during the previous night are modified to suit the state of the weather and the time of the year: in cool weather it is heated up to 81° or 82° at "setting" time, and in warm weather to 78° or 79°; in cool weather the space between the outer and inner shells of the vat is merely filled or partly filled with cold water, the stream of it being then conducted to the water-wheel without running through the vat on its way; in warm weather it is not easy to over-cool the milk, and the water runs through the space all night. These modifications, if carried out with thought, not only save trouble, but improve the quality of the cheese.

Adding the Rennet.—The exact quantity of rennet to be added to the milk will depend on its strength and purity, but it ought to be so that half a pint of it will coagulate 100 gallons of milk in about an hour; the efficacy of the rennet is greater in ripened than in unripened milk. A test of the strength of rennet is that the milk shall have perceptibly thickened in a quarter of an hour, and that it shall be sufficiently coagulated in an hour; the vats meantime being covered, if the weather is cool, to preserve uniformity of temperature.

The test of coagulation having advanced far enough is that the curd shall break cleanly over the finger which passes through it; and at this point the curd-knife—a many-bladed cutter, the blades of steel, tinned to preserve them against the effects of acid in the curd, sharp on the edges, fixed parallel to each other about half an inch apart, and perpendicular in position—is passed slowly through the mass of curd backwards and forwards, from one end of the vat to the other, until all is cut. Later on another curd-knife, the blades of which are horizontal in position, is also passed to and fro through the mass of curd, cutting it into cubes and strips about half an inch square; or, in default of this second knife, the curd, having rested a short time since the first cutting, is turned over gently by hand, and the first knife passed repeatedly about it until it is all cut into small pieces. The cutting and turning of the curd at this period are performed in a very gentle manner, because the newly formed coagulum is for the time being very tender, and it is desirable not to crush or bruise it by hasty manipulation.

"Cooking."—Again the curd rests for a time, during which the whey is rapidly separating from it. After a short time a little steam is turned into the space between the shells, and the curd is kept stirring—a little faster than before. The whey now exudes from the curd very rapidly, and the latter shrinks in bulk, becoming firmer and tougher as it shrinks. More steam is now turned on, and the curd will bear without injury a little rougher usage. It must be kept constantly moving, or the bottom of the vat will scorch it, the result of which would be that a thin hard skin would form round the scorched particles of curd and would keep the whey inside them. The bottom of the vat is made very hot by steam; the whey is rapidly leaving the curd, and the curd is kept in quick motion to prevent scorching. This is a very busy period of the process. Meantime, the whey has almost completely left the curd, the particles of which have shrunk from half an inch to about the size of grains of wheat, and they are no longer tender and delicate.

This steaming of the mass of curd and whey is called the "cooking process," and it is advisable not to hurry it too much—not to raise the temperature too rapidly, we mean. When the thermometer marks 90° the steam is turned off and the curd kept stirring for some little time longer, until the bottom of the vat has cooled down somewhat; at this stage the vat and its contents remain at rest for fifteen or twenty minutes, during which time other vats are being attended to. Presently the steam is again turned on, the curd and whey are kept in motion by a curd-agitator, or stirring-rake, and the temperature of the contents of the vat is raised to 98° or 100°. Throughout the steaming part of the process the manager uses his thermometer frequently, as it is advisable not to heat up the mass too high or too quickly, and when 100° is indicated the steam is turned finally off. Again, the steaming is modified to suit the weather—to 96° or 98° in very hot weather, and to 100° or 102° in very cold.

The direct effect of the steaming is to expel the bulk of the whey from the curd, and to develop lactic acid, which expels the remainder. After the steam has been finally turned off, and the curd has been kept stirring a short time longer to prevent scorching, the curd settles to the bottom of the vat, and is left at rest for the longer or shorter time which is required to develop a perceptible degree of acidity; this will depend on two things chiefly—whether the milk was or was not perfectly sweet and fresh to begin with, and whether the atmosphere is hot or cold. If the milk is quite fresh and the weather cold, acidity is sometimes several hours in developing.

Acidity.—It was formerly usual, as we have said, to add sour whey to milk at the time of setting it for coagulation, in order to hasten the development of lactic acid. This was a practical anticipation of what is now a scientific practice. It was the employment of what is now known as a "culture" of lactic acid; it could not be called a "pure culture," for the lactic acid bacillus had not then been isolated and cultivated, as it is nowadays. It was, in point of fact, a raw and crude way of introducing the lactic ferment into Cheddar cheese-making in primitive days. That it has been discontinued may be taken for granted.

This acidity, borrowed now from pure cultures of lactic acid, and not from sour whey, is a ferment which assists the rennet in its work, and the milk coagulates in less time; hence it must be cautiously employed. If, however, in this case all the whey be removed soon after it has left the curd, the cheese will be firm to the touch, sweet and mild in flavour, rich in quality, and of fine texture. But if the whey is left for some time resting on the curd, it is a matter of the first importance that the development of acidity be closely watched, for if it is allowed to go too far the cheese will not ripen as it ought to do; it is necessary to watch it very carefully, and to draw off the whey as soon as the acid is perceptible to the taste or smell. The formation of acid may be easily seen by a careful watcher in the changed appearance of the whey—not a change of colour, but a sort of glimmer or brightness on the surface. But the ordinary test is to take a piece of curd in the hand, squeeze the whey well out of it, and touch hot—not red-hot—iron with it; if sufficiently acid, or if the "cheesing process," as it is termed, has advanced far enough, the curd will adhere to the hot iron, and draw out in fine threads an inch or so long.

The Cheddar system of cheese-making is, perhaps, the most celebrated of all systems, and the most generally useful; and in that system acidity is the most salient feature. It is brought about by what is termed slip-scalding—not by heating up the whey and curd by steam. But in the Cheddar system acidity is developed in the curd alone, rather than in the curd and whey together; and this is now proved to be the soundest and safest way of employing acidity. The method employed in English cheeseries at the onset was what we may term the American-Cheddar method, which was a modification of, though not necessarily an improvement on, the old Cheddar system. The chief difference between the two lies in developing acid in the whey on the factory system, and in developing it in the curd on the Cheddar system.

It was long open to doubt whether on the American system the "cooking" process was not carried too far—whether the end aimed at, acidity, could not better be attained by the use of a small quantity of sour whey and less steaming. What was then a doubt is now a certainty. The practice of developing the required acidity in the whey and curd together is a dangerous one in the hands of a careless person. A better plan is to "dip" the whey sweet—that is, before the acid is perceptible in it—and to pack the curd in the bottom of the vat, keeping it warm until the whey is out of it and the acid is developed. This may be the more easily done by piling the curd on racks in the bottom of the vat, after the Cheshire manner, and covering it up with a thick cloth to keep it warm, a gentle heat from steam or hot water being maintained. The object of piling the curd on racks is to enable it to avoid being scorched if it is found advisable to turn on a little steam now and then to keep up the temperature.

It is not desirable to draw off the whey while the curd is still soft, but to draw it off *before any acid that can be easily detected* has formed in it. This is coming very near to the pure Cheddar system, and the system now employed in the cheeseries is midway between that and the first modification of the Cheddar plan that was adopted in America. That first modification consists in developing *all* the acid in the whey, and then vatting and salting the curd at once when the whey is dipped off; the midway system consists in developing *part* of the acidity in the whey, and the remainder in the curd; while the pure Cheddar consists in developing *all* the acid in the curd.

When the whey is deemed ready for dipping, a perforated strainer is placed close to the lower end of the vat and sunk to the bottom of it, and a siphon is filled with whey, and one end of it placed inside the strainer, the other end being outside the vat. The siphon has, or ought to have, a faucet at the long end and a valve at the other, thus preventing the whey from escaping when filled; by placing the valve end in the strainer, which is made of perforated tin, the whey is drawn off from any of the vats; it will immediately commence running on opening the faucet. When the bulk of the whey has run off, two blocks of wood are removed from underneath the two legs of the vat at its lower end, and the vat tips on the two legs in the middle, causing the whey to incline to the spot where the siphon is at work. As the whey runs off through the siphon it is either conducted straight to the whey-vats, where it is allowed to remain until it has thrown up its cream, or it passes directly away to the tank. Meanwhile the curd adheres together, and is drawn to each side of the vat, leaving a space down the middle by which, as the vat is now tilted, the remaining whey can drain off as it leaves the curd. The curd is then cut into lumps, which are piled on edge in the upper end of the vat, or on racks; the lumps are turned over occasionally, as well to expose them to the action of the oxygen of the air as to facilitate the escape of the whey.

After the curd has thus lain long enough to develop acid, and the whey has nearly all left it, it is ground to the size of raisins and currants mixed, and salted at the rate of 2 per cent.—that is, 2 lb. of salt to 100 lb. of curd, or per 1,000 lb. of milk, which comes to about the same thing. The salt and the curd are well mixed up together by hand, so that the former may be equally distributed through the latter. The curd is next measured into the press-vats which are in use, and for a while at first is put under a light pressure, so that the remaining whey may leave the cheese without carrying away with it too much of the solids. The grinding crushes the curd to a degree that would, if possible, be gladly avoided, and if a heavy pressure is put upon it immediately afterwards the whey that comes from it is quite white with minute particles of curd. In the course of an hour, the pressure having in the meantime been increased, the newly formed cheeses are taken out of press, bandaged, and put in again; but they do not require "dry-clothing," like farm-house cheese. A heavy pressure is now put on them for the night, and next morning they are finally taken out of press and taken to the cheese-room, weighed—the weight booked—and put on the shelves to ripen. Before being placed on the shelves, however, they have strong tissue-paper hot-ironed on the flat sides of them; this is done to prevent cracking and to exclude the air, but some do not consider it necessary for either of these purposes, though it is, no doubt, useful in assisting to "coat" the cheese,—the hot ironing, that is, is useful.

Self-turning Cheese-Shelves.—The shelves used in cheese factories are generally self-turning. In each frame are three or more "sets" of shelves, and therefore three or more rows of cheese. Each of these sets is turned separately, quickly, and easily in about the time it would take to turn a single cheese by hand; and they have the advantage of allowing each cheese to rest on a dry place each time the turning is done. The sets are held in position by a catch-and-carry latch in the end, and the strips of wood at the back

Curd upon Cooler

Photograph by "Topical"

Cheese Presses

C

p
a
o

C
b
Is
se
sc
—
fi
G
al
gı
la
Tl
ab
th
ca
of
qu

de
the
na
Th
of
Ag
foll
ope
the
gall
for
che
han
rece
and

prevent the cheeses from slipping off. These self-turners are great labour-saving contrivances, and they offer no obstacle to a due examination of the cheese.

The Co-operative Creamery System in Ireland.—Co-operative dairying in Great Britain has been dealt with, but with regard to Ireland we may point out that the Emerald Isle is to all intents and purposes a grass land, and consequently a live-stock breeding country. The character of the soil—for the most part derived from carboniferous limestone—is well adapted to stock-raising; and the climate, beneficently influenced as to temperature and humidity by the Gulf Stream, is eminently favourable to grass, which, after all, is the king of crops in the British Isles; and where grass is predominant, as in Ireland, we have the foundation laid by Nature in a land pre-eminently adapted to dairying. There are some four and a half millions of cattle in Ireland, about one-third of which are milch cows. The milk of these cows, minus what is required for human use and for calf-rearing, is almost all made into butter, the amount of cheese made in Ireland being quite insignificant in quantity.

The creamery system developed rapidly in the last decade of the nineteenth century, in the last year of which there were 506 so-called "dairy factories," viz. in Connaught 29, in Leinster 52, in Ulster 92, and in Munster 333. The ownership of these institutions is given, in a volume of agricultural statistics issued by the Department of Agriculture and Technical Instruction in Ireland, in the following way: Proprietary, 97; joint-stock, 219; co-operative farmers, 190. The quantity of milk supplied to these creameries in the year denoted was 120,392,434 gallons, and of cream 185,431 gallons. The total production for the year was 401,490 cwt. of butter and 439 cwt. of cheese. The number of separators at work was 985, and of hands permanently employed 3,656. Two of the creameries received only cream from the farmers, 9 received cream and milk, and 495 only milk. The number of cows whose milk was allocated to these establishments is not given, but probably amounted to about 300,000, or about 20 per cent. of the whole number of milch cows. This is the form into which tuition is developing Irish dairying, and any open-minded man who knows the conditions which prevail generally in that country, be he whom he may, will readily admit that this great departure is a long step in the right direction. The blot on the creamery system if blot there be, will be found to arise out of one or other of two causes, viz. first, the carelessness, or worse, of farmers who supply the milk; and, second, the incompetency of creamery managers.

Dairy Tuition in Great Britain.—To this chapter we may appropriately add some notes on Dairy Tuition. During the last quarter of a century many important steps have been taken with the object of disseminating the best information amongst all classes and all ages of dairyers in the British Isles, but it has always been recognised that tuition both of a technical and a scientific nature must for the most part be offered to the younger people in the shires. Generally speaking, the younger folk are more readily receptive than their elders are, though to this rule there have been some notable exceptions.

Dairy tuition was taken up earlier in Ireland than in England or Scotland or Wales. Two earnest and hard-working pioneers in the crusade against ignorance in butter-making, Canon Richard Bagot and Mr. James Robertson, whose names ought to be long held in grateful memory in the Emerald Isle, are no longer on the scene. They were well supported by such men as Mr. Barter, of Cork, and Professor Carroll, and by many other well-wishers of Old Ireland. " Travelling dairies " were set to work thirty years ago, and these left their mark like a trail of light through various districts. They were migratory. The " dairy " consisted of a van on wheels, and it went wherever it was wanted. It was duplicated in order that more ground should be covered. The routes taken by these itinerant schools could be traced, it was said, on the map by the names of places from which butter of an improved character was poured into the market. Evidence of this nature was highly encouraging, and the work of instruction has been continued with energy and success.

Dairy tuition in Great Britain is now well established and well appreciated. There are, however, the inevitable few—the minority—who still prefer the old ruts and to run in them. These are they whose conceit will not allow them to admit that to them tuition can do any service. But the need for oral and written information, and for technical instruction too, is willingly acknowledged by all whose desire is to rest content with nothing that is not the best which is known on the subject. Fortunately, an emulative spirit is abroad in the land. It has been greatly stimulated by the butter-making competitions which have been promoted by agricultural societies everywhere, and by lectures and demonstrations provided by county councils in the dairying districts.

The Midland Dairy College.—Dairy schools have been established in many places, mostly under the auspices of the county councils. Perhaps the most important of these is the Midland Agricultural and Dairy College, at Kingston, Derby, which was promoted by the County Councils of Derbyshire, Leicestershire, Nottinghamshire, and the Lindsey Division of Lincolnshire. Then there are, besides, the British Dairy Institute at Reading, the Eastern Counties Dairy Institute at Ipswich, and various dairy schools elsewhere; while for Scotland we need only mention that at Kilmarnock, which for years has been doing excellent work.

In order to convey a succinct and at the same time a comprehensive impression of the tuitional advantages which are now available, we give herewith a portion of the syllabus of lectures which are delivered at the Midland Agricultural Dairy College, an institution excellently provided with all the latest and best equipments:—

Dairying

Milk—its Nature and Composition.
Circumstances affecting the Quality of Milk.
Milk Testing. Gerber Tester. Babcock Tester. Creamometer, etc.
Cream Raising. Hand Skimming. Separator.
Cream Ripening.
Points to be observed in the Making of Butter.
Causes of Variation in the Quality of Butter, Flavour, Colour, Texture, etc.
Preparation of Milk for Cheese-making.
Points to be observed in the Manufacture of Cheese.
Hard and Soft Cheeses. Methods of Manufacture.
Ripening of Cheese.
Utilisation of By-products.
Dairy Utensils.
Elements of Bacteriology as applied to Dairying.
Construction of Byres and Dairies.
Dairy Cattle. Their Characteristics—Rearing, Feeding, and Management.
General Properties of Milk.
Properties of the different Milk Constituents.
The Nature of the Chemical Changes taking place during the Souring of Milk.
Inflnence of Temperature on Milk.
Chemical Substances used to preserve Milk and its Products. Their Action and Detection.
Milk Testing and Analysis.
Principles of the Method of extracting Bntter from Milk.
General Properties of Butter.
Difference between Butter and Margarine.
Circumstances affecting the Flavour, Colour, and Aroma of Butter.
Principles of the Manufacture of Cheese.
General Properties of Cheese.
The Nature and Action of Rennet and its Substitutes.
Canse of Variation in the Quality of Cheese.
Chemical and Physical Changes taking place during the Ripening of Cheese.

Bacteriology

(With Practical Laboratory Work)

Structure of Bacteria, Yeasts, and Fungi.
Identification of the various forms of Bacteria and Fungi.
Food and Respiration of Bacteria and Fungi.
Method of Multiplication.

Influence of Temperature on Bacteria.
Secretion and Excretion by Bacteria.
Fermentation and Putrefaction.
Importance of Cleanliness.
Isolation and Cultivation of Bacteria.
Influence of Bacteria on Milk and its Products.
Useful and Injurious Species of Bacteria and Fungi.
Pathogenic Germs. Diseases spread by Milk.
The Destruction of Germ-life by Chemical Means.
The Destruction of Germ-life by Physical Means.

In addition to these courses, there are lectures on various other subjects that are useful to dairy farmers, such as veterinary surgery, poultry-keeping, fruit-growing, and book-keeping. The technical part of the instruction is given in the dairy, where butter and various varieties of both hard and soft cheese are made each day, and the students are expected to do the work themselves under the direction of competent teachers.

The full course of study and work—of science and practice—at the Midland Dairy College extends to nine months, and this in truth is not too long a time in which to acquire all the information that is available. But there are six weeks' courses for students who, unable to spare a longer time, wish to learn all they can about the making of cheese and butter. This period of time is too restricted for anything beyond the salient points involved in dairy work; but a good foundation may be laid in that time, upon which intelligent and energetic students may build a superstructure of great practical usefulness. It may be as well to say now that the dairy schools demonstrate the value of a good grasp of the subject of bacteriology, lacking which it is not too much to say that success in dairy work must necessarily be to a great extent merely adventitious. Everything, indeed, turns on the action of ferments, and the trend of modern dairy research has been to show how we may successfully employ the services of the infinitely little.

Herewith is a list of principal Dairy Schools in the British

Islands, as given in the *Year Book* for 1911 of the Dairy Students' Union :—

1. Albert Institute, Glasnevin, Dublin.
2. Bath and West of England Society's Dairy School,—itinerant.
3. British Dairy Institute, Reading, Berkshire.
4. Cumberland and Westmorland County Council Farm and Dairy School, Newton Rigg, Penrith, Cumberland.
5. Cheshire County Council Dairy Institute, Worleston.
6. Eastern Counties Dairy Institute, Ipswich.
7. Essex County Council Dairy School, Chelmsford.
8. Hampshire County Council Farm and Dairy School, Basing, near Basingstoke.
9. Lancashire County Council School, Hutton, near Preston.
10. Midland Agricultural and Dairy College, Kingston, Derby.
11. Munster Dairy School, Cork.
12. Scottish Dairy Institute, Kilmarnock.
13. University College of South Wales Dairy School, Aberystwith.
14. University College of North Wales Dairy School, Lleweni Hall, near Denbigh.
15. Warwickshire County Council Dairy School, Griff, Nuneaton.

In addition to the above there are smaller Dairy Schools of a more or less private sort, and also Travelling Dairy Schools under County Councils' auspices.

INDEX

A

B

T

U

V

W

Y

Printed by
Cassell & Company, Limited, La Belle Sauvage,
London, E.C.