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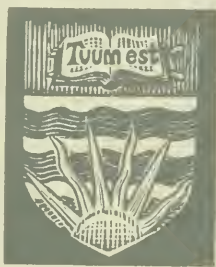
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THE PRACTICAL DIRECTORY
FOR THE
IMPROVEMENT OF LANDED PROPERTY

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THE PRACTICAL DIRECTORY

FOR THE

IMPROVEMENT OF LANDED PROPERTY

RURAL AND SUBURBAN

AND

THE ECONOMIC CULTIVATION OF ITS FARMS

BY

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PREFACE.

It has been for some time foreseen by shrewd observers, that a change in the leading characteristics of the agriculture of Great Britain was about to take place. The depression which has, unfortunately for so numerous a body of practical farmers, characterized the past few years, is only one of the phases of the change above alluded to, not the cause of it. It may certainly be said to have influenced the circumstances operating to bring about the change, to have hastened its development, and to have directed public attention most closely and eagerly to it. It has also, doubtless, made the claims more urgent which have recently been brought forward for what certain parties designate as agricultural reforms, and has brought to the front, in what many deem to be a very ominous way, certain propositions of a somewhat revolutionary character. But notwithstanding all this, the elements of the change of these reforms, and those propositions have existed from a period long before that in which the 'depression' appeared; and the change consequent upon the moving influences has, as we have stated, been long foreseen by close observers.

What the characteristics of this change are, and what its effects are likely to be upon the future of British farming, will be found explained in their appropriate place in the following pages.

The demands of an increased and ever increasing population, no less than the influence which the success of farming has upon the national prosperity, can only be met by an increase in the productive powers of the soil.

It must be observed, however, that this increase is not one merely in the annual produce of what are the usual crops of this country, such as wheat in grain and turnips in green crops, but an increase in the number and variety of crops to be henceforth cultivated. This last addition to farm enterprise has long been advocated by many, and these the most advanced amongst our agricultural authorities, as at once affording wider scope to the energies of our farmers, and as yielding produce useful in the general work of the farm in much demand chiefly for stock-feeding purposes. This new enterprise has received a fresh impetus and derived vastly increased importance from the keen competition to which British farmers are subjected by those of America; and what renders the competition of all the graver importance is the fact that the like is coming from our own colonies of the North American Provinces, as Canada, and of Australia and New Zealand, not to lose sight of that coming from not a few of the peoples of South America.

But the primary food demands of our vast and dense population are to be met, not merely by an improved system of working the land at present under cultivation, by the introduction of a wider range of crops, and by pressing into the service of the farmer many aids which have been hitherto greatly neglected or wholly overlooked; but also by bringing into cultivation of one kind or another the large tracts of land which are at present lying waste, or at least greatly unproductive. This department will therefore be fully discussed in our pages, keeping

in view what, however, is often—at least popularly—forgotten, that there are large tracts of waste land which, so far as our present knowledge permits us to predicate, must ever remain so, being literally and truly waste or unproductive land.

In some measure connected with this department—put by some in close relationship with it—is the question of Small Farms. The Author has endeavoured to consider its various details from the one point of view which he conceives to be the only true one, namely, its agricultural aspect. This limits the discussion of the question to small farms cultivated on the same system as that adopted generally on the larger ones. Small farms specially cultivated with a view to meet the peculiar wants of special districts or towns are purely exceptional, and do not come within the range of that system which must be followed if the small farms are to be universally extended in the way advocated by some. Second to none in his desire to see the status of the labourer and the working man raised in the social scale, he has, in common, as he believes, with the majority of practical men, come to the conclusion that this will not be effected by giving small farms to them. With the increase of the area of land under culture as small farms, there would arise an increase of the peculiar difficulties attendant upon small farming, when carried out on the wide and extensive scale proposed. There is all the difference between small farming carried out upon what may be called the naturally limited scale, which admits of those exceptional circumstances which alone secure success, and that general system which of necessity brings into existence those which, if not always strictly inimical to success, tend to make that much more difficult to be attained. The subject being one of such great importance, from the peculiar phase which it has now been made to assume, the Author has endeavoured to discuss it as much as possible from the practical point

of view here indicated, while at the same time giving all due deference to the somewhat erroneous opinions, as he conceives them to be, held by many in connection with it. Doubtless, many of the errors arise from the different views held as to what constitutes a *small* farm. In some districts, farms of from forty to sixty acres are considered to be, if not large, certainly not small farms, although by the majority of farmers on the large scale throughout the country they are thought to be so. On these farms men make not merely a good living, but often manage to save some money. Many now, however, advocate farms so small as to be but little better than unusually large allotment gardens. On holdings such as these, under the average of circumstances, it will take very hard work indeed to secure a good living; money saved can scarcely be looked for, certainly not sufficient to allow of improvements being carried out. It is to small farms, or rather land allotments, of this kind, and also, in some if not in great measure, to those of six, ten, and even, under certain circumstances, up to fifteen and twenty acres, that the remarks in the text chiefly apply. One point we draw special attention to, not merely from its importance, but from the fact that it is generally overlooked, namely, the influence which will certainly be exerted, and not for the better, by the adoption of the general system of small farming upon the future progress of agriculture, both in its practical and scientific aspects.

It is one of the popular mistakes held upon the subject, that the number of 'small farms' throughout the country is very inconsiderable; so much so, that it is scarcely worth while to reckon them as an element in, or as adding much to the general aggregate of, the industrial forces and resources of the kingdom. The number of small farms coming within the strictest meaning of the term, spread over its various districts, is vastly greater than is generally suspected or stated. Nor is it right to maintain, what some

do, that the difficulties thrown in the way—as they state, by, of course, the proprietors of land—of getting them are so great as to be almost insuperable. The fact rather is, that up to the present the supply has been equal to the demand, and that if the demand were greater the supply would be forthcoming. As pointed out in the body of the work, proprietors of land have no interest to serve in withholding land for small farms, if the desire of mere money-making, indeed, was all that was to be considered. Quite the reverse. But it is the opinion of not a few, thoroughly competent from their practical acquaintance with the whole subject to give expression to it, that there is a limit placed to the system of small farming preventing it from very greatly extending. And a strict investigation of the whole circumstances does certainly tend to show that the general extension advocated by some cannot be successful, unless a change come over the system of our cultivation and general industrial economy as at present established,—a change so remarkable, that what its characteristics will be has not yet come within the domain even of speculation or conjecture.

Much in the same practical way of looking at and discussing them, other leading questions which have an important influence more or less direct upon the future of agriculture are treated of in the text. Of these may be named here, farm leases, covenants, or contracts, tenant rights, and the essentially vital points embraced in the comprehensive title of the ‘Revision of the Land Laws.’

All of the above-named subjects are, however, but secondary or subsidiary to those which constitute the chief subject of the work, namely, the practical departments of landed property improvement, and they are only alluded to in so far as they bear upon these. It is further necessary to state that what is given under the general subjects above named bears chiefly on the opinion, which so many now maintain, that the greater number, if not the whole, of the difficulties pressing upon

agriculture can be got rid of by arrangements between the interested parties themselves;—arrangements of the same class which, carried out during a long course of generations, have gradually given rise to that code of laws or assemblage of customs, not always written or embodied in recorded laws, which have tended so much to raise us, a business nation, to a position unrivalled in the world. This individual action or freedom of contract is perhaps more valuable in the business of agriculture than in other departments, inasmuch as there is an uncertain element in soils, climates, and localities, which necessitates the application of peculiar arrangements suited to each case, and which renders the rigid application of one unvarying law to all cases a matter of, at least, very great difficulty. This peculiar feature in the land question, considered in its widest acceptance, is too often overlooked. Repeated reference is made to it in the text as modifying, more or less, the practice of certain departments of rural economy. And it is on account of this modifying influence that it so happens that a system or rule of action which is found to be applicable to and to work well in one district or locality, will not be found so in another and a different one. This feature of the land question will be found to be operative, although in a different way, in the case of such legislative enactments as may yet be carried out. In the text more than one instance of this is referred to. And although it may be doubted by some, and broadly denied by others, the Author has little hesitation in expressing his belief that it will be found in practice to be the cause of much practical difficulty in adjusting the working of such laws as may be passed to the circumstances of the various districts of the kingdom. He believes that this will yet be forced upon the public mind in a way somewhat unexpected by many. The indications at present that this will be so are by no means few, and are well worthy of the attention of our legislators, and of those who urge them to the

completion of schemes more or less complicated in character. That there are difficulties, however, to get rid of which legislation is required, is admitted on all hands, although it may not be so readily granted by some of us that they are either so numerous or so important as many hold them to be; certainly not to justify exceptional legislation on lines different from those on which other departments of industry depend.

One leading idea the Author has throughout attempted to bear in mind in discussing the various departments of Landed Property Improvement, namely, that the interests of landlord and tenant are always identical. The landlord, in improving his property in a strictly agricultural sense, is assuredly improving its revenue; and so, in thus attending to his own interests, he is attending to those of his tenants. And the converse holds equally true. The phrase above given, as applied to the land industry, is objected to by some, openly sneered at by others. We are told by the highest authorities, and the point is almost universally conceded as correct, that in all other branches of national industry the interests of the employers and the employed are identical. Why it should not be so in that connected with the land we fail to see. The Author does not assert that in all cases the relative interests of landlord and tenant are identical. Exceptions are held as proof of a rule in other cases, why not in this? And the exceptions ought not to exist, and need not. They are the result of individual action, and this action is not always confined to one side; and if this is found in practice, in departments of industry other than farming, to be capable of setting matters wrong, individual action can set them right.

For reasons easily explained if space had permitted, it was from the very outset, on the first planning of the work, decided by both Publisher and Author that other and vexed questions, such as the Game Laws, the Law of Settlement, etc., should not be taken up in its pages. As one

result of this decision, it is hoped that their readers will be gainers rather than losers, from the greater space thus afforded for the giving of specially practical matter. There are other subjects discussed which have much of a social, but yet also of a practical character, to wit, the labour question, wages, the recreation of the labourer, village clubs and allotments. While the various points of these are stated, still they are discussed in so far only as they have a direct bearing upon the practical subjects of the work.

These embrace almost every detail connected with the Improvement of Landed Property in its varied and important departments. It is throughout borne in mind that the practical purpose which these improvements aim at securing is the increase of the produce of the land, and thus directly and indirectly to increase the revenues of the estate by ensuring its economical management, and by widely developing its resources. Hence, while what may be called the ordinary departments of the property have their various improvements described and illustrated, marked attention is paid to those now overlooked and neglected resources from which so much that tends to economy and to increase revenue can be obtained. It is hoped that what is given under those heads will alone render the following pages of great practical value. Certainly, for the most part, they constitute a thoroughly novel feature in a work of this class. Of those departments one or two may be named here, and first that of Suburban Land. Not a few estates throughout the country have wide areas situated near towns and populous villages, suitable for building purposes, as well as for certain special classes of farms. Large revenues may be obtained from these areas, and the best way to make them yield the highest amount is placed before the reader.

Another department much more closely connected with the property question than the above named is that of Cropping of the farm. Many able authorities, in view of the ever increasing

demands of our large population, have of late contended that the crops grown generally, almost exclusively, are all too limited in kind and variety, and that an extension of cropping is demanded, and this no less in the business interests of the farmers themselves, than in the social ones of the public generally. The Author endeavours to support this view by a number of special paragraphs, which will be found in their appropriate place in the text. It seems useless to maintain that we grow on our farms all the crops which they are capable of growing, on the ground that our soils and climates are antagonistic to an extension of their number. With soils less fertile, and under climates less genial than ours, a much wider variety of crops is produced than is to be met with on British farms. And they are raised, moreover, by farmers who can lay no claim to the possession either of the means and appliances we have at command, or of that scientific knowledge and sound practical skill which distinguish our farmers as a class. This extension of the list of our farm crops is advocated by some chiefly on account of the corresponding extension in the number of our live stock, which would, as they maintain, be thus realized in practice. This view bears upon the question, which has been and is still being so much discussed, as to the increase of grass land, and the corresponding decrease of arable culture. This will be found fully discussed in the text, with some points not always taken into account which are closely connected with and greatly influence it. One is, that corn and arable culture are not, as many suppose, one and the same thing. Many more crops come under the department of arable culture than wheat, barley, and oats, which are popularly considered to exhaust the list. And as regards the increase of live stock, thought to be wholly dependent upon the increase of land under grass, it is not seldom forgotten that grass is not the only food for cattle which is at the command of the live-stock farmer. A growing opinion, indeed, of many able authorities is that

grass is not the best food. If this be doubted, as it will be by some, it is not so doubtful, to say the least, in the case of dairy cows. Growing out of this question of the extension of cropping is that of the live stock of our farms. That as much can be done in this direction as in that of an extension of crops may be doubted; but that more can be than has been done is obvious enough to any one who has at all considered the intensely interesting subject of the acclimatizing of animals foreign to this country. A very fair example of this position may be cited in the case of the Yak, the rough-haired ox of Thibet and Tartary. Beyond all doubt, this animal is possessed of qualities which render it invaluable in the countries in which it is indigenous, and which would not be less, but, under the peculiar wants of our population, more so in our country; and it is also equally beyond doubt that the animal is particularly capable of being easily acclimatized, and that, while adapted for a wide range of our climatic and local conditions, it is specially so for hilly, sterile, and exposed situations. And what is true of the Yak is true, with greater or less modification, of other animals well worthy of our attention. It is not denied that they may not—do not—possess all the characteristics desirable for our peculiar circumstances. But this objection has little practical force, and is not likely—ought not—to be made by the descendants of our Bakewells and other eminent breeders, whose skill formed from materials infinitely less promising than those the magnificent animals which make up our flocks and herds, which are the admiration of every one. Should anything given here or in the text induce but one of our readers, possessed of influence and position, to give serious attention to the few subjects here named, out of many which this work discusses, the Author will be well repaid for the long and arduous labour which its preparation demanded.

Every care has been taken to render the description of works proposed as practical as

possible, to aid in which drawings have been introduced with an unsparing hand, and they, together with their accompanying full descriptions, will enable any one to devise, organize, and carry out to completion the greater part of the work of Property Improvement.

Since the introductory chapter, explaining the scheme and scope of the work, was written, various improved details and methods of working have been introduced, and sundry departments have had a much wider significance given to them. To notice these, and bring the matter of the various Divisions up to the date of issue of the work, a Supplementary Division has been added, which gives a very varied amount of practical matter.

In a subject so extensive and so varied in its details, a reference to works bearing directly and indirectly on the subject has been necessitated. These, gathered from a wide variety of sources, home, continental, and colonial, have been so numerous that it is impossible to name them here. Where special parts are quoted, the source is, however, generally stated. The Author cannot permit this opportunity to pass without drawing pointed attention to the journals of the leading Agricultural Societies of the kingdom. From more than one of these he has derived sundry hints and suggestive details of a practical character. But those journals contain throughout, such a vast variety of papers, scientific and practical, that he expresses the hope that some means will yet be taken to make their contents as widely known amongst the agricultural classes as their unquestionably great utility to them demands.

In conclusion, the Author may be permitted to say, that nothing in the departments of labour, either in that of the Publisher or in his own, calculated to secure the thoroughly practical efficacy of the work, has been omitted. Greater haste might have been made as regards its issue, but he feels that, considered from almost any point of view, this delay has been judicious. It has enabled the most recent improvements in

various practical departments to be treated of; it has also allowed—and the importance of this will at once be seen—the excitement consequent upon a remarkable period of agricultural depression greatly if not wholly to subside, and calmer and juster views of the situation to take their place. These have had the natural and salutary effect of placing before the minds of those truly interested in the future progress of agriculture in Great Britain, those steps to be taken by which that can best and most rapidly be secured. There seems now, as the result of the calmer and wider discussion of the whole question, a pretty general consensus of opinion as to what those steps should be, and what the nature of the work of the future which they involve. The opportunity has thus been given to profit by all that has been thus discussed and decided, and the matter bearing upon this will be found in its proper place.

In conclusion, the Author again refers to that bond of mutual interest which ought to exist between landlord and tenant as a factor in the general sum of agricultural prosperity, which affects the nation vitally, and which it is impossible to over-estimate. That this bond exists to a much larger extent than is popularly supposed is happily true, and wherever and whenever it exists is one of the best guarantees that the agricultural prosperity of the country, in the highest sense of the term, is certain to be secured. And so secured that with the extension of this mutual interest in each other's welfare, which is being effected much more rapidly than many choose or care to admit, one need have little fear as to the future of British farming. In the text the Author gives his reasons for thinking hopefully of this future, notwithstanding all the gloomy anticipations and disturbing vaticinations indulged in by not a few;—a future which, he believes, will be even more remarkable for its triumphs over difficulties than has been the past, marvellous as those triumphs have admittedly been.

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42. Hurdles—Rustic Woodwork—Rustic Fences—Different Forms of Plain and Ornamental Palings.
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66. Plans showing different arrangements for the Setting out of the Grounds—Ornamental and Kitchen Garden, adapted for Suburban Building Plots and for Farm Houses, etc.
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68. Ground Plan and Elevation of Out-buildings, containing Two-stalled Stable, with Loose Box and Corn Room or Crib, Coach House and Harness Room, to which is added extra accommodation, when Cows and Poultry are kept, comprising Cow House with two Stalls, Turnip or Root Room, Hay-bin, Poultry House.
69. Ground Plan of the Celebrated Model Farm Buildings at Luton Hoo, on the Mixed Husbandry System.—The steam power of this gigantic farm steading is arranged on the divided or isolated system, a number of separate steam engines being distributed over the steading, arranged at various points to meet the requirements of the fattening cattle, dairy cows, sheep, pigs, etc., in their separate buildings. These steam engines are supplied with steam from a central boiler of eighty horse power. The steam is distributed to the various engine-rooms by means of underground pipes. The sheet contains also Ground Plans of Huntsman's House and Whips' Cottages, for the Plan of Stables and Kennels of the same Estate illustrated in Plate 71.
70. Plans on larger scale of the leading parts of the Model Farm Buildings given in preceding Plate. From the large size of the steading, the sheet only admits of a Block Plan being given in the preceding Plate; in this Plate various parts are illustrated on a larger scale, comprising Plans of the Steward or Bailiff's House, with Out-buildings, Work or Cart Horse Stables, Sheds and Yards for Fattening.
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73. Plan of Buildings for Suburban Poultry Farm—
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74. Drawings, Elevations, and Sections of Apparatus
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75. Perspective Elevations of Entrance or Gate

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- Lodges, which can be adapted to other
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etc.
76. Ground Plans of Entrance Lodges in preceding
Plate, showing Living Accommodation for
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for Bailiff, etc.
77. Ground Plan (alternative) of Entrance Lodge,
with House and Office Accommodation—
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Harness House, Living and Bed Rooms for
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of Rain-water Collecting Ponds or Areas,
and Tanks in Fields.

PRACTICAL DIRECTORY
FOR THE
IMPROVEMENT OF LANDED PROPERTY,
AND
THE GENERAL MANAGEMENT OF THE LEADING CLASSES
OF ITS FARMS AND WORKS.

CHAPTER I.

IMPORTANCE OF THE SUBJECT CONSIDERED IN ITS INDIVIDUAL AND NATIONAL ASPECTS.—THE CAUSES WHICH HAVE BROUGHT ABOUT THE NECESSITY FOR IMPROVEMENT IN LANDED PROPERTY.—PLAN OF THE WORK, AND DETAILED STATEMENT OF ITS SUBJECTS.

AMONGST the varied arts and sciences which minister to the well-being and add largely to the wealth of the community, there is none which ranks in equal importance to that connected with the land. All other branches of trade, manufactures, and commerce are dependent upon it, and without its produce they would languish and die out. It affords employment to a large proportion of the population, scope for the investment of enormous capital, and its wants and necessities call for the exercise of the skill, knowledge, and business habits of the most advanced and highly trained of our scientific men, and the most eminent of our mechanicians and artisans. To their connection with the land, some of the most brilliant of the discoveries of our highest chemists and physiologists are due; and, so far as present experience would indicate, it is destined to afford as brilliant a field for the display of the talents of our mechanical and civil engineers. No doubt much of this high position which the land, and the departments of science and industry connected with it, holds, has only been reached within a comparatively short period. Time was, and that not quite beyond the memory of those able farmers who have not yet retired from the field of active labour which their skill and fine management have done so much practically to enrich, when matters connected with the land presented a very

different aspect,—when its departments seemed to have reached the point of lowest ebb in those tides of time and circumstances which pass over nearly every one of our industrial callings,—when the results of farming were but poor and unsatisfactory, and the farmers who carried it out were about the last of the various classes of the community from whom was to be expected any evidences of that stirring life, restless activity, and untiring energy which had tended to raise other branches to such a high point of social importance, and which gave to those connected with them the power of accumulating the gigantic fortunes and the many comfortable competencies, of which all have read, and which so many have witnessed. But a number of circumstances, social as well as scientific, brought about a change, as remarkable for its effects on the future prospects of all work connected with the land, as it has been for the revolution which it has wrought in the minds, the habits of thought, and the manner of doing business of the classes more immediately affected by it. And just as we find, in tracing the history of other departments of industry,—such, for example, as the very striking instance of the introduction of the steam-engine at a time when coal mines began to be unworkable from the accumulation of water, from which the power alone of that very motor was

able to free them, and the coals thus set free gave a wider field and a more economical range to the steam-engine in turn,—so we find that, at a certain period in the history of our country, those circumstances began to exercise a reflex influence upon each other, which tended to give the wonderful impetus to farming to which we have alluded. Very interesting would it be to trace these in detail, and suggestive withal; but, this not coming within our province, suffice it to state that all the departments concerned in the industrial working of the landed property of the kingdom received such an impetus, that farming, considered as a whole,—and that is the *raison d'être* of landed property,—took rank as one of the most advanced branches of scientific industry, claiming a position second to none, alike from the readiness with which those connected with it availed themselves of every improvement, and from the energy, skill, and business prudence which they displayed in all their labours, and the large amount of capital which they expended upon them.

These improvements in what might be called the minor details of the work of landed property, brought about, as may be conceived, a new and superior method of working, which added largely to the productive powers of the soil, and in like or in greater proportion to its intrinsic value, although it was some time before this told in the way most pleasing to those who had invested in it, namely, in a decided and a steady rise of rents. But, at a later stage or period in our national history, other causes came into operation which still more increased, in greater or less degree, the letting or pecuniary value of land, and also, to a very marked degree, the demand for its farms. To notice only one of these inciting causes, the increase of the population and the gradual—in some instances the sudden—rise of wages and incomes of its various classes have created such a demand for the produce of the land, and have given purchasers the means of paying the higher prices which this increase naturally created; and these, again, have had a reflex influence upon the rents, which have risen greatly, and attained a point far beyond what could or would have been conceived possible but a comparatively few years ago. Other causes, doubtless, have led to this remarkable

change in the development of the resources and the rise in the value of landed property, considered only here, for obvious reasons, from the farming or productive point of view. The chief of those causes will be noticed incidentally in the body of the work, as they come up in connection with the subjects treated of; and others will doubtless present themselves here to the minds of many of our readers. But, by way of example, we may cite one of those causes, the extended and extending demand there is for amateur farms by men of business, who, possessed of ample means, give high rents for the farms they take a liking to, quite irrespective of their value to what may be called the class of legitimate farmers.

In view, then, of the necessities of an ever increasing population, possessed at once of new desires for the enjoyment of a higher quality of style of living, of greater luxuries, and of the means of gratifying these to an extent never before in the history of our country witnessed, the question how best to augment the food supplies produced from our farms, thus to obtain from these the maximum of produce with the minimum of labour expended or of capital sunk or invested, has of late assumed a vast importance, which it is difficult either thoroughly at once to grasp or to over-estimate or exaggerate. There is, indeed, no question so vitally affecting the pecuniary and industrial interests, and so closely affecting the material, the social, and, as an almost necessary consequence, the moral and religious welfare of the country, as this. It may be said truly and characteristically to come home to every one, for with it every one is concerned, from its influence none is exempt. Hence the necessity which requires, and, indeed, which demands, that the investigation of all its points should be conducted with the most painstaking and scrupulous care, so that from it may be deduced those sound principles upon which all true and lasting and progressive improvements depend, and upon these based a system of application of the results which will draw towards them that successful practice, the outcome of the study and of the daily practice of those connected with this, the most vitally important of all the branches of our national industry.

Numerous, however, as have been the improve-

ments introduced during the period we have alluded to, and manifest as has been their influence upon the general condition of our farms, and upon the increase in the produce of their soils, it must not be supposed that these are incapable of further improvement or of yielding increased produce; for, as our population is increasing at a wonderfully rapid rate, as also, apparently, its means of spending larger sums upon the necessaries as well as not a few of the luxuries of life, so ought also the productive powers of the land to increase, if not in like, still in some proportion thereto. Nevertheless, the fact remains that there is a remarkable difference between the ratio of increase of the population and that of the production of crops and cattle required to maintain them. Indeed, in many districts it is to be feared that the increase in the productive powers of the land is very trifling, if, indeed, in some it does not go back. Even in what may be called the external work of our farms, a vast deal has yet to be done before they can assume that degree of completeness of laying out, and in every detail of their management, of which examples are only to be met with in our cotton, wool, and other manufactures, in which perfection in planning or arrangement and completeness in detail are carried out to the utmost limits which capital, energy, and skill can secure. And as regards the productive powers of the soils of our farms, taking them all round throughout the kingdom, it is admitted by all those who have given thought to the subject, and are acquainted with its practical details, that this power can be increased to a very large extent, some authorities going the length of putting the percentage of increase resulting from the best possible style of farming as high even as fifty per cent. But while admitting this to be a somewhat exaggerated estimate, it may nevertheless be accepted as a practical fact, that the produce of the soils of our farms can be increased to a point very much beyond what is now the rule, taking them on the average, if not, indeed, taking our best cultivated farms as the standard. Numerous examples are to be met with in proof of this; and that these could be followed on a much more extensive scale than has yet been witnessed, admits of no doubt. Not that in all instances it is true that

because a certain work of improvement in land has been done in one place, it can be done in another, inasmuch as in agriculture there are so many conflicting influences at work, tending to render the results of one trial very different from those of another; still, a close examination of the land, locality, climate, soil, and other points, will enable the farmer to decide how best improvements can be carried out in his special case, and in how far they may or must differ from improvements of a similar kind of which he has heard. There are but few farms of which, if not the whole, at least a part of them can be greatly improved. Our best farmers, indeed, keep their lands in a constantly progressive state of improvement, so that, however slow may be the rate at which this proceeds, it proceeds steadily. Each succeeding year, apart from natural casualties to which all are subject, finds the farm better than it was the year preceding. This is what ought to be the normal condition of the farms of the kingdom; but our highest authorities are compelled to admit that this is not their condition, and that a vast deal has yet to be done before it be so.

And it may be deemed a matter of really high national importance, that, as aiding our farmers to bring about this greatly improved condition of matters, there are now a number of helps and appliances within their easy reach, and available at comparatively moderate prices, which even but a few years ago had no existence; or, if some were to be met with, it was in the crudest of forms and at the dearest of prices. To these, which we owe to the inventive talent and the constructive skill of our mechanics, engineers, and architects, must be added the important help afforded by our chemists and physiologists, from which list it would be unpardonable to omit those agriculturists who combine in themselves all the advantages of a finished scientific education and learning, and of a thorough practical knowledge of all the details connected with the management and improvement of property.

We thus see that there is, in connection with the management and improvement of the landed property of the kingdom, a future so encouraging in its aspects as to be almost classed as brilliant, but which is not the less practical. This future, however, can and will only be realized by the

united efforts of all the parties interested in the subject. While, beyond a doubt, the work done in isolated districts, and by a few, comparatively, individual proprietors, cannot fail to be of considerable value, and to influence the circles immediately within their influence; and while believing that it is the duty of every proprietor, irrespective of what is thought of or done by his neighbours or acquaintances, to improve to the utmost the property entrusted to his charge, and for which he is responsible at once individually and nationally, still it must be remembered that such isolated circles are limited in their influence, and it can only be when the united body of landed proprietors rise to a due conception, at once of the dignity of their position and the wonderful influence which that position gives them for good, that the general improvement of land and the large increase in the products of its fields, to which we have already alluded, can ever be realized. But, while the landlords have their duties to perform, and, seeing that they have the largest stake in what will result from the proper fulfilment of these, they ought to be, as they will be, the first to give an impetus to the subject, in the general movement which is expected and hoped soon universally to take place; still it must not be forgotten that the farmers, their tenants, have also their duties to perform, and that upon the way in which these are done will depend largely the ultimate success of the movement. That it will succeed is beyond a doubt, but the period of its fair, if not wholly completed, realization—which will necessarily be a work of long time—will depend upon the way in which the bond of union thus hinted at is formed and carried out. Never was there a time more propitious than the present for the realization of such a scheme. It will be a source at once of individual and national wealth if it be taken advantage of, and efficiently carried out.

From all these and other considerations, which might here be named did space permit, but which will be obvious enough, it is by the Conductors deemed to be a period in the progress and history of landed property peculiarly and markedly auspicious and appropriate for the issue of a work which shall take up, and treat as fully and exhaustively as possible within a space which will not exceed

what may be called reasonable and practically available, all the points connected with the subject; a work, the practical details of which will not be narrowed and, so to say, confined in their application by local circumstances and other considerations, but will embrace, as far as may be said to be practically possible, the chief of the conditions of the varied districts of the kingdom; a work so arranged to meet the wants and necessities of those engaged in the practical improvement of landed property as to take in a wide range of circumstances, and give instructions, hints, and suggestions thereon so comprehensive, that, as a rule, they will be able to find in its pages something which will bear practically on almost every point of practice in which they may be interested.

Connected with what may be called the natural features or characteristics of landed property, and of the various classes of farms into which it may be divided, there are obviously certain points which must be taken into grave consideration, as affecting not only its value or the price which it would bring if it were to be sold, but also the scheme or plan of its general management, or of the details of the work necessary to be done in the way of effecting a thorough improvement should it have been neglected as a whole and its farm lands impoverished, or where certain work of re-modelling of its parts was deemed necessary, or where, as in the case of a purchase of new lands being effected, the laying out of the whole *de novo* was determined upon. These points of practical detail are numerous; and although obviously all are of importance, still some of necessity rank higher than do others, while all are so intimately connected with and influence each other in a way more or less direct, that they must be considered as forming a perfect and fully developed whole, the neglect of any one tending to injure some other. The whole may, in other words, be looked upon as a chain of practical details, the links of which, while they may be considered as separate pieces, are connected indissolubly together; and as the greatest strength of the chain is tested or shown by that of its weakest part, it is the object of the designer so to proportion its parts that as a whole it will be able to bear throughout the

greatest strain put upon it, and which it is calculated to bear. The work, therefore, connected with landed property, when treated in any of the ways just noted, must be done with painstaking precision, and all its details carefully planned, so that their execution may be effected with the maximum of efficiency and economy, and the minimum of expenditure in time, labour, and money. In carefully examining the details of work planned in such a way, it will be found that there is what may be called a natural sequence of subjects, or a regular order in which they best come up for treatment, and it is when this is followed that the efficiency and economy we have just hinted at are most certainly secured. These considerations have led the author of the present volume to decide upon the scheme of its arrangement.

After mature consideration, it appears to him that these above-named and other obvious advantages will be gained in perhaps the readiest and most easily referred to way, by adopting the following classification, giving the whole subjects connected with the improvement of landed property under one or other of certain divisions:— (1) Structures of every kind, whether concentrated on one part of the several farms or isolated in various outlying parts of the property. (2) Varieties of soils met with on the property, their distribution, and laying out into farms and fields. (3) The reclamation of waste land, etc. (4) Internal resources of revenue of the property other than that derived from directly agricultural operations, as marl pits, clay beds for brick and drain tiles and tubes, lime and stone quarries, etc., brick and tile kilns, etc. (5) A general review and notice of subjects not coming closely within, or embraced by, one or other of the foregoing divisions, but having a close connection with, or bearing practically upon, the general subject. This classification of the leading divisions starts upon the principle, that before any business can be properly carried on in which various operations are conducted, it is a matter of primary importance that the necessary buildings be erected, and the various erections and appliances in which construction be more or less demanded be provided, by which the work can be done in the quickest and most economical way, either in the field or at the fold. These being

supplied, the consideration of the best way of working up the materials, close or near at hand as the case may be, which may be required to carry on the business, comes naturally in sequence; as, next, consideration of every point in order to render these materials more valuable, to extend their sources of supply, and thus directly and indirectly to add to the profits of the establishment. The application of this principle to the improvement of landed property is so obvious, that we think it need not be here further insisted upon. We proceed, therefore, to lay before the reader *in extenso* the various subjects which will be treated of within the various divisions we have named, not merely to show the sequence with which one subject follows upon another, but the vast variety of the different details which will be illustrated and described in a thoroughly practical way in the text of the work.

It is not always easy at the outset of a work to detail fully and precisely the detailed subjects which will be treated of in its pages, if, indeed, it be wise or prudent to bind oneself within the strict lines of such a limitation; for, however well considered these may be deemed to be,—and these in the present instance ought to be, as they have been in preparation and under classification for many years,—still, as the work progresses new ideas are elicited, new suggestions made; while with the progress of time, which in one sense, on the one hand, is quite rapid enough in the way in which it brings forth changes and promotes progress, is nevertheless slow enough on the other to bring out such a number of improvements, and such a wide variety of suggestions, that the plan of to-morrow, if not altered in its general features, in the more complete filling up of its departments and details, may be very different from that decided upon to-day. Notwithstanding these contingencies, which are all the more likely to arise the larger the work, and the longer therefore the time over which its preparation and the full realization of its details extends, the following may nevertheless be accepted as a brief, but on the whole accurate, exposition of the subjects which will or should be embraced within its pages.

Under the first division, as already named, the subjects—which may be classed as ‘home structures’ of the farm—will be taken up in detail in

chapters and sections somewhat in the order as follows. Those in the first division are connected with what may be called the *farm buildings* proper: under this, the first department, will be considered and fully illustrated, all the details connected with the *position* of farm buildings with relation to the fields and roads of the farm, their *site*, *aspect*, *soil*, and the principles upon which their *arrangement for different kinds of farming* depends. Then will be described and illustrated the various apartments, such as *stables* and *horse sheds*, *cattle courts*, *yards*, *sheds*, *boxes* and *hammels*, *cow houses* or *byres*, *sheep houses*, *piggeries*, and *poultry houses*. Under the general department of farm buildings, those connected with the *dairy* demand special attention, and in connection with which will be given descriptions of the latest improvements in arrangement and construction. This department of farming is now going through a process of revival, the end of which will be a complete revolution in all the details of its management. How this revival, so to call it, has been brought about, this revolution carried on, and what the details by which it is characterised, will be found fully explained and illustrated in the text. Suffice it to say, that dairying in all its branches is likely now once more to assume the position in British farming it formerly held, and its produce be as highly esteemed and valued as before, but which, from a variety of causes needless to be named, had been so far and was being so rapidly and completely lost, that some time ago it seemed as if dairying was no longer to hold a place in it. The methods of managing and preserving *manure*, in keeping with the results of the researches of scientific and the experience of practical men, will also receive full consideration; and the most recent forms and styles of arranging the *dung heaps*, *stanees*, *pits*, and *covered manure courts*, with their adjuncts of *liquid manure tanks*, together with the materials recently introduced into their construction, such as concrete, will be fully illustrated.

What may be called the *domestic architecture and buildings of the farm* will next follow, and will comprise all that can be well said on the subject of *farm-houses*, the *bailiff's house*, and the *labourer's cottage*. In connection with the farm-house, the fullest information will be given, so as to make it afford the maximum amount of accom-

modation with the least expense, that accommodation being considered in its threefold aspect of the entertaining-rooms, the living-rooms, and those parts of the house devoted to work and domestic arrangements. In all these, an endeavour will be made to present, possibly for the first time in practical literature, under this department, a number of hints, suggestions, and details bearing upon the relations not only which one set of rooms has to another set, but which the various parts of each room considered individually have to one another—as, for example, the relation of windows and doors to fire-places and free wall-space, so that the furniture can be placed in the best and most convenient positions for the general comfort. Nor will such minor details in the working parts of the farm-house, such as fire-places, closets, pantries, sculleries, shelving and its fittings, be deemed unworthy of notice, ministering materially as they do to the conveniences of working and to the economy of time taken up in doing it. In brief, it will be the endeavour of the author so to place the whole arrangements, conveniences, and fittings of the farm-house before the reader, that the connection between each will be at once seen, and the reason why every detail recommended is given.

So also with reference to the arrangements and conveniences upon which the *health* of the occupants of the farm-house is dependent; these will be treated of, or attempted to be treated, in the same thoroughly practical way, without on the one hand giving undue prominence, or in some instances no prominence at all, to those refinements in sanitary science, the utility and practical adaptability of which to ordinary dwelling-houses is, to say the least, very problematical; but, on the other, giving all the necessary practical and easily adapted details, without fear of giving too much or being too prolix.

The *labourer's cottage* question has long engaged attention, and given rise to almost endless discussion on the platform and by the press, much of which would have effected more practical good had it not been given to the public, who have got bewildered amidst the conflict of opposing opinions and the extraordinary diversity of plans of procedure. An attempt will be made in the text to place the whole subject on the basis which

those authorities who have viewed or tried to view it in a common-sense way have of late brought forward and advocated. The writer has been one of those who have considered that the subject has been dealt with too much from one point of view, and that perhaps philanthropy to the exclusion of practicality has been too much thought of. One thing appears obvious, as the outcome of the most recent experience in this question, that what the labourer himself thinks of in connection with and requires in his cottage, must have more prominence given to it in the future than it has received in the past. Under this section a number of plans will be given, showing the various styles, modes, and classes of cottages, adapted to give varying accommodation, according to the necessities of each individual case.

Under the second great division of the subject we have named, will come to be considered all that for the purposes of the work more strictly fall to be treated of under the general designation of 'exterior or outlying structures' of the property, as distinguished from those connected with farmeries, steadings, or home structures. The first subject which comes up for consideration in this division is obviously *roads*; next in sequence to which is that of fences, gates, etc., of various styles and forms, applicable to all parts of the property. The form of the *fences in relation to roads*, and the way in which they influence one another as regards position, and consequently in the saving of land as well as in the convenient working of the fields under arable culture, fall to be here discussed and illustrated. So also the relation and the *setting out of the roads and the fields of a farm* with reference to the farm buildings are also here considered. Next comes up the subject of *drainage*. As a large amount of ignorance prevails as to what constitutes the true principles upon which this depends, so far at least as *deep drainage*, and especially in heavy soils, is concerned, and as this forms an essential feature in the commercial improvement of landed property, we shall devote a few paragraphs to its consideration and illustration. Having got to this point, the next subject, which is closely connected with the last, is that of *irrigation*. The matter we shall give in connection with this will concern itself chiefly with the methods in use for the utilization of the water

supply of the property in irrigating meadow land, the grass of which is either to be made into hay, or cut as green or forage food for horse or stall fed cattle, dairy cows, and live stock generally, and will embrace all details connected with the different styles of irrigation, their laying out, construction of water ways, sluices, etc. etc. While, however, these will be the principal points treated of under this head, we shall notice more or less completely the methods in use for using the *sewage water of towns*, where there are parts of the property to which this can be supplied, on the most economical methods. What these are, and what the principles upon which they are founded, will be described with special reference to their practical application to fields most favourably situated for utilizing this source of manurial supply, and an endeavour will be made to show where this can be done with profit and the reverse. Intimately connected with the department named above of drainage and irrigation, is that connected with the *saving and storing up of water*, in situations where much at present is allowed to run to waste, or, at least, not made available to anything like the extent to which we hope to be able to show it can be. Under this department fall to be described and illustrated the various points connected with the *localities best adapted for the collecting of water, and the formation of the necessary reservoirs; the best position for the retaining embankments, the construction of embankments, leading the water collected in the reservoir to the points to be used, whether for purposes of irrigation or for the supply of the farm buildings; and the position and construction of ponds and of drinking-troughs for cattle in pasture fields or at the farm steading*, will at this point be fully detailed. The next subject in what may be called natural sequence to be considered is *river improvement*, either with a view to *prevent the destruction of the banks, the sweeping away of good land on the margin, or the placing and construction of embankments to prevent the submersion of adjacent land, or to reclaim or restore land which lies at a distance from it*.

Under the subject of *soils*, the following may be taken as a brief exposition of the subjects which will be embraced within this division. Preliminary to the discussion of the details of which,

will come naturally the methods by which shelter will be secured to the various forms in which the soil of the estate is divided into fields, these being discussed under the head of *plantations*. This important department will be considered under the head of plantations or shelter for fields,—those designed as ornamental additions, as well as a means for affording shelter, to the grounds, parks, and the like, surrounding or in the immediate neighbourhood of the mansion of the proprietor or the house and garden of the farmer, and the still more humble yet necessary shelter required for the house of the bailiff or the garden plots of the labourers. Lastly comes the department of *plantations*, as affording chiefly a source of revenue from the timber which they supply, and the shelter they at the same time afford to wide tracts of land, ameliorating the climate and adding to the value of lands either under arable culture or used as pasture. Strictly, the subject of *fences* would come here to be considered, as in one sense, at least, acting as shelter to fields; but as this is done only in a modified sense, and as, moreover, they are erected in close connection with roads, of which they form an essential part, it has been deemed advisable to confine their consideration and illustration to that part of the work under which roads are discussed. Next comes the classification of soils, their characteristics, peculiarities, constituents, and the culture or management of their leading classes; reclaimed lands from bogs and peaty parts of the property, from marshes, river and sea margins; heath, common, and woody lands, etc. etc.

Having thus considered the points connected with the kinds or classes, the peculiarities and the local characteristics or formation of the lands of the property, and the nature of the soils of which these are made up, we come to the next division of our subject, which concerns itself with the best methods of the *laying out of the fields* into which these are and must be divided so as to be worked in the quickest and most economical way. This department takes up, then, all considerations connected with the best form or shape to be given to the fields, the dimensions best adapted for horse power when that is used for the working of implements, with special remarks on what is required for the adaptation of steam

power. Under this head, the question of the *size of farms*, and the various points, *pro* and *con*, with reference to the small and large holding systems, will be taken up and discussed. And in close relation thereto, and as bearing upon the subject, the legislation and attempted legislation of the past few years come to be noticed.

The subjects now named bring up those connected with that wide and important one of *waste lands*, which has, in consequence of the large amount of public discussion which has been given to it, bulked largely in the estimation of the general public, who have not, as we believe, always, if ever, fairly had its true elements presented to them. To do this, than which, perhaps, there is no more important department of agricultural social economics, an attempt will be made; and by endeavouring to take a common-sense view of the whole bearings of the case, it may be that many, or some at least, of the considerations we may have to offer will do good service in placing the subject on its right basis before our readers. Having discussed the general subject of waste lands, the special points connected with the reclamation of such portions of them as are capable of being cultivated to a profitable extent will come up for consideration.

The division which embraces what may be called the extra sources of revenue which the estate may be possessed of, will embrace the practical points connected with such subjects as marl pits and clay beds, lime and stone quarries, and the best methods of utilising their products; drawings and descriptions of *yards*, *drying sheds*, and *kilns* of various kinds for the making, drying, and burning of *bricks*, *tiles*, and *drain tubes*, for use either on the estate or for sale to neighbouring proprietors, will be given, as also illustrations of *lime kilns*. Under this division some remarks will be presented on the utilising of old and worked-out marl pits, etc., either by the formation of *fish-ponds*, or of reservoirs for the storing up of water, or by filling them up, and adding by this means so much to the acreage of the land. As useful in the new system of working dairies, etc., the construction of economically formed *ice-houses* will be illustrated and described; as will also various structures and parts of structures calculated to be useful in, and to aid, the economical working of farms, etc. For the

first time, we believe, in a class work such as the present, a subject will be taken up and discussed as practically as possible, which comes under the extra sources of the revenue of the estate, namely, the appropriation and setting out of such parts of estates for which there may be a demand for *general building purposes*. There are many properties, the bulk of the land of which is situated in close proximity to towns and large villages, etc.; while others have part so placed, the remainder being in the country and strictly rural districts. From a variety of circumstances which it is needless to name here, there is now a demand, which is daily growing into a point of great importance to the proprietors of such estates, which may be designated as suburban or suburbial, for portions favourably situated on which buildings of various kinds can be erected. When these are of the domestic class, belonging generally to those who have abundant means, a good and in many instances a handsome price is offered, and is easily obtained. In view of this, it is obviously a point of great importance *so to lay or set out such parts of the estate as may be appropriated for building purposes*, in such a way that the various sites for different classes of buildings may be in the most attractive positions; while it is equally obvious that there is one method of so setting out the land by which the highest revenue may be obtained from it, and another by which this may be very much reduced. Not a few good building plots have been spoiled by the mere way in which they have been laid out. An attempt will be here made to show how such plots can be made the most of. As bearing upon this department, and as also applicable to the mansion and the farm-houses of a superior class, is the setting out or *designing of the ground surrounding or in connection with the house*, the position of the gardens, kitchen and flower, and the ornamental grounds, etc. By the display of some degree of taste in this department, there is no doubt that the value of building property is increased. In close connection with the sale and letting of suburban building plots, is the setting out of land for amateur farms. Various causes have increased the demand for these, and as a rule high rents are easily obtained for them. A few remarks will be given on this subject, which may be of service as indicating the

best and most economical way of setting them out, their buildings, etc., and the leading terms of the agreements which should be entered into respecting them.

The last division of the work will be devoted to the discussion of such subjects as could not be so appropriately taken up in preceding divisions, which dwelt with specific and clearly marked off departments of landed improvement, but which, being more or less closely connected with this, and some of them of special importance, although too much overlooked as a rule, could not in the interests of the work be left out of consideration. The following list will give the reader a fair idea of the leading subjects discussed in the division, although they may not be given in the same order as now stated:—The relative position of the various classes connected with landed property, practical points connected with this, letting of land, different kinds or classes of occupancy, leases and freedom in farming, rotations and general method of working farms, causes of success or non-success in farming, leading points connected with good and bad farming, the position of the labourer on the property or the farm, his wages, perquisites, and privileges, allotments, gardens to cottages, etc. These and some other kindred subjects may be considered as exhausting the topics connected with what may be called the first class of this division, namely, ‘The Organization of the Working Staff of the Property.’ The second class will embrace subjects bearing upon the working of certain departments of practical farming tending to the improvement of the land and the increase of its revenue; a brief review of the condition of British farming, and of the causes which influence it; directions in which improvement is required to bring the production of land up to the maximum point; important part played by live stock, considered chiefly as producers of manure; ‘the leading wants of English agriculture are stock and manure;’ general management of live stock; leading features of the cultivation of the chief classes of soils, as heavy clay lands, light soils, etc.; deep culture and autumnal or early winter culture of the soil; management of grass lands; pasture and meadows; arable as against grass lands, considerations connected with the increased supply of food for live stock, etc.

In concluding this, the Introductory Chapter to our work, we deem it necessary to point out that we have thought it right to discuss certain subjects, such as the question of the labourer, his wages, etc., which may appear, at a first glance, not to have a very close bearing upon the general subject of the work. But a little consideration will suffice to show that they have in reality a very intimate connection with it. No doubt they have not had the consideration paid them which their importance, we believe, demands,—have, indeed, in many instances, as a whole been wholly overlooked. But this is precisely the very reason why they should be taken up in the pages of a work which treats of a subject of vital national importance, and which aims at not leaving out the discussion of any point which is likely to promote the interests and to increase the value of landed property. In this matter we proceed on the assumption that the property may be considered as a vast manufactory, so to say, for the carrying out of a certain object; and that just as a manufacturer of cotton or wool, for example, pays every attention to the buildings which are to contain the machinery, and to the perfection of this machinery in all its details, he no less deems it a matter of vital importance to organize the working department thoroughly, and to see that the ‘hands’ which have the care of the mechanical appliances are capable of not only doing their work, but have everything necessary to enable them to do this well. So in like manner with Landed Property; the same principle runs, we venture to think, through all its departments, since just as it is essential that the farmer should not only have on his farm the necessary buildings required to carry on the work, but should take care to supply himself with all the requisite machines, appliances, and materials, so also is it essential, we consider, that he should be as careful at once in the selection and the organization of his labourers, and also to see that these have every facility given them, and be placed under such circumstances as will enable them to do their work well and economically.

So much for the relationship between the labourer and the farmer. As regards its influence on the interests of the property, the same principle evidently affects the relationship between

the farmer and the proprietor, whose tenant he is. While it is the landlord’s duty to give every assistance to the farmer, so that he can do his work in the best way, it is equally the duty of the farmer to do all he can to promote the interests of the estate, in doing which he may rest assured he is best promoting his own, while there are certain points which peculiarly affect his own position in relation to all the departments of farming. These and other obvious considerations, therefore, have had weight with us in giving a place to the discussion of certain points which, we venture to think, will prove of direct practical value in the improvement of landed property. We live in a period in the history of agriculture—if not in that of our nation—which can lay claim to being considered as perhaps the most remarkable of any which has preceded it. It is essentially a transition period, in which we are passing from a state of matters to one altogether new in its features, and which will exercise a potent influence, either for good or evil, on the future fortunes of the arts and sciences. It behoves all, therefore, connected with agriculture—the ‘nursing-mother of all the arts and sciences,’ and the primary support of the people—to consider well everything calculated to advance its interests and to promote the welfare of all concerned in the doing of its work, from the highest down to the humblest engaged in this, which has been well called the most ennobling and dignified, as it is the most useful, of the arts.

Such may be taken, then, as a comparatively brief statement of the various divisions of the work, and of the subjects treated of under each. These as stated, while giving a fair idea of their leading features, fail, however, in doing so as regards the number of practical points discussed, and details illustrated in each class of subjects. To have stated all these would have taken up a much larger space than we could afford to give in our Introductory Chapter; suffice it to say, that we believe the reader will find few points unnoticed; while some idea may be formed of the comprehensive way in which they have been further and more clearly elucidated by means of illustrations, by a glance at the drawings, amounting to several hundreds in number in the form of plates, independently of the woodcuts in the text.

CHAPTER II.

FARM BUILDINGS.—PRACTICAL CONSIDERATIONS CONNECTED WITH THE GENERAL SUBJECT.

Well arranged and constructed Farm Buildings a matter of primary necessity in the Improvement of Landed Property.—There should be little occasion to say much on this point, for it should be obvious on but a very slight consideration of the subject, that when any work is to be carried on requiring the accommodation and shelter of buildings, these should be of such a character as to enable the special work they are designed to aid to be carried on in the shortest of time, and with the least expenditure of labour. But while this is or should be obvious even to the most casual observer, even though he should happen to be in no way learned in practical farming as a calling, it is remarkable that it is not obvious to many who have more than a mere passing interest in agriculture; or if obvious, it is then strangely overlooked and set aside as a matter of no moment. But that this end is also of the highest value, we shall be able, we trust, to show in a word or two. At the same time, it is only fair here to record the fact, that while some landed proprietors are thus neglectful of the duty they owe to their tenants, and still more strangely of that which they owe to their own best pecuniary interests, there are others, and they constitute a numerous body throughout the country, who have done all in their power to provide their tenantry with buildings of the highest class in every department. All honour is due to them for the position they have taken and the example they have given in a matter of the weightiest importance, although, in truth, but scanty share of honour have they received beyond their own immediate neighbourhood, and, indeed, in some instances, even there. We have said that the principle with which we commenced this paragraph, obvious though it be, is by some so wilfully

neglected,—for it is scarcely possible to conceive that what is so clear to others is not so to them,—that the buildings on many of their farms can best be described in the negative, as being all they ought not to be—fit, in point of fact, for nothing else than to be pulled down and got rid of as eyesores and standing reproaches to their owners. Those who have a fair knowledge of different districts of the kingdom will have no difficulty, as we have none, in bringing to memory the recollection of too many buildings of this kind, and yet situated upon farms the soil of which is good and capable of the highest improvement. The wonder is that the tenants continue to hold the farms; but the wonder is lessened when we consider that in many cases they have lived all their lives upon the land, been born and brought up on it, and may be representatives of a long line of preceding occupiers. He can scarcely make up his mind to leave the ‘old place which his forefathers tilled;’ and he is content, possibly from being in no sense one of the modern class of go-ahead farmers, to jog on from day to day with what has so long served his purposes, such as they are, or because hopeless of any improvement ever being made. It is clear in such a case that a tenant of a different order of mind will not like to take such a place, however well convinced he may be that it is capable, by being put under the thoroughly efficient system, the details of which he knows so well, of answering in every way his requirements. But his first visit would show the hopelessness of such an improved system of cultivation being backed by the landlord, knowing well that he who could permit such buildings,—if buildings indeed they can often be called, made up of a wretched conglomeration of all materials,

much of which is in the last stage of decay,—and who obviously refuses to amend them, will just as readily refuse to carry out, possibly even to consider, such other improvements which he knows would be at once required were he the tenant. Little inducement, therefore, is there for a man of skill, energy, and capital to take to such farms, however tempting in other respects they may be. While believing that landlords of this class are but few, it is painful to know that they exist in numbers sufficient to afford material enough for the picture we have drawn. At the same time, it is only right to point out that the carelessness we have alluded to arises not so much from want of will as lack of means,—a view which takes very much indeed off the sharp edge of censure otherwise due. Again, a number of interests may be involved in the estate, rendering it a matter of almost impossibility so to reconcile them as to agree to the improvements in question. In such cases the only matter for regret is, that the difficulties cannot be overcome so as to set free the land from a restraint which does it infinite damage, by annually reducing its value. It is a mistake, however, to suppose that all the advantages to be derived from having good buildings on a farm are exhausted when it is said that they afford healthy and convenient shelter for the live stock, and accommodation for the machinery necessary to work up and prepare produce either for the feeding of these, or to be sent to market. There are other advantages which should act as an inducement to landlords, difficult to move in the matter, to do so at once.

Immediate Advantages obtained by putting down Improved Buildings.—The chief of these, and which brings others in its train, is the increased supply of farm-yard manure which they enable the farmer to produce; not only because, by the extra accommodation he has at command, he can feed his stock and keep his dairy cows, horses, etc., on the system best calculated to produce manure in the greatest quantity, and of the highest quality; but this quality he can not only retain, but greatly improve, by means of the accommodation he is now possessed of, in its storing up, preservation, and its general treatment. Now this supply of manure beyond that

which he could obtain under the old system, and this, moreover, of greatly superior value, not only enables him to keep up the fertility of such land as he had contrived to maintain in fair order, but to improve the quality of soils, for arable culture and pasture lands and meadows, which had been allowed to go back. By the improvement of the soil he secures increased produce from his crops; and thus he is enabled to raise larger supplies of food for his live stock, or to increase their number. This, again, gives him an additional supply of manure, which enables him still further to improve the cultivation of his arable land, and the treatment of his pastures and meadows; so that in process of time the land which but barely yielded sufficient to maintain a few, will be found capable of supporting a largely increased number and variety of stock. Thus we see the cycle of improvement completed, and the proverb exemplified,—the truth which it symbolizes, vital to the true interests of agriculture, being too often unfortunately forgotten,—‘No crops without manure, no manure without cattle, no cattle without crops;’ or, as still more tersely if not so elegantly put, ‘Muck is the mother of meat,’ as meat is the mother of cattle. The case we have here put is no imaginary one, it is exemplified in hundreds of instances throughout the country; and we could point to one in which the land, when originally taken, was so poor that it was let at a merely nominal rate, but following upon the erection of proper buildings came a series of operations, no doubt extending over a series of years, but with each year better than its predecessor, till at last the land was brought to that high pitch of perfection, that it, and the marvellous crops and stock which it bore, and the name of the gentleman to whose prescience,—so to say,—energy, skill, talent, and high business qualities all was due, became world-wide in their reputation. We have said enough, therefore, to show the imperative necessity which exists, on every property about to be improved, for putting down as amongst the first things, if not actually the first thing, to be done, farm buildings in every way calculated to meet the ends which the farmer has in view. How best and most economically to do this involves many considerations of importance, to which in a few

succeeding paragraphs we beg leave to draw the attention of the reader. Of these the first is, that there shall be a

Consistency in the adaptation of the Accommodation of the Buildings to the Special Requirements of the Farm on which they are to be erected.—At first sight so obvious is this, that it seems as if it could be discussed in a single sentence. But as there is more in the statement than at first appears, and as it concerns those who are closely interested in the designing or planning and in the construction of the buildings, we shall have to offer a few remarks upon the whole bearings of the case. For long it was, and, indeed, in a large number of instances still, when farm buildings are required on a property, it is not the practice to call in the aid of a skilled architect; the agent, bailiff, or farm manager furnishing a plan which, however rough it may be considered from a professional point of view, gives accurately the requirements of the proposed buildings. From this plan a specification is prepared, and some trusted and skilled builder in the neighbourhood is called in to give an estimate for the whole, and very likely gets the 'job' to erect the buildings. As already stated, the plan or design is certain to be good from these circumstances, the designer being not only intimately acquainted himself with the farm from his official position on the property, but he has doubtless taken to counsel the farmer, who knows precisely what he wants and does not want. But while the plan is good as such, it can scarcely be expected, as a rule, that the planner can have such a knowledge of architectural design as to enable him to give a building which is as pleasant or beautiful to look at as it is conveniently arranged. Hence the reason why we see so many farm buildings throughout the country the 'plainest of the plain' in external appearance, having no single element of what is known as architectural design. Here the manager may be quite capable of doing much better things, but the agent may object to 'money being thrown away upon such fripperies.' But of late years the desire to have architecturally beautiful buildings on estates has increased very much. Hence skilled architects are now frequently found to be planning and designing farm buildings in districts

where such a practice years ago was unknown. Many of these, in addition to possessing a high status in their own profession as designers, had acquired either by study, by practising the art themselves, or by gaining knowledge from practical farmers, a more than fair acquaintance with the practice of agriculture, so that their plans showed a thorough knowledge of the requirements of the farm, and a capability to cope with such difficulties as might arise in endeavouring to fulfil them. But another class of architects, and designers not architects, entered the field, whose only knowledge of farm buildings, of farms, and what work was done on them, was obtained from studying the designs of other and more qualified men. This study was not likely to afford them the information that a design or plan of farm buildings, suited for one locality or farm, was not necessarily suited for another and a differently situated farm; nor was it more likely to warn them of the danger arising from the fact that, because they had seen or otherwise become acquainted with the names of certain rooms, accommodation, or apartments, therefore every building designed for a farmer must have all these apartments. This has given rise to the issue of plans, published, and even in some cases erected, the whole principle of which displayed ignorance on the part of the designer of the true principles upon which all farm buildings must be designed. One of these principles, from which may be deduced the consistency named in the heading to this paragraph, is, that no apartment or building is put down which the necessities or style of cultivating the farm do not require. One should suppose that this common-sense principle would be sure to be carried out in a farm steading, as it is as a rule universally carried out in other business buildings. But that it is not so can be seen at once by merely inspecting some of the plans of erected or proposed steadings, in which there are apartments and structures put down which any practical farmer would know at once could not possibly be required on a farm worked upon any of the methods in use. The conclusion appears inevitable, that their designers had not been aware of the fact that, as there are, as we have already pointed out, different kinds of farming,

there must be or ought to be different kinds of buildings required for these. Thus the accommodation in a dairy-farm steading must be different from that required on a pastoral or common, and these again from a mixed husbandry farm. It is, indeed, only in the steading of the latter that those fancy plans, as they have been called, are admissible; as there are so many modes of cultivation, etc. carried on, a variety in the steading accommodation is more necessitated. Still there are many buildings in which there is

much that is not necessary; and if the architect be employed by the agent, he will be wise if he consults the farmer as to what is wanted before he prepares his plans. This, then, is the consistency between the accommodation of the buildings of the farm to its special requirements named at the head of the paragraph. But there is another principle yet to notice of great importance, connected with the apartments of a farm steading, namely, that stated below in first paragraph of Chapter III.

CHAPTER III.

POINTS CONNECTED WITH THE GENERAL ARRANGEMENT OF FARM BUILDINGS, THEIR POSITION ON THE FARM AND ON THE SITE SELECTED—DETAILS CONNECTED WITH SITE, ETC.

Placing of the various Apartments of Farm Buildings in proper relation to each other.—The style of farming being known, the accommodation required to suit it will soon be decided upon. The apartments—we use the term for lack of a better, department or compartment being scarcely applicable—making up that accommodation should be so arranged in relation to one another, that the work done in them shall go on regularly, each operation following upon another; so that there may be no loss of time in turning back, but that it may be economized to the utmost by the regular sequence of operations being maintained. Thus all the apartments connected with one branch should be placed in close contiguity to one another. For example, in a dairy farm, it is sometimes noticed that the working rooms of the arable department of the farm are mixed up with those connected with the dairy; whereas it conduces very much to economy and to good management, if all the apartments connected with dairy operations be on one side of the steading, and close together, such as the cow-house, the milk-room, churning-room, washing-house, cheese-press room, etc.; while those connected with the arable part of the steading should be on the other side, as the stable, cart and implement sheds, etc. This principle is also capable of extension, in determining the positions of the various rooms themselves. Thus, the milk-house should be near the cow-house, and the churning-room near the milk-house, and the room for washing the dairy utensils near both, yet so far away or in such a position that the steam, etc. do not gain access to the above apartments. The hay-house should be near the stable, and the turnip stores and food stores near the cow-house;

the principle in all cases being, that no time should be lost in going unnecessarily from one apartment to another, but all the rooms should be so arranged as to aid the work in the natural sequence of its details. The same principle also dictates the position of the straw barn in a steading, that being the central one; and as this is the heaviest, or at least the least easily transported material, the cattle-feeding places which consume the most should be placed nearest the source of supply. These principles of arrangement may be exemplified by a plan of farm buildings, Plate 1, which the author designed for a small estate, on the system of mixed husbandry, in which all the branches of usual farming were carried on; and although designed on a small scale, it will be sufficient to illustrate our remarks. The stack or rick yard (fig. 1, Plate 1) is placed at the north at the point *a a*; on this side are the boiler-house, *b*, and engine-house, *c*. From these, which are placed north and south, the corn barn, *d*, and straw barn, *e*, form the central part. From this the folds or cattle-yards, *f f f f*, are supplied with straw right and left, these being placed east and west of the central division, *d* and *e*. On each side of the store barn, *e*, are placed ranges of cattle-feeding boxes, *g g*, supplied with turnips from the root store, *h*, and with straw from the barn, *e*. Forming part of the westward boundary of the steading is another range of cattle-feeding boxes, *i*, outside of which is a dung stance or covered manure-pit, the position of which is shown at *j'*. Forming the eastern boundary of the steading is the cart shed, *k*, at one end of which is the calf-house, *l*, and outside of which is a second manure-pit or dung stance, *m*, serving for the range of stock

apartments of the east end of the northern side of the steading. This part is occupied with the work-horse stable, *n*, with a loose-box, *o*, the cow-house or byre, *p*, with a hay-house, *q*, placed between the byre and stable; and next to the former is placed the cooking or boiling house, *r*, next to which is the food store, *s*, contiguous to the machine-room, *t*, the power for which is supplied by a shafting connected with the engine-house, *c*. To the left of this apartment is an oilcake and turnip store, *u*, next to which is the infirmary, *v*. The next apartment eastward is the hay-house, *w*, root or turnip store, *x*, bull-house, *y*, outhouse or store, *z*, poultry-house, *aa*; and terminating the north range on the east side is a shed for young stock, *bb*, to which is attached a court placed southwards in the corner at *f*. Coming now to the southern range, and beginning at the western end of it, we have the slaughter-house, *cc*; next to which is a young nag house, *dd*, which also has its small court in the corner, *f*. The next to this is a sheep shed, *cc*, and adjoining which is a covered passage, *ff*; next to this a hay-house, *gg*, a root store, *hh*, pig-sties, *iii*,—these placed east and west of the manure or general store, *jj*. Going eastward is a lamb shed, *kk*, adjoining which is another passage, *ll*, next to which is a hay and oilcake store, *mm*. In close connection with the cart shed, *k*, is first the implement and tool house, *nn*, smith's shop, *oo*, and joiner's shop and timber store, *pp*. The arrangement here described gives first a northern range running east and west, comprised within the letters *bb*, and *o*; a central range, *b, jj*, running north and south; two wings parallel to this, as *i* and *k*; and a southern range, *cc, nn*. And it will be observed that the whole of the apartments making up the steading as a whole are arranged in relation to one another, so that the work can go on regularly from beginning to end. Thus the corn is conveyed from the rick-yard, *aa*, to the corn barn, *d*, where it is thrashed, and the straw delivered to the straw barn, *e*, from whence it is passed right and left for use to the cattle-courts, *ff*, cattle-boxes, *gg*, and *i*, and the other live-stock houses which have been already indicated. From these the manure is passed on to the dung stances at the positions *j* and *m*. An alternative plan is given in fig. 2, Plate 1, showing

another method of filling up the open space occupied by the cattle-yards, *ff*, in fig. 1, to the westward of the straw barn, *e*, and manure or general store, *jj*. Thus in place of the open cattle-yard, *ff*, fig. 1, cattle curtains are placed in which, as in fig. 2, *aa* are the yards bounded by walls as shown; *bb*, the open sheds with ranges of mangers, *cc*, which are supplied with roots from the central store, *dd*. Northward of these curtains a range of hammels for young stock may be placed as shown, of which *cc* are the yards, and *ff* the sheds. An alternative arrangement is also shown, in which a cattle-yard, *gg*, and shed, *hh*, are placed with a calf-yard, *i*, and a shed, *j*, next to which are the pig courts and sheds, *k, l*, turnip store, *m*, workshop, *n*, implement store, *o*, and cart shed, *b*, corresponding to *k* in fig. 1. By locking up the passages, *ff, ll, gg, rr*, and *ss*, the whole range may be enclosed at night under lock and key.

Here it will be observed that not only is the principle of sequence carried out, in which each step of procedure follows upon another, but that this is done in the way best calculated to save labour, inasmuch as the least easily handled or transported material, the straw, and which is used in the largest quantities, compared with the comparatively small bulk of other foods, is so placed in relation to the courts, sheds, and feeding-places in which it is most largely used, that the shortest distance is to be traversed in transporting it, and also in carrying the resulting manure to the dung stances or covered shed. So also with the turnips, the next heaviest if not the most bulky feeding substance used; these are placed in close relation to the cattle-courts and the feeding-boxes, etc. Then, again, in the feeding of the dairy cows—the food store and the room in which the food is prepared, the hay or straw cut, the turnips and other roots sliced or pulped, the oilcake broken, the beans, etc. crushed or ground, etc., and that in which mashes or cooked food are prepared, are all in close contiguity to the cow-house or byre. So also with the stable; that has got its hay-house and machine-room. This principle of arrangement might be illustrated by an endless range of plans, ranging in variety of arrangement according to circumstances; but we have given enough at present to

illustrate pretty clearly the important issues, as regards work to be done on a farmery, which the principle involves. From what we have said, this fact also may be deduced, that

'Model Plans,' or plans so called, are a mistake, inasmuch as they cannot serve the purpose for which a 'model' is designed, namely, to be followed or imitated under other circumstances or in other localities. Now as we have hinted, and will hereafter have occasion more particularly to detail, as one of the peculiarities attendant upon the practice of agriculture, the circumstances attendant upon locality, climate, soil, position, and other points bring about such a conflicting variety of peculiarities, and these in turn decide the requirements to be met to suit the case as regards cultural arrangements, and these, again, decide those of the buildings, that it is not possible, certainly by no means likely to be often probable, that any one plan can be designed to meet the varying conditions and circumstances of a variety of farms in different localities. True, it may readily enough be admitted that a well-designed plan may so aptly illustrate the principle contended for in last paragraph, that this may in its application be modified to meet the necessities of other cases; but this will not affect the kind and style of accommodation required, which will be found, as we have stated above, perpetually varying. And even this may further be admitted, that a well-designed plan may be found in a few cases nearly altogether adaptable, with but little alteration, to other localities. But these exceptions only prove the rule, which is, that just as a house is planned to suit the requirements of the family which is to inhabit it, so must a farmery be designed to meet the peculiar circumstances of the farm for the purposes of which it is erected. True, there are parts which are required in every farmery, these being what may be called essential apartments; and what these are will be seen as we proceed. Having thus given what may be called the preliminary principles connected with farm buildings, and which we trust we have shown to be of essential importance, we now proceed to the more practical parts of the subject. These are of necessity very numerous, embracing as they do every detail connected with each kind

of room, apartment, or part of the steading; these details, of course, varying in construction and arrangement. We shall, however, endeavour, by throwing the whole into a series of paragraphs, and by certain modes of treatment, to take up as little space, and to draw as little upon the time and patience of the reader, as possible. Much of both of these will undoubtedly be saved him by the arrangement adopted; as, if desirous to look at one point or to consider one detail only, he will find it very readily without having to do so after wading through a long range of matter embracing within it all the various subjects to be treated of. Having decided upon the plan to be adopted, in the preparation of which the farm manager or designer may find some hints useful to him in the illustrative and comparative plans of farmeries which will be found amongst the Plates, and described in the paragraph entitled 'Various Plans of Farmeries,' the first point thereafter to be considered is the

Best Position or Locality for erecting the Farm Buildings.—A variety of circumstances are to be taken into account in deciding this very important point. First, as the health of the stock is the first consideration, this ought to decide the position; and as, of all evil influences, dampness or humidity is the most to be dreaded, that position ought to be taken which gives the driest, even if that be the coldest part of the locality. Cold may, and indeed can, be guarded against; damp cannot by any means known to us be prevented entering into and hovering around buildings; it is the most insidious of all the enemies we have to contend with, or, humorously to put it as one of Thackeray's characters did in referring to the horn of the hippopotamus, 'It's the most penetratingest thing as is.' The neighbourhood of large pieces of water should therefore be avoided, especially of swampy, undrained, marshy lands. The local winds should also be studied, and shelter by a plantation belt, if possible, be obtained from those which blow from the north and north-east directions. Sites on level stretches of land, which are surrounded on one or more sides by high ground, are generally bad. They form, in fact, the drainage deposits of these same high lands; and unless particularly well drained, they are sure to be subject to damp

emanations. Even if well drained, they are more or less so, for, being level, the surface water does not run easily off, at all events does not go away quickly. When in such places white mists are seen often to hang over the land, the locality may be set down as unhealthy for a site, and one almost impossible to be made otherwise.

Lay or Lye of the Land and Roads influencing Position of Farm Buildings.—‘Position’ involves also the relation of the farm buildings to the general ‘lye’ of the farm fields. Some advocate the centre as the best position for the buildings, as this obviously equalizes the work of carting materials to and from the farm; others would make the roads decide the position of the buildings, although we think the lesser should give way to the greater, and therefore that, the position of the buildings being decided by the highest considerations, the roads should be made to conform to the conveniences of that position. We have indicated one or two of these considerations; another is the

Supply of Water.—Now this is of the highest importance—cannot, indeed, be dispensed with on any consideration; hence, if a supply of good water can be secured only at one point, and that by sacrificing other advantages, there can be no alternative but to dispense with these. Indeed, the most obviously common-sense way would be to look out for what would give the majority of the ‘higher considerations’ we have alluded to, and then, before any building operations were commenced, to ascertain whether water could be obtained at this position. If not, then, ‘force perforce,’ another must be looked for. There are some sites available possessing nearly all the requisites for good ‘building stances,’ close to or upon the immediate margin of rivers, from which water of the best or at least of superior quality can be obtained. But not a few of the most eminent sanitary authorities, if not indeed the majority of them, strongly doubt the propriety of having buildings near water, from which damp emanations more or less powerful in effect are so apt to arise, and these without a doubt exercise a bad influence upon the health of the stock. If the running water be of small breadth and depth, as a mere rivulet, then the evils are lessened in proportion to the size. Upon the whole, there-

fore, although water of good quality could be obtained easily in such places, it might thus have to be purchased at a rate dearer, so to say, than what it was worth. And the facilities now at the command of the architect and builder for sinking for water are such, that there should be no excuse for a bad site being chosen, simply because it afforded a good supply of water easily obtained.

All the requisites of a good site should therefore be first looked for, and then the trial for water made. And here, in passing, is a hint which may save large expenditure; we may remark that the ‘Abyssinian Tube Well Pump or Water Apparatus’ may be used with great advantage and economy in sinking the ‘trial holes.’

Assuming, therefore, that water is obtainable, we have yet to glance briefly as may be at the leading points affecting the

Actual Site of the Farmery, or the Position chosen.—We have said that the roads should be made subservient to the best site, not the site to the roads; these, therefore, should be put out of consideration; only, that if there be already good roads on any part of the farm where a good site is obtainable, some little matter as regards the site may be sacrificed, but only a little. The centre of the farm we have also stated to be theoretically the best position for the farmery, but practically there may be some points which will influence or modify this. Mr. Stephens, the well-known agricultural authority, advocated the centre; as does Mr. Newlands, and indeed the majority of writers on the subject. But if the exact central position involves some objectionable point, such as an extremely uneven character of the land, or a site which slopes or falls too much in one direction, or one which gives a hollow, or one near a marsh or damp land, then this position must be sacrificed in view of the greater importance of avoiding these objectionable features. The point, indeed, is one of those which can only be decided by good judgment, and a ‘quick eye’ to pick out, so to say, the advantages of one position over those of another. One word only we have to put in here, and that is by way of caution. The general idea is, that the central point of a valley, or, in other words, its

lowest point, is more sheltered from winds than the sides. Now the truth is, that as a rule the heaviest winds will be found to blow along the bottom of the valley, although in every sense it may be supposed to be the most secluded. If the sides of the valley be not too 'pronounced,' that is, the declivity not too great, a better site will be afforded there than in the valley, which, moreover, is more likely to be damp. A gentle slope, not such as to fatigue the horses too much in going up, although they regain it in going down,—and the times of market work and carting out dung to the fields, which will all be going-down carting, will be as a rule more frequent than the going up with full loads,—is perhaps the best site, if the aspect, etc., be good, inasmuch as it facilitates drainage. And it does not follow, although what may be called the general position is such, that the particular portion of it occupied by the farm buildings, or 'site,' as it is named, may be so much off the level as to interfere with foundation work. A quick and ready eye may be able to hit upon a site which, for building purposes, offers every advantage desirable, and yet secures inclination enough for drainage, etc.

Aspect of the Buildings.—Having once decided on the position of the farmery, the next point to be considered is its aspect or its 'look out.' All authorities agreeing upon the advantages of sunlight for farm buildings, the south would therefore appear to be the best aspect for them; but considering the whole cycle, so to say, of the sun's range, it appears that the aspect which gives the greatest average amount of sunlight, not only throughout each year, but each day, is the south-east.

Soil of the Site.—Position or site and aspect being decided upon, there is yet a point which exercises a material influence upon the health of the animals, and that is the nature of the soil. This may be so unhealthy that other advantages may have to be sacrificed, or partly so, in order to gain a better. As a rule easily remembered, the drier the soil of the site naturally, the healthier will it be. Clay, being peculiarly retentive of moisture, comes, therefore, at once under the category of unhealthy soils, and is in fact the worst; gravel, possessing the

opposite qualities, comes under the opposite category. Sites, therefore, approach the good or the bad requisites according as they are more or less gravelly or clayey. Those soils which lie upon the sandstones and the calcareous rocks are said to stand the highest in the scale of healthy site soils, those on clay the lowest, while those on chalk occupy the medium position.

Drainage of the Site.—No matter what the nature of the soil may be, it is essential that the site be thoroughly drained; that is, drained precisely as a field is, or should be, only the drainage must be carried out to a much fuller extent. Of course, this will be modified according to the soil of the site,—a close, heavy, retentive clay demanding much closer and thorough drainage than a gravelly soil. In this matter the architect must be guided by the result of his observations; and these will only be truly valuable if aided by 'test-holes' sunk at various points over the surface of the site. The more numerous these are, the more trustworthy will be the data on which to base the ultimate decision as to what extent drainage must be carried out. Not only must the site, however, be cross-drained throughout its length or breadth, according to the slope of the land, but the whole must be surrounded by catch-drains, at least one at the highest line along the length of the site. In short, the utmost precautions must be taken to have the ground on which the buildings are to stand thoroughly dry. And if the expense of doing this, so far as the whole of the site is concerned, be grudged, then let economy be practised—although it is such an economy as we cannot recommend—at those points on which buildings or apartments are to be placed in which dryness may not be so essential, and let the money to be expended be expended upon those points where it is—that is, those buildings in which live stock are to be housed. We should, however, be strongly inclined to say that money 'held in' on any department which concerns not only the life of the stock, but the 'life' of the buildings of any part of the farmery, will be 'ill held in;' for buildings, like machinery, live longest or last longest if constructed properly; and a damp building is not so.

Before dismissing the various points connected

with the question of position of the farmery, it will be well to advert, if only in a word or two, to a point which may in some degree modify it. This is the supply of water which may be obtainable by the force or power of gravitation, by placing the farm buildings at a level considerably below some point at which there may be a natural, abundant, and continual supply, as a small lake, etc., or by leading the drainage water of the high lands to the farmery. Even in these days of steam-engines, fixed, portable, and traction, water power is not to be despised. Nay, rather, it should be far more valued than it is, and far more frequently taken advantage of, as it would be, if attention were more paid to it as a matter of business importance. Estimates have been made of the available horse power of streams on farms in certain districts of the kingdom which are both startling and suggestive; and if a thorough investigation of the subject were made by any one of our leading societies, the result would be equally so. There are now many cheap and easily-set-up hydraulic machines, by which the power of water, now running uselessly away past farm steadings, could be made so available that steam power might be, if not altogether dispensed with, at least largely supplemented, or less steam power required to be put down. In either case it is obvious that economy would be the result; no small matter in these days, when fuel is so dear, especially in rural districts, which very often are situated pretty distant from sources of coal supply. Another point of importance connected with the subject is the use to which such supplies of water could be put in the case of fire. These two points are worth thinking about and looking after, when one is deciding upon the site of a farmery.

Some Practical Details connected with the Site of the Farmery.—In the foregoing paragraphs we have pointed out the leading features connected with the choice of position, and of the site itself. It is obvious, however, that it will be a remarkable example of a series of happy coincidences, if all the best points can be secured in any one position. In every way more likely is it to happen that, in order to secure what we have pointed out as essentials in a position and site,

one or two, if not several, may have to be sacrificed, however unwillingly. Some of the circumstances modifying the choice of the best points may now be noticed. For example, while, theoretically, the centre of the farm is the best position for the buildings, the central point may be situated near a marshy, ill-sheltered piece of ground, or in other respects quite unsuited for a building site; or it may be near a slow, sluggish river, low-banked and liable to flood, or close to a piece of water, the outflow of which is so slow that it may be said to be practically stagnant, at least possessing some of the evil characteristics of this class of water. All these, and such as these, will obviously decide the builder at once to change the position for one more nearly approaching the standard, even although that should be some considerable distance from the centre or theoretically best position for the buildings. Again, as to what we have said regarding the influence of a valley upon the choice of position, while we have stated that the sides will likely afford a better, at least a more sheltered, position than the bottom, still there may be modifying influences at work which may make the bottom the best position. Valleys are of course different in formation; one side may be very steep, the other only comparatively so; and yet the steepest side may give the best aspect, and otherwise good points worth securing. If these be not too high up, but placed at that height which will enable the balance between the carting to and from the farm buildings to be maintained, a careful examination of all the points should be made, with a view to fix the buildings here. One good thing will be secured,—drainage from the buildings; and another will probably be, namely, a constant and large supply of water obtained from the high lands above; or springs having their source there may be found on the site, with such pressure as to enable the water to be conveyed to all parts of the building, tanks, boilers, etc. etc. One difficulty will, however, likely have to be encountered in such a position,—getting a sufficiency of land level enough for the site of the buildings,—offices, farm-house, cottages, etc. etc. Still this difficulty may be overcome by a careful survey of the land. We are here, of course, supposing that the whole or by far the greater

proportion of the lands of the farm lie on the sides of the valley under notice; hence the difficulties which may arise in choice of position for the buildings. But however tempting the wrong side of the valley possessing the easiest slope may be in offering certain points, still it ought not to be chosen as the position for the buildings, as the aspect—in our supposed case, as we see above—will always be bad, and exposure to cold wind will scarcely be avoided. Now the health of the stock must take precedence of all other points, thus putting this side of the valley altogether out of court. The supply of water, at least at any pressure, will, moreover, be more uncertain. Unquestionably the worst case to deal with is where the lands of a farm lie wholly or chiefly on the sides of a valley both sides of which are about equally steep, and the general inclination or fall pretty well pronounced. Theoretically, the best way of dealing with this case would be by placing the buildings at the bottom of the valley, and laying out the fields and roads on the faces of the slopes, not at right angles to the line of valley, but oblique thereto, or in winding lines with easy curves having an oblique direction, thus saving largely in horse labour both in carting and working the soil. But unfortunately it too often happens that a small river or rivulet flows through the bottom of the valley, thus sometimes rendering it necessary that the buildings should be placed on the worst side of the valley. Care must be taken in this case to follow the counsel given above suited to such a position. Another point which may alter the position for the buildings from the central point of the farm may be the existence of a small stream available as a source of power to drive the machinery. So valuable is this, that, apart from the points of position affecting the health of the animals, it may be worth while to sacrifice some other point or points in order to secure this; but it should at the same time be remembered that it may be bought too dearly, so that judgment will require to be exercised. Some conceive such advantages to arise from having buildings near a river, that they will sacrifice excellent positions in order to secure these fancied advantages. We say 'fancied' advisedly; for we have shown that, especially in

the case of sluggish rivers, such a position cannot be a uniformly healthy one, and sure to be most so at the most unhealthy part of the year. But if it be chosen, or if it must be taken as the only one available, the utmost care should be taken to place the buildings at such a high level that no damage will arise from the highest known floods which may again occur. The caution is not unnecessary, as we have known buildings being placed in a hollow much lower than the normal level of the river. Some rivers, though not sluggish, are liable to sudden floods if connected with high lands in close proximity.

Roads in relation to the Position for Buildings.
—We have said that frequently good positions for the buildings which might otherwise have been obtained, are sacrificed for the sake of some road already existing. This is a wholly erroneous principle; the lesser must always give way to the greater; and while it is not denied that, other things being equal, it is a great point to secure immediate access to a main road leading to the market town, and past the accommodation roads of the farm itself, still to sacrifice even one good point for this ought never to be done. For, independently of the advantages arising from having the buildings somewhat secluded, at least not coming right up to a main road, with its 'tramps' and vagabonds ever ready to lurk about a place for evil purposes, it should be remembered that it is a comparatively easy thing to connect the buildings with the main road by a feeding road, so to call it, laid down in the best position and line. If a farmery must—that is to say, if its owner wills it so—be laid down close to a road, whatever else in the wrong way may be done, at all events let this monstrosity be avoided, namely, of dividing the buildings, so that part of them are on one side of the road, part on the other. This is no imaginary case—we have seen examples of it; and it is one which gives rise to a variety of evils and inconveniences, all the worse that they are perpetually recurring, or rather they exist in perpetuity. The loss of time caused by this arrangement is alone sufficient to condemn it. Roads should always be made subservient to the buildings, not the buildings to the roads.

Site modifying Position.—Where a good posi-

tion for the buildings may be obtained, this may yet have to be changed in consequence of its not affording a *site* with peculiarities or characteristics which are absolutely necessary to be present in it. The position chosen may possess all the external appearance of being a good building site, with characteristics of soil, etc. well fitted for the purpose. But in view of the important character of the buildings to be placed upon it, the large expenditure which their erection involves, the health of the valuable animals which they are designed to shelter, which must be maintained, all demand that a rigorous inspection of the whole area of the intended site shall be made previous to any part of the work being begun. Now this inspection may disclose the existence of very serious faults. The trial-pits sunk or borings made, which form an essential part of this inspection, may make known the existence of a very treacherous and uncertain soil, on which it would be unsafe to build, or, if built upon, might involve large expenditure and much trial of patience and loss of time to make good. Indeed, in view of the very dangerous character of some soils, it is questionable whether any attempt should be made to overcome it by the various expedients known to engineers and architects; the probability being, that it would be cheapest and certainly safest in the end to change the position to one where a good site soil could be obtained, involving no extra outlay in preparing it for the reception of the building. Only those who know what it is to deal with treacherous soils know the trouble and outlay of time and money which they involve; while, after all that is done, one is never certain but some occult cause may undo all the remedial work which has been done, and cause future and ultimate greater loss. We note these points to show the importance of attending to the nature of the actual site, and to take care that it possesses all the requirements of a good sound one for build-

ing on. In another paragraph (see *Foundations*) the reader will find a statement of what are the faulty and treacherous points which examination may disclose in a site the position of which is otherwise excellent. It does not follow that the actual site should be level throughout its superficies; a gentle slope will be no detriment, indeed rather an advantage, as it will facilitate drainage; and if somewhat irregular, giving sloping surfaces in more than one direction, a skilful architect or builder will make one or more of them usefully available in the placing of dung stances, liquid manure tanks, etc. etc. We have said enough to show the great importance of the subject, and to indicate the points connected with it which should be secured to the largest possible extent. All, of course, cannot; but he who has charge of this department must carefully balance the *pros* and the *cons*, and choose the position best calculated to secure as high a standard of efficiency as possible. To do this will demand from him the exercise of no small amount of forethought, judgment, and skill; and that a decision ought not hastily to be made, without considering well every point, and the influence which it may exercise, will be evident, when we consider that upon the good or bad placing of the buildings very much depends of the success with which farming may be conducted. If a mistake be made, the loss arising from waste of time, labour, material, and possibly from the necessity of after-work being required, will be great, for it will be continuous; and, further, it will be irremediable. The evil must be simply endured; and the losses arising from or caused by it, a great drag as they will be on the resources of the farm, though quietly submitted to, will be none the less felt. All this may be avoided, and a position as cheering as this is gloomy may be secured, by giving all that attention to the subject which the important issues it involves require and demand.

CHAPTER IV.

PARTS OF A FARMERY CONNECTED WITH THE PRODUCE OF THE FARM.—STRAW OR RICK YARD.—
STRAW BARNs, ETC.

Detailed Description of the different parts of the Farmery or Farm Steading.—Having now discussed the various points preliminary to the actual construction of the building, to be taken in conjunction with the plans elsewhere explained, showing the arrangements of various farm buildings from which some lints of value may be gathered in the setting out of the plan proposed to be erected, we are now prepared to take up the consideration of the arrangement and construction of the various parts which go to make up the farm buildings as a whole; and in doing so we shall 'begin at the beginning,' that is, at the source from which the straw is derived, that being the material which is used in by far the largest bulk in the working of the steading. This comprises the stack-yard and the thrashing barn, and may include the corn and straw barns, the latter being the place in which the straw is stored up for use. And, first, as to

The Rick or Stack Yard.—This, if the buildings as a connected whole be set down on the site with the aspect recommended in a previous paragraph, will always be at the north side of the steading or farmery. It should be as level as possible, or, if inclined, gently, and with the slope towards the barn, so as to facilitate carting towards the gangway leading up from the level of the stack-yard to the floor of the thrashing barn; well drained, so as to keep the ground not only free from actual wet, but from that degree of moisture which gives rise to exhalations of damp. It is impossible to keep the corn in the stacks too dry. With this object in view, and also to secure an immunity from the attacks of rats and mice, they are raised from the ground on what are called stathels or rick-stands, that is, pillars of wood,

stone, brick, or preferably of iron, provided with a platform of timber or iron bars, on which the corn rests. But if these be used, as used in one or other of the many forms open to choice they ought to be, a good deal of the advantage they yield will be lost if the ground on which they are erected be so ill drained that damp is pretty constantly arising from it. We have seen stack-yards more like swamps in rainy weather, than what a well-ordered stack-yard ought to be. To carry off surface water, which may collect rapidly in extremely wet weather, and may remain there for some time till carried off by the drains in the soil, it will be well to have surface drains or channels also. These will be best placed if running under the line of stacks, so as not to interfere with the level surface of the spaces between the stacks where the carting is done. Those channels or surface drains may be led to a sunk-fence ditch, which some prefer as the best fence for a stack-yard; or they may be led to a common point, at which they should deliver to a drain tube conveying the water to the underground liquid-manure or rain-water tank (which see under its appropriate paragraph). We prefer a good stone or brick wall as the fence for a stack-yard, although some like it to be quite open, with not even a sunk fence. This, however, gives the place an untidy, disorderly look, and affords too ready access for the incursions of passing herds of cattle or flocks of sheep. Each part of a farmery should have its own division. It need scarcely be said that the stacks should not be placed irregularly in the yard, but, to facilitate carting the corn from the fields to the stacks, and from them to the thrashing barn, they ought to be in regular and parallel lines, with ample space

between them for carting. These parallel lines thus form a series of roadways, intersecting each other at right angles, and dividing the whole surface over which they extend into a series of rectangles or squares, according to the size of the stacks. This size, it may be here remarked, is often made far too large when the rectangular plan of building them is adopted, in preference to the circular, which we deem the best plan. Vermin are most difficult to deal with; and the larger the stack the greater is the difficulty, and the freer and more extensive the scope for their ravages. Again, from the large area of the stack, there is such a difficulty in placing and building up the corn with perfect regularity, that unequal settlement often takes place; hence we too often see those huge stacks leaning over to this side or to that, or one part leaning one way, another part another, while parts bulge out here and there, giving a most unsightly appearance; whereas by the adoption of stacks of moderate size, built up on the circular plan, a regularity and solidity of construction, so to say, is secured, together with a neatness and trimness which satisfies the order-loving eye. Moreover, they afford, in some measure at least, greater security against fire; for if one or even two take fire, they can be more easily isolated from the others, pulled down, or reached by the engine or jet of water from the steam pump or high-pressure tank, with which every farm steading should be supplied; whereas in the case of huge stacks, the bulk of material is so great, that when once it takes fire little remains to do but to see it wholly consumed. Vermin, too, are more easily dealt with in small than in large masses or feeding-places. The system of cutting off the enemy in detail may be applied to small, scarcely with any hope of success to large, stacks. It is by no means so easy a thing to build a stack symmetrically, its sides perpendicular, or rather the centre of gravity of the whole mass on the proper point, so as to secure the greatest stability. And the difficulty is increased from the liability which the rick or stack stand has to settle unequally. This arises, in the first place, from the generally soft and yielding character of the ground of which the rick or stack yard is composed, it being left in its natural condition. The neatest and best

way would be to form concrete sills or foundations for each rick or stack; or if the expense of this was objected to, the plan might be modified by placing the rick pillars or stands *in situ*, as they are intended to be placed in the yard, then marking off the position of each pillar, and thereafter forming a concrete foundation in which the pillar is to rest. The great defect of rick pillars is the unevenness of their base; the more extended the bearing surface, the greater stability, and the less the inclination to settle unequally; the concrete foundation for each pillar should therefore be much wider or of greater diameter than the base of the pillar itself. And it would be a good plan, while the concrete was yet soft, to indent the surface with the base of the pillar, taking care to press it down perpendicularly, and withdrawing it immediately; when the concrete sets, there would be a seat formed in the foundation for the reception of the pillar base. If these plans be objected to, the sites of the ricks should at least be well rammed down and consolidated. In exposed situations and in severe gales, it is no unusual thing to see stacks overturned and many blown much to one side. To increase the security and stability of the rick-stand pillar, Messrs. Bayliss, Jones, and Bayliss, of Wolverhampton, have introduced an ingenious adaptation of Mitchell's screw-pile system to the pillars. These have a lengthened base underneath the sole plate, which base is provided at its lower part with a one and three-quarter turn of the flat-bladed screw. When the pillar is screwed into the soil, it takes a remarkably firm grip, so that when all the outside pillars are screwed in, and the central ones placed in position with the horizontal bars, the whole has such a degree of stability that few gales can overturn the stack, while unequal settlement is wholly or nearly altogether prevented. We think very highly of this ingenious adaptation of an ingenious invention. In place of having the rick-yard open, as is the general arrangement, it has been recently proposed to cover it in, after the manner of a railway station, with a roof, but having the sides open. This arrangement may be carried out in several ways: it may be a large roof enclosing the whole space, as in fig. 4, Plate 2, or the roof may be in two or more bays, as in fig. 5; the

arrangement of the yard may be as in fig. 8, where the spaces *a*, *b*, *c*, *d*, indicate its exterior boundary, a central roadway, *e e*, being provided, with a tramway, by which the contents of the ricks, as *g g*, can be carried forward on trucks to the corn-thrashing barn. This tramway may be placed between the rows of ricks, as shown by the double lines *h h*, small turn-tables being made in order to shift the trucks from the side tramways to the central one, *e e*. On one of the largest farmeries of the kingdom the corn is placed under a shed of great length, but of comparatively small width, in order to have a roof of narrow span. This is illustrated in rough plan in fig. 9, Plate 2, in which the small dark dots indicate the position of the pillars or posts of timber which support the roof, and which are shown in larger scale at *a* in fig. 10, these being let into a low retaining wall, *b*, of brickwork or masonry, enclosing the whole space of corn shed, *a*, *b*, *c*, *d*, fig. 9. In this arrangement the corn sheaves are not placed in stacks as usual, but are packed quite closely together, filling the whole shed, the ends and sides of which are open, exposing the ends of the sheaves. A very ingenious arrangement to prevent vermin from gaining access to the corn in the shed, is shown in simple diagram, fig. 11, Plate 2. This is simply a sheet or sheets of zinc or galvanized iron, which are fixed to the upper surface and to the retaining wall, *a*, and bent over as at *c*. It will be seen from this ingenious arrangement, that it will be an impossibility for rats, however they may climb up the retaining wall to *b*, to pass over the curved part of the zinc plate, *e*, and get to the grain in the shed.

Stacks are made of all sizes, some, especially in the southern parts of the kingdom, being very large; small stacks are better, however, than large ones, for obvious reasons, the air getting better through them, etc. As to form and shape, the circular we believe to be better than the rectangular; but in both cases the tops or roofs, so to say, are sloped off, and regularly and carefully thatched. If circular, the diameter should, for wheat, not exceed fourteen feet; barley should be the least-sized of all stacks, ten feet being the maximum; while for oats, the mean between wheat and barley should be the maximum diameter.

The stacks should in all cases be raised from the ground, and the best method, without adopting the plans we have already described, for securing a good foundation is to use the cast-iron rick-stands now so largely adopted. These are made up of a series of cast-iron vertical standards, with broad base and with hooded or capped tops. These hoods are like what may be called inverted bowls, hollow in the inside and rounded at the outside. By this arrangement no vermin can get up the stack, as they cannot pass round the hollow inside of the cup, even if they are able to climb up the vertical stalk, which they are not likely easily to do. The tops of the hoods are slightly flattened, and made with slits or openings to receive the ends of iron or timber beams, which go across from one standard to another, and which make the bottom or foundation for the corn to rest upon.

To prevent overheating of the grain, it is essential that all stacks should be hollow in the interior, the hollow extending from bottom to top. There are several methods in use for ventilating stacks by thus making them hollow. The old-fashioned way, and one which is still most extensively used, is the 'boss' system, as it is called in the north. This consists in placing wooden erections as in fig. 4, Plate 3; these open up the centre of the stack, and, reaching from the bottom nearly to the top, permit of free ventilation throughout the mass. The ventilation through the extreme upper layers of the stack, and of the outer thatching, is found to be effected in the natural way (plan of fig. 4 in plate 5). These wooden structures are of different shapes or forms, another being shown in fig. 6, Plate 3; but the object of all, of whatever form, is to keep the interior of the stack open, so that currents of air can pass through the sheaves. They usually rest upon horizontal tressels, which keep them off the ground, and still further assist ventilation. The only objection to these is, that the currents are too apt to be formed in one direction—the vertical only; hence, if some method of having lateral openings communicating with the vertical one could be arranged, a more thorough system of ventilation throughout the mass of sheaves would be secured. This to a certain extent will be attained by keeping down

the diameter of the stack; for it is obvious that, the farther the air has to travel in a lateral direction, the less efficient will be the ventilation through and amongst the sheaves; and the greater, therefore, the diameter of the stack, the thicker must be the walls, so to call them, of sheaves surrounding the interior framework, as in figures just given; and the farther, therefore, the air will have to travel from the outside to the inner open space, and the more difficult will it be to keep up the continual currents of air which it is the object of the arrangement to secure. These considerations would therefore militate strongly against the plan of some farmers, who maintain that you cannot make your stacks too large. It is impossible, or almost impossible, to lead corn from the field so thoroughly 'won,' as the technical phrase is, or dried, that there shall be no moisture in it. Now, when the sheaves, containing this moisture to a greater or less amount, are placed in mass in the stack, it is the evaporation of this moisture, when it cannot gain access to the outer air,—in other words, get freed from the interior of the stack,—that causes overheating; and it is scarcely worth the demonstration, that—to use a familiar phrase—it will take longer for the moisture-laden air to travel ten than it will take to travel five feet, and that it is likely to meet with more obstructions to its free exit in the greater than in the lesser length.

If stacks were so constructed that free ventilation in all directions was secured, it would not matter much how large they were; and a plan to secure this was some time ago proposed and carried out by a Mr. Smith of Darnock, N.B., which was found in a large measure effectually to secure this. The rough diagram, fig. 7, Plate 2, will show the general arrangement of Mr. Smith's system of stack construction, the principle of which may be said to be, first, the making of a longitudinal air-way or ventilating channel, so that the stack could be made of any length; and, second, the building up of the sheaves above and around this, so that the shortest way from this interior channel to the outside may be secured, or nearly so; while, from the way in which the timbers are trussed, the downward pressure arising from the weight of the upper portion of the stack is prevented, which pressure is in

the majority of cases very difficult to meet, and is the cause of that compression of the lower sheaves together which hinders so much the free passage of the air through them, and which the usual plans are not calculated to prevent. From the sketch in fig. 7, Plate 2, it will be seen that a central opening or space is left from end to end of the stack,—which may be made of any length,—and that this is made by the arrangement of the diagonal timbers, *b b, c c*, crossing at the top, and secured there by a band or rope. Longitudinal spars, as *h h*, are to be nailed near the top of these diagonal timbers, *b b, c c*; but those marked *f f, g g*, resting on the horizontal rafters, *d d*, are designed to be moveable, and are not placed on the rafters, *d d*, till the corn sheaves reach this height. The downward pressure of the corn at the top of the stack is relieved or got rid of by the employment of the diagonal struts or braces, *e e*, which are connected at one end with the horizontal rafters, *d d*, and the diagonal timbers, *b b, c c*. The dotted points show the ends or position of the sheaves. The width of the stack is arranged to be some 12 feet, the height of the central opening, *a a*, some $6\frac{1}{2}$ feet, and the width about $3\frac{1}{2}$ feet. By the employment of rough home timber, the woodwork may be put up at a cost varying from 3s. to 4s. per lineal yard, according to circumstances of locality, cheapness of labour, etc. The great advantage of the plan is the having a central opening from end to end of the stack, by which not only a perfect through-draught longitudinally can be secured, but a capability of inspection of the condition of the grain, also a point of great importance. The plan would be greatly improved, we incline to think, by having cross openings at intervals in the length of the stack; these could be very easily arranged for by vertical timber and short diagonal struts. These need not open quite at the sides of the stack, but stop short a little distance therefrom; this would ensure the ventilation required, and also enable the condition of the corn to be examined. There are obviously many modifications of the principle, which carries with it not a few important points worthy the attention of practical men.

Somewhat on the same principle, but by no means securing such a hollow condition of stack,

is the plan proposed by Mr. Usher; but the chief point aimed at in the plan is to relieve the lower part of the stack, as *a a*, fig. 6, Plate 2, from the pressure of the upper part, *b b*, thus keeping the sheaves in the lower part quite free and open throughout;— and this to such an extent, that in practice it is found that each straw, as it were, acts as a ventilator, being so loose and free from the pressure on it of the upper straw; thus, in fact, getting rid of the great evil in ordinary stack-building, where the pressure of the upper sheaves compresses the lower ones so much that they become a solid mass, so to say, through which little or no air can pass. Mr. Usher obviates the evil by supporting the upper part of the stack on timber, *c c c*, not on the sheaves of the lower part, but by the arrangement shown in fig. 6, Plate 2. In addition to the loose state of the lower sheaves relieved from the upper pressure, it is found that there is a subsidence of the whole lower portion, *a a*, to such an extent, that an opening of some inches is found at or near the level of what may be called the timber flooring, *c c c*, which, being at the very thickest, are, in stacks as usually formed, the very densest part of them, and admit of an amount of ventilation which is highly beneficial. The principle, therefore, on which the stacks are thus formed may be said to be a 'self-acting system' of ventilation, which, taking advantage of the weight or pressure of the grain in ordinary cases, the source or cause of evil, forces it, so to say, to be the very means of getting rid of it, thus making the 'enemy fight himself,' and, what is the best of the business, conquer himself. The diagram requires but little explanation: the timbers used may be of the roughest, the method of fitting them up the same, so that security be attained, the stack may be made of any length, the best breadth being found to be about 14 feet, the height of the posts up to what may be called the timber or dividing floor being 10 feet, the distance between the vertical posts being 14 feet, so that the framework is erected in 14 feet squares. Mr. Usher states that, in ordinary weather, corn may be safely stacked on his system after being in the field only for one-half the usual time, so that the chances of being

'caught' in bad weather are very greatly reduced; and further, that, after being stacked, it is brought much more quickly into a condition ready for the market. It is obvious, moreover, that the time saved, and of course the expenses, in heading or finishing off the stack at top, are considerable as compared with a round stack, two sides only in the new system being required to be headed, in place of all round, as in the other plan. The expense of erecting the framework is in itself comparatively a mere trifle, as any kind of rough timber will do, which will, he also states, be saved in the course of a year or two, by the mere difference in the cost of stacking, finishing off, etc., to say nothing of the increased value of the corn. The whole principle, so far as keeping up the currents of air throughout the grain is concerned, lies in relieving the lower layers of corn from the pressure of the upper, by the introduction of the timber flooring in the centre of the stack; and it is therefore a question whether the advantages would not be increased by adding to this relieving principle, by giving more than one row of horizontal timber. Mr. Usher, however, obviously relies upon the importance of relieving the pressure at the point where it is most felt, about the centre of the height of the stack; and there is no doubt that, by putting in too many horizontal timbers, the difficulties of stacking would be increased, and also of unstacking, as the timber would come in the way of the pitching-off forks.

The plan of having rick or stack yards wholly covered in has been very much advocated, as we have already said, by some of late years, and there is no doubt that many advantages would arise from it. At the same time, the difficulties attendant upon the carrying out of the plan must not be overlooked. The structural ones are in themselves of no mean order; not that we mean to infer that roofs of any span, calculated to cover areas sufficiently large to take in the whole of the grain of the largest farm, cannot be constructed; but one has to look at all the points of a question, and one of these would be, and is, the expense.

Before taking up the next part of the buildings connected with the barns, an important point will have to be decided, and one which

will modify considerably this part of the steading. This point requiring decision is connected with the *motive-power of the steading*. Setting aside for the present all consideration of water power, or supposing that it is not available, the question to be decided at this stage is, 'Which is best to be employed, stationary steam-engine and thrashing machinery, or portable?' The points involved in this question are important, and somewhat difficult is it to come to a decision, so much may be said on both sides. At the same time, we believe that a fair balance of the advantages and disadvantages of both will result in favour of

The Stationary System of Steam-Engine and Thrashing Machinery.—In this, the whole machinery throughout is housed in appropriate apartments in proper relation one to another, of which the thrashing machinery and that for corn-dressing are under the roof of the main building, stretching along the north side of the steading. The steam-engine may be also under this roof; or it may be placed, as it often is, in an offset building at the back, the boiler occupying the outside apartment of this offset. But whether the engine be in this or under the main roof, the boiler, for obvious reasons, as for safety from fire, convenience of firing, etc., is always, or should always be placed at the outside of the main building. One great advantage in having a fixed steam-engine in the steading is, that it can be employed not only to drive the thrashing machinery, which may be said to be its primary duty, but also to drive the various machines for preparing food, as straw cutters, root slicers or pulpers, crushing and grinding mills, etc. etc., which, although a secondary, is still a point of great importance,—one, indeed, which cannot be dispensed with. Again, the stationary system of steam-engine admits of the highest degree of economy being obtained in the working of all its parts. Thus, to begin with the boiler, space for the boiler-house of any requisite area can easily be obtained. This admits of ample boiler space or power being given; and nothing contributes more to the economizing of fuel for steam-raising than a boiler with ample water and steam space, and a furnace duly proportioned and arranged to suit these. A boiler of this description can be

fired without that system of forcing, than which nothing tends to wear out the boiler more rapidly, and to expend fuel without any useful result being obtained from a large percentage of it. If the boiler be on the tubular principle, the advantages are even more apparent; for these can be arranged with ample water-space, so that the full effective heating surface can be secured, while with slow, steady firing, and consequent steam-raising, and with abundance of steam-space, there is no violent ebullition and consequent 'priming' of the steam (*i.e.* steam carrying from the boiler a large proportion of contained water), which does great injury to the engine. Large and properly-proportioned boilers are the most economical in their expenditure of fuel, and last very much longer in good order than small boilers with confined water, steam, and furnace spaces, in which forced firing is almost indeed a necessity. Coming now to the engine, it is an axiom that the more steady or stable the foundation on which it rests the better, thus giving an immunity from all shocks, jolts, jars, and unsteady, irregular movements, than which nothing is so prejudicial to the working parts of a steam-engine, so fertile a cause of loss of power, and of a never-ending demand for repairs. A stationary steam-engine, of a good kind and of good workmanship, and well fitted up in the first instance, will work years without requiring any repairs, save the readjustment of parts which naturally wear out, but which can be done at small expense. The same truths apply to the thrashing machinery and corn-dressing machines, the whole of which, being fixed, admit of being worked in the way best calculated to enable them to give out their full effective power, and to do this with the minimum of wear and tear. Stationary boilers and steam-engines, in brief, admit of the easy application of the best and most economical methods of working, and of all those improved systems by which their effective power can be increased to a maximum, many of which are not applicable to the system we are now about to take up and consider.

The Portable System of Steam-Engine and Thrashing Machinery.—This would be more correctly termed the moveable system, inasmuch as the whole can be moved from place to place,

each individual part of the system being fixed in framework provided with wheels; the steam-engine, if on the locomotive type, being as a rule unprovided with traction gear, by means of which it could then be able to carry or drag itself along with its attendant thrashing-machine from place to place. Portable engines, so called, are now frequently made with traction gear, so as to be serviceable either for stack-yard purposes, or for field work in steam cultivation. An excellent type of this class of engine has been recently introduced by the well-known firm of Messrs. J. & F. Howard, Bedford. Portable engines may also be of the vertical type, of which there are numerous examples in the market, in which the boiler and steam-engine are alike vertical, the whole standing upon a base-plate which requires no prepared foundation, but may be placed in any desired position and set to work at once. But, as a rule, the engines used along with thrashing machinery are on the locomotive type, in which boiler and engine are horizontal in position. There is in this moveable system, applicable to stack-yard and barn work, a simplicity which is certainly taking. It dispenses with all special buildings, is independent of any special position, so that it may be set down either to thrash out corn from ricks or stacks left in out-fields, or it may be brought up and set down to work—as it is generally made to work—in any convenient part of the stack or rick yard. But the steam-engine, being independent of the thrashing machinery, can also be used separately, taken to any part where a machine has to be worked; or the machine may be brought to it, and the strap or belt connection instantly made and the work done. But if we examine the system more closely, we shall be able to perceive that if it has its advantages, it has its disadvantages also; and these are somewhat important in their issues. First, as regards the working of the boiler and of the steam-engine; both are placed in circumstances the very antipodes, so to say, of the stationary system. In place of ample room for either one or the other of those important members of the system, the very necessities of it compel the following out of compression, so as to have the maximum of working parts in the minimum of space, with the

least weight of material possible. Hence, to begin with the boiler,—and the evils are more apparent in the vertical than in the horizontal type of engine,—the water and the steam spaces alike are, as a rule, far too small to admit of steam being raised without that forcing system of firing which in the previous paragraph we have shown to be such a source of waste of fuel, damage to the boiler, and, through excess of ‘priming,’ to the engine itself, the most valuable and delicate member of the system. The same remarks apply to the engine, but on the converse principle which we in last paragraph applied to the stationary engine. Here in the portable we see all the vices of unstable working exemplified. In the case of the engine on the locomotive type, however well chocked and wedged the wheels may be, the whole machine rocks to and fro with every change in the motion of the piston; and however admirably fitted the parts may be in the first instance, under the influence of this perpetual movement they rapidly begin to work loose, and jolts, jars, and clicking noises give evidence of the mischief which is at work, and which is ever calling for amendment or repair. It may be taken as an axiom, that wherever in the working of machinery there is noise and jarring, there is loss of effective power and the going on of rapid wear and tear, which goes forward at an accelerating rate, so that if faults are not amended, and repairs made so soon as their existence is indicated, the labour and cost of ultimate work will be increased in a rapidly-increasing ratio. The same remarks apply to the thrashing-machine, the parts of which are subjected to the same evil influences, necessitating a system of bolting and bracing, which, while they add to the cost and weight of the apparatus, by no means quite cure the evil. No doubt, as a rule, the machinery of the system sent out by the first makers is of a highly superior class, and affords examples of ingeniously arranged and admirably constructed mechanism; but the evils inherent in the system do away with much of these advantages, and unfortunately those evils are a necessity of it. And, as one result, it is certainly startling to know the very small proportion of the effective power given out by this engine which is available for the very purposes

for which the whole system is set to work. From what we have said, then, as to the two systems, the stationary or fixed, and portable or moveable, the question between them as to their relative merits cannot rest on the issue or point of economical working. That, beyond all controversy, is wholly, we think, on the side of the stationary system. The decision, however, may turn, as it is likely as a rule to turn, upon the score of convenience. Here much may be said in favour of the portable or moveable system. Still it is a point which can only be decided by the peculiar circumstances of each individual case, or, as may be and is often the case, by the mere opinion of the farmer or proprietor, without special reference to the economical and other points to which we have drawn attention. In view of the great extension of the system of steam cultivation—or rather preparation of the land, cultivation in the higher sense being yet a system *in futuro*—it is likely to be an inducement to many to adopt the portable system. Yet, apart from all the considerations we have brought forward as bearing practically upon the point, there is yet another which is worthy of some slight notice, and that is—

The Relative Congruity in the Working of the two Systems of Thrashing.—Trace the operation of the stationary system, from the removal of the corn sheaves from the rick or stack to the gangway leading from the yard level up to that of the thrashing-floor; the orderly and quiet way in which they are fed to the feeding-board of the thrashing-machine; pass through this, the corn falling to the corn barn below, where it is dressed and made ready for storing in the granary, or sent, if fit, to the market; while the straw is passed quietly in to the straw barn, where it is packed closely and carefully together ready for use. With one exception, every part of the process is carried on under cover, so that the work is independent of weather; and, however high the wind may be, no loose straws are blown about, but all is orderly from beginning to end. Trace now the same operations in the open stack-yard. How differently are they carried out! The bustle and generally untidy state of matters which reigns around is in contrast to the quiet and order of the other system; and if the weather

be wet, and especially if it be windy, it will not be difficult to decide which system seems to fall into or fit with the nature of the work which is carried out, dealing as it does with a valuable substance, liable to be damaged by untoward circumstances, whatever they may be. But it is not only on the score of congruity, or of the 'fitness of things,' that the two systems may be judged. There is yet another and very important point to be considered, and that is—

The Relative Danger of the two Systems with reference to Fire.—Whatever may be said of the importance of the other points noted, no doubt of the full importance of this can for a moment be held by any thinking person. The incongruity of a burning furnace placed in the very midst of a highly combustible substance, is manifest at once; and the higher degree of congruity of the stationary system, where the straw is not allowed to approach at all within the vicinity of the furnace of the steam-engine, but is carried off and deposited at once in the straw barn, affords a striking contrast to the other system. We thus see

The Danger arising from the Use of Portable Steam-Engines in Thrashing out Corn in the Open Rick or Stack Yard, and the Measures to be taken in order to lessen the Risk.—Numerous as are the fires which are recorded in the columns of the papers of the day, as having taken place at farms through the agency of the steam-engine, those are, we believe, still more numerous which are not recorded; and this probably from the fact, that although considerable damage may have been done, still it had not reached the point deemed worthy of a 'newspaper paragraph.' But, then, what as to the risk which in those cases was run of total destruction of the farmery? This risk is run much more frequently than is dreamed of by those who employ steam-engines, and very few farmers there are now, who, with anything like a moderate extent of land, do not; and this even in the cases where fixed or stationary engines are used. Not that we would maintain that the risk of fire in the case of portable engines is dependent upon, or arises from, the fact that they are portable; but chiefly from the fact that they afford facilities, so to say, for the attendants being careless, and also from the fact that they

are worked in positions where fire can be easily communicated to highly combustible materials lying about.

When a portable engine is used on the farm, and in the rick or straw yard, for the purpose of thrashing, common sense would dictate that every precaution should be taken to prevent accidents by fire. But it is not always—some cynics would say it is not at all—that common sense prevails, to judge from the general method of using portable engines in a farmery. We have seen them in full work surrounded by heaps of loose straw, coming so closely up to and invading the precincts of the engine, that the attendant kicked the loose straw away, impressed evidently with the idea that there was danger in the near vicinity of the inflammable straw to the flaming furnace and heated ashpit of the engine. We should insist upon a clear space being kept for the engine to stand upon, and a wide space all round it, upon which it would be a *fineable* circumstance for the men if a single loose straw was found. We should go farther, and say that it would be but the right way to do, to have a stand made in the rick-yard purposely for the portable engine to be placed and to work upon, this being enclosed by boarding, better still by sheet-iron plates, which it would be easy also to make portable, so that they could be removed when the engine itself was laid up for the season. Say somewhat after this fashion: let *a, b, c, d*, fig. 1, Plate 2, be the outline of the stand, at intervals alongside of which, holes, *a a*, are made in the brick, stone, or concrete floor;—this last-named material we prefer above all others for such-like work. In these, when the engine is at work, posts, *a a*, fig. 2, are placed, these being provided with grooves, in which boards, or boarding, or plates of sheet iron are put down, forming an enclosure into which at least straw must be lifted, but into which it cannot easily find its own way. The floor of the stand we should make inclined, sloping from the corner or end, *d d*, fig. 1, Plate 2, in which the coals are placed, towards *b b*, at which we should place a small depression or shallow tank, into which the water, which always accumulates around the stand of a portable engine at work, would collect, and from which it could be

baled out when necessary. We should also in the concrete floor make depressions for the wheels, in which they could be ‘scotched’ or wedged up, thus securing the steady working of the engine. We think that this arrangement would secure some higher degree of order, cleanliness, and safety, than the happy-go-lucky way in which portable engines are too often set to work in our farm-yards. And if iron plates were substituted for the wood boards forming the enclosing sides, greater safety still would be ensured. If these were corrugated, the lightest plates obtainable could be used, and the corrugation would give great strength to them. There may be those who may think the arrangement an over-refinement in farm-building work. We do not think so. Prevention is always better than cure, and assuredly, in view of the dangerous practice we have already described, any simple arrangement or appliance, by which the danger will be lessened even in a moderate degree, is worth carrying out. One cannot afford to play with so potent a power as that of fire. At all events, whether this or some other safeguard be used or not, we cannot err in counselling a much greater degree of carefulness to be exercised when thrashing is going on in the open yard with a portable steam-engine in the midst of straw or near it, than is generally the rule in practice.

The Granary, its Arrangement and Construction.

—The granary, in which is stored the thrashed-out corn and grain till it is ready to be sent to market, or, if deemed advisable, partially used for stock-feeding purposes, is always placed on the second floor or storey, which, as a rule, extends in the case of large buildings over the whole range of the north side; or if less accommodation be required, it may stop short at a point in a line with the east wall of the straw barn, this being extended back so as to admit of its roof being carried along to the north wall, meeting that of the granary running east and west. This will form a cheaper roof, at least one more easily constructed, a valley being saved, than if the granary was extended a little farther east. The granary is generally low overhead, and the roof may either be open or a ceiling provided, the latter being a great aid towards keeping the room rat-

proof. The windows of the granary may be placed on one side only, that being the south; but better if on both sides, as more perfect, at least more efficient, ventilation will be obtained. The best form of window is the swivel, swung on central pivots, and provided with cords and pulleys and staples, by which it can be adjusted and fixed at any angle, so as either to throw the air towards the ceiling or the floor. In the construction of the granary two points are essential: first, absolute freedom from damp; second, rat-proof. The first may be secured by paying particular attention to the construction of the walls; if of stone, carefully avoiding the honeycomb system, in which the centre is merely a mass of mortar, often of very poor quality, and stone shivers. A wall of this kind, especially if the winds blow often north and south, and the climate a rainy one, will very rapidly get damp outside; and when this is the case, it will shortly extend to the inside. The only remedy for a wall which does get damp, is lining the interior with Portland cement concrete, made of cement two parts, one of the best river sand—not sea-shore sand, or taken from pits in which marine shells abound. No damp will come through a wall so lined. To prevent drip from the roof, a ceiling will be the best appliance to adopt, this being finished off to meet the vertical walls, not as usual with a right-angled corner, but with a curve of as wide a radius as possible. This curve prevents dust lodging; and if a battue be made amongst the rats, should they unfortunately gain possession of the granary, if they run up the wall they will drop at the curve, and be taken up by 'Tiny,' or other-named famous ratting terrier, as they fall. The best form of floor, if a slight additional expense be not grudged, is that constructed with light wrought-iron beams; the section known as Zore's gives the maximum of strength with the minimum of weight. The iron beams admit of a Portland cement concrete floor being laid down, which is at once damp-proof, fire-proof, and absolutely rat-proof. In another paragraph will be found a description and illustration of the best form of granary floor, and how it should be finished at the surface and at the sides where it joins the walls.

The Barns.—These are three in number: (1) the thrashing barn, (2) the corn barn, and (3) the straw barn. (1) The *thrashing barn* is on the second floor, and, as already stated, may be reached from the level of the rick or stack yard by a gangway, built solid generally; but if it be made of T-iron bars and angle-iron uprights, with boarded floor, a space is free below it, so that passage to and fro can be made. It will not be so inconvenient as a solid gangway, round which it is necessary to go before one side can be reached from the other. Moreover, a solid gangway, or rather roadway, obstructs the light, which a bridge-like structure such as we have recommended does but in a very limited way. If no gangway be desired, the corn is forked up from the carts, etc., brought up to the wall, or a 'straw elevator' may be used. The thrashing-barn door is wide, and may be made folding fashion with a horizontal cut near the centre, so that the lower part may remain closed while the upper is open, and *vice versa*. This arrangement also admits of different leaves being opened, which will facilitate ventilation and clearing away of the dust, the result of the operations going on in the barn. The floor, if fireproof, like that of the granary elsewhere described, should be left grooved and rough, so as to give secure foothold, and prevent falling amongst the machines, etc. The sheaves are fed to the thrashing-machine from the barn, the straw passing in to the straw barn, and the corn to the corn barn below, where it is winnowed and dressed. The corn-grinding mill and the bean and oat crushing mill are placed in the thrashing barn, the produce when finished being passed by spouts to the corn barn below, where it is sacked and taken to the food-store room. (2) The *corn barn* should be roomy, large, and well lighted. This is often done by the medium of the folding and split door (see par. on 'Doors'), but side windows should be added, as light is greatly promotive in the keeping apartments neat and orderly; dark rooms are almost invariably dusty, dirty, and disorderly. The floor of the corn barn will be best of Portland cement concrete, which will be rat and damp proof. (3) The *straw barn* is made of considerable length, projecting at right angles to the line of apartments at the north side; it is in height

equal to two storeys, or that of the granary walls, the roof running on to meet that of the granary, and finished with two valleys. But the straw barn, though the height of two floors, has no floor at the height of the second storey, but is open from floor to ceiling, to give as much space as possible to stow away the straw. This, as it is delivered from the thrashing-machine, is taken to the outer or far end, and built or packed carefully up, keeping the different kinds of straw separate, as they have to serve different purposes in feeding and also as litter, gradually approaching the roof vertically, and the corn-barn wall horizontally. Doors are provided at both sides, to aid in the quick distribution of the straw to the cattle courts, etc., these being placed at appropriate points, according to the disposition of the straw either for fodder or litter. The floor should be damp-proof and rat-proof; and to promote a free circulation of air through the mass of straw, port-holes are made at both sides, and it will be all the better if ventilation be fitted to the roof. Every precaution should be taken to prevent the straw becoming damp and musty, as the stock will not eat it with relish; straw at the best not being a very tempting article of diet alone, and in truth bad straw is not fit either for fodder or for litter. The south end of the projecting part of the building containing the straw barn, is in some instances provided with a floor at the second storey level, so as to form an apartment of any desired dimensions to be used as a *store-room for wool or general store*; this room being reached either by an open or outside stair at the end of the building, or by an internal stair from the room on the ground floor under, which room may be used as a *food store or a turnip or root store* for the supply of the stock in the courts, hammels, and boxes, which are placed in the area on each side of the straw barn; see plan, fig. 1, Plate 1. The apartments at the north side external to the wall are

The Boiler-House and Steam-Engine Room.—The space for coals and for firing is generally in boiler-houses too limited to admit of the free exercise of the fireman. There may be, and often is, an excuse for this in towns, where ground space is dear, but there can be none in the country, where a yard or two extra can make

little difference in the cost of the farmery. Work is always better done, and more easily, when the workman has plenty of what he calls ‘elbow-room,’—an expressive phrase. Dirty of necessity as the work of a boiler-house is, there is no necessity to make it dirtier and more slovenly still, by arrangements calculated to promote such a state of things. The coals should be placed in a regularly-built brick or stone walled-in space or ‘bunker,’ with floor sloping to the back to keep the coals in, and the water with which they are sometimes sprinkled. The coals should be delivered to this by a shoot from the outside, the upper part of this being large enough to hold a good supply of coals, and thus to prevent them being knocked and kicked about, as they too often are when laid down loose. The shoot should have such a slope, that when the coals are taken out of the bunker to feed the furnace with, a fresh supply will slide naturally down, keeping the bunker always provided with coals. A bunker should be placed at the opposite side of the house, for the reception of the ashes and clinkers. These should be kept separate by a division in the bunker, and each should be wheeled off from time to time to their separate heaps; the clinkers being used for the repair of roads, cinders being as carefully as possible consumed in the furnace, while the ashes are good to form a basis for top dressings mixed with other manures, or to be added to the compost heap (see ‘Compost Heaps—Manure Sheds’). All these details may appear to be over-refinements. They are not so, but thoroughly practical in their nature; for just as in a well-conducted farmery the principle of ‘A place for everything, and everything in its place,’ should be and is always kept in view, so also ought the companion principle, ‘Waste not, want not,’ both being fully and conscientiously worked out; and if so, it will be to the advantage alike of employers and employed. The boiler-house ought to be well ventilated, and top or side lights provided in the walls, for the purpose of throwing abundance of light upon the whole length of boiler top, so that all the appliances, as feed and safety valves, etc., may be clearly seen. Some boiler-top spaces are quite dark, necessitating the use of a light, and inducing carelessness in keeping all the fittings bright and clean and in good

working order. Although the front is usually left open, a four-leaved door will be of great service in regulating the draught, and affording shelter from driving rains, not only to the boiler-front fittings, as water-gauges, etc., but to the fireman. The *engine-house* may either be in a building outside the north range, or inside, forming part of it. It should be exceedingly well lighted, so that every part of the machine may be seen. The walls should be plastered or cement-coated, with rounded-off ceiling to prevent dust lodging. Ventilation is necessary to carry off the sickening, oily, offensive smells; and so also is a floor affording a firm foothold, thus getting rid of the greasy floor so often seen, and which is dangerous as causing falls, which may lead to grave accidents by the workers falling amongst the moving machinery. This, however, should be guarded off by rail fence. A fire-proof bunker should be made of brick lined with cement, and provided with an iron cover, in which to hold the 'waste' used for cleaning the engine and the oil cans. Greasy waste ought never to be allowed to accumulate, as it takes fire spontaneously with great readiness.

We now come to the parts of the building occupied by machinery and appliances connected with the stock. The first apartment met with next the engine-room on one side, or the corn barn on the other, being the *machine-room in which food is prepared for the live stock*. The completeness with which this may be fitted will depend upon circumstances; but the greater the number of machines, the more will the feeding of the stock be economized in time and material. The fittings of the machine-room will be very similar to those of the engine-room (see preceding par.). As there are generally apartments for stock, of one kind or another, in both wings extending east and west of the central range containing the straw barn, etc., some prefer a machine-room in the west as well as the east range, on the north side of the steading; this to save the taking of the food prepared in the machine-room—if one only—of the east range to the stock apartments in the west range, or *vice versa*. As this is a work to be performed so frequently, there is no doubt but that the plan of having two machine-rooms will result in the

saving of a large amount of time in the aggregate of the year's work. The same remark applies with equal force to the *mash or food-cooking room*, which should be the apartment next contiguous to the machine-room, as the roots cut or sliced or pulped, or the grain bruised or ground, or the oats and beans crushed in the machine-room, will be taken directly from there to the mash-room, in which they are cooked or steamed. The question as to whether it is advantageous or otherwise to cook food for live stock of any kind is one of the vexed questions of the practice of farming. Certainly, the balance of opinion is altogether in favour of cooking; and apart from the practice of habitually giving them cooked food, it is certainly admitted by the party opposed to habitual feeding in cooked food as part of the animal's meals, that occasional feeds are useful, and in the case of illness are essential. Seeing this, then, a mash-room will be a useful addition to the apartments of a steading, and should be provided; not forgetting the other reason for so doing, that while one tenant may be opposed to cooked food, the succeeding tenant may be an advocate for it. (See the chapter on the Live Stock of the Property.) The mash-room will therefore be ready for him, while the other during his occupancy can use the room for other purposes, of which he will have more than one waiting for accommodation. As regards the fittings of the mash-house, seeing that it is pretty well ceded by all the users of cooked food that steam cooking is quicker, more cleanly, and gives better food—that is, of a more uniformly cooked quality—than that done by fire or furnace cooking, the best apparatus to put up will be one of Messrs. Richmond & Chandler's make (Greengate, Salford, Manchester), with swivel steam pans connected with the boiler. Some prefer to have the cooking pans or vessels supplied with steam from the steam-engine boiler of the steading, but this is a roundabout and therefore not an economical plan; for it should be remembered that the steam-engine is not always at work, and to light the furnace and raise steam in a large boiler in order to supply the very small volume of steam required, will be a process somewhat akin to the 'erecting of a steam-engine to crush a fly.' Considerations such as these are often lost sight

of, commonplace as they are seen to be when once explained, but they nevertheless are those which go far to render the working of the steading economical; and nothing can be unimportant which tends to save either time or labour, both of which are but other forms of money. An ample supply of water should be provided to the mash-room or rooms, and washing appliances for the cleaning of the vessels or 'licking tubs,' etc., out of which the animals feed. Cleanliness in these is a great help to the maintenance of their health, as well as an inducement

for them to eat their food. Cattle and horses, especially the latter, are dainty animals, and will often turn from good food given to them in a dirty box or manger, sour-smelling, and of 'evil odour' altogether. More harm is done to stock from this cause alone—lack of cleanliness—than is thought of by many. This is another point worth thinking over and looking for, and, when found, as worthy old Captain Cuttle—one of Dickens' most admirably drawn characters—would say, 'When found, take a note on't.'

CHAPTER V.

PARTS OF THE FARMERY OR STEADING CONNECTED WITH THE LIVE STOCK OF THE FARM.

Accommodation for Fattening and Store Cattle, and for Young Stock.

'Cattle Curtains' and 'Courts.'—This kind or class of accommodation is one of the four classes

into which the methods of sheltering and feeding cattle are divided; the other three, presently to be described, being the 'hammel,' the 'stall in byre or shippou,' and lastly the 'box.' The 'curtain' and 'court' methods of keeping up

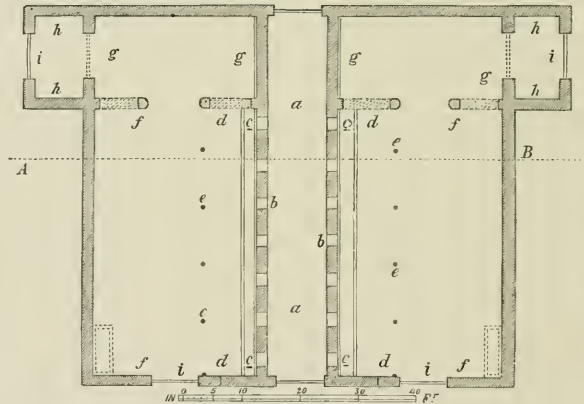


Fig. 1. Cattle Court or 'Curtain,' with Central Turnip Store for feeding right and left to Sheds in Courts, showing position of Dung-Stances and Liquid-Manure Tanks.

cattle are distinguished by the accommodation being chiefly open to the air, a small shed being

the only covered part. Of these two methods, the 'curtain' is distinguished from the 'court'

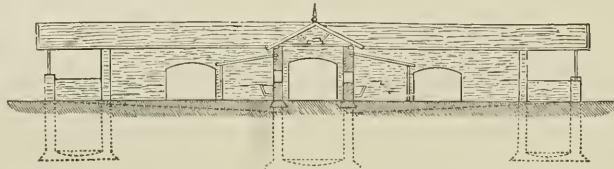


Fig. 2. Cross section on line A B in fig. 1. Scale as in fig. 1.

by its having the turnip store central to two open yards, with covered sheds right and left of

it. This arrangement is illustrated in fig. 1, being a plan with scale attached. Fig. 2 is a

section of the same on the line A B. In fig. 1, *a a* is the central turnip store, with roof over. Some would save the expense of a roof by keeping it open, as they are of opinion that the turnips are better by being exposed to rain and even frost (if the latter be not too severe), in which case

they are covered over with straw, or but few are brought up at a time from the pits; as when covered up they get dried and withered, and not so much relished in this state by the stock. The turnips are delivered through port-holes, *b b b*, in the side walls to the mangers, *c c c c*, the animals



Fig. 3. Front Elevation of alternative Arrangement of Cattle Curtain, without roofed-in Back Sheds.

eating under a light wooden pent-roof or covered place, *d d*, supported by light vertical posts, *e e e e*. The open straw courts are at *f f*; *g g* being the shelter sheds or houses proper; *h h*, the dung stance, with liquid-manure tank under; *i i*, the gates. A superficies of 60 feet of ground

space should be given for each animal in the shelter sheds, *g g*, and 240 feet in the open court, *f f*. The floor or bottom of both courts and shelter sheds should be paved or concreted, and made to slope or converge to a point at which the liquid can be carried off by a drain

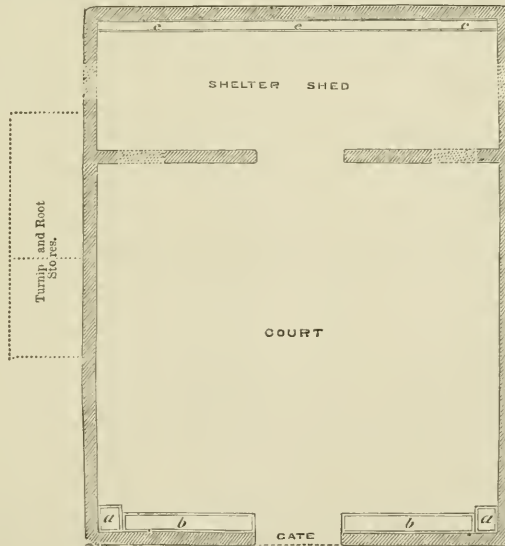


Fig. 4. Plan of Open Court and Shelter Shed for Cattle.

to the tank. One door only should be given to each shelter shed, as two doors cause unnecessary draughts; there is this advantage, however—apart from this—in having two doors, as shown by the dotted lines, that it permits of young or weak cattle escaping when pressed by the older

or stronger. Dunging doors—as at the dotted lines—will be a convenience to the sheds, *g g*. All the openings should have the angles taken off, and made round or 'bull-nosed;' this simple expedient will save the animals from being hurt, as at sharp corners. Water troughs are shown

in dotted lines in the plan in fig. 1; they should be always provided and supplied with water at pressure, if possible, so that a constant supply may be kept up, the waste water being allowed to run constantly off in small quantity. The best, certainly the cleanest, material of which to make the troughs is earthenware; these can be had of various sizes, and cheap. The shelter shed will be the more complete if a hay-rack be provided, running along the back wall.

The Open Court and Shed System of Sheltering Cattle.—The position of water-troughs, *a a*, manger, *b b*, and hay-racks, *c c*, in shelter shed, are indicated in fig. 4, which is a plan showing the ordinary arrangement of cattle courts; it is drawn

to the same scale as fig. 1. The placing of a turnip store, as *h h*, fig. 1, in the immediate vicinity of cattle courts, is a point of essential importance, and on which nothing requires to be said, being so obvious. These are indicated by the dotted lines in fig. 4. The smaller division may be for mangolds, etc. In fig. 5, which illustrates the 'stall' and 'hammel' systems of feeding in one building, the turnip store is placed at *i i*; this will be described in due course. The troughs or mangers for the animals to eat the turnips out of, as *b b*, fig. 4, may be made, as they usually are made, of wood, supported on raised brick pedestals; they are now frequently made of earthenware, and any number may be placed end to end to get the desired length.

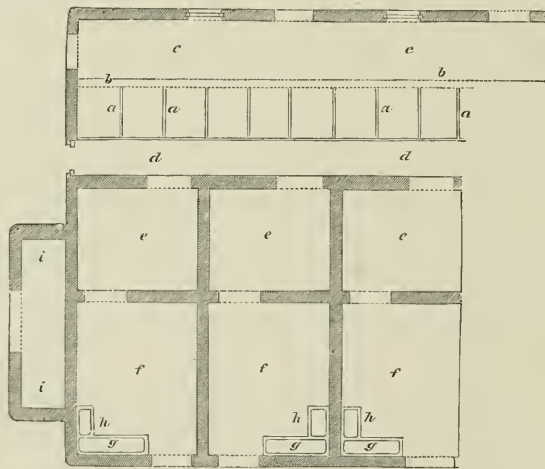


Fig. 5. Plan of Stall and Hammel Systems of Sheltering and Feeding Cattle.

The height of the brick pedestals on which these rest is 2 feet. If the trough is made of wood, a convenient depth is 15 inches; the front, of 1-inch 'batten' thickness, being secured at intervals to the walls by iron bars. The front slopes from a width of 18 inches at the bottom to 2 feet at the top. Moveable hay or straw racks are useful appliances in a cattle court. As gates hung in the ordinary mode are apt to be in the way when the courts are being cleaned out or 'dunged,' the more convenient method is

to have them to slide on a side rail, or rather rails, one at each side of the gate-road, so that the gate can be moved full open either right or left, as desired. It is not a good plan to have one court open into another; but if it cannot be avoided, or if it is desired, the gates between the courts must be suspended in such a way that, no matter how much straw or dung may be in the courts, they can be opened to allow of free ingress and egress.

We now come to the 'stall' system, which is

illustrated in fig. 5, and also figs. 8 to 12, Plate 3. A description of the details of this system will be found in this section under the head 'Cow-byres and Shippens,' the arrangements of part of which are equally applicable to the stall-feeding of cattle.

The Hammel System of Sheltering and Feeding

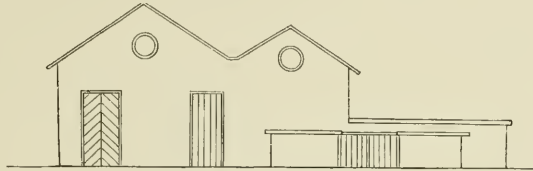


Fig. 6. Front Elevation of fig. 5.

mangers, *g g*, and water-troughs, *h h*; a turnip store is shown at *i i*. By all those who have adopted this plan of sheltering feeding-cattle it is highly esteemed, and we are inclined to go to a great extent with those who maintain that it is the system which combines in the closest way the necessities of artificial with natural shelter, and in the opportunities it affords of allowing the animals to have the exact amount of exercise necessary to maintain their health. A section of this is given in fig. 6.

The 'Box' System of Sheltering and Feeding Cattle.—We now come to the last mode of sheltering fattening stock, namely, the 'box' system. Each box should give as a maximum 100, and as a minimum 80, square feet of floor surface. The boxes may either be arranged in single line, as in fig. 7, or in double line, with a feeding-

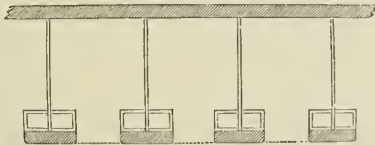


Fig. 7. Part Plan of Range of Cattle-boxes.

passage of 6 feet wide between the two ranges. Each box is provided with a manger, which, if loose, rises with the dung, or it may be fixed by hooks to a series of 'eyes' fixed in the corner posts, so that the height may be adjusted as desired. It will be seen from the section in

Cattle.—The third mode of sheltering stock is that known in the north as the 'hammel' system, illustrated in fig. 5. This system may also be called the 'small court and shed' system, for it is in reality this. Convenient sizes are, for the shed, *e e*, 14 feet by 12; for the court, *f f*, 14 feet by 18. These are provided with

fig. 8, the floor, *a a*, of the box is some distance below the ground level, *b b*, so surfaced as to drain

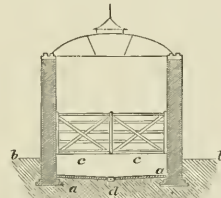


Fig. 8. Section of Cattle-boxes in fig. 7:

to points leading to the liquid manure tank, when this excavated part is floored with stones, as shown, or it may be concreted, as already described. A trap communicating with a drain leading to liquid manure tank being placed in the centre at *d*, the floor should dip towards this in all directions, that is, from the four corners. The divisions between the boxes may be made of brick, or as hurdles, as shown in fig. 7.

Stables.—The stables given to farm buildings are of two kinds or classes: first, those given to the horses which do the work of the farm in its various departments, and are therefore called by the name of, or are placed under, the first class of work, 'work-horse stable'; setting them out as apart from the second class, known as or named by the title of the 'carriage or riding-horse stable.' The name of this sufficiently indicates the class of work which the horses allotted to this stable per-

form, namely, the carrying or the driving of the farmer, his family, and friends. The details of arrangement and construction are, in both, identical as regards principle; the only difference arising from the superiority, on the one hand, of the fittings, calculated either to promote the comfort and the convenience, or to minister to the health of the animals; or on the other, to add to the appearance of finish or even of elegance to the general look of the whole interior. The fittings of the work-horse stable, while they are generally plain, even to a point of ugliness, should still be so designed and constructed as to minister to the health and the comfort of the animals. Such are the two classes of farm stables; and we now proceed briefly to describe their general arrangements. The first point to be attended to, and one which is too frequently overlooked, is the width of the building. This, as a rule, is too narrow, 16 feet being that generally recommended. That this is too narrow by at least a couple of feet, and we should be inclined rather to say thirty inches, will be very obvious, when one considers the space taken up by the stalls and their fittings, which will leave practically very little room for the important work of dunging, cleaning, and the general management of the animals. One has but to analyze, as it were, the dimensions of a 16-foot wide stable, to see that these important operations cannot be carried on with anything like comfort and convenience, which alone can secure that thorough cleanliness and order in every detail of stable management which it should be the ambition, as it is really the best interest, of the farmer to secure. Thus, taking the length of the stall with its manger fittings at 8 feet, the width of the gutter at 1 foot, and the harness racks, which project at least 2 feet from the opposite wall, a width of only 5 feet is left for the dunging and general work to be done. That this is far too narrow is clear enough; but in point of fact it is even less than this, inasmuch as the length we have given to the stalls and their fittings is at least 1 foot less than it ought to be, in order to give more room to the horse, with the full width of the fittings. The difference between work done in ample space and that where it is confined is in any case so great, and all in favour of the

larger area, that it is mistaken economy to limit the size of any farm buildings, more especially where such work is to be done as that of a stable. A good width, then, being decided upon, say 18 to 19 feet from wall to wall (inside measurement), the next point to be decided is the arrangement of the stalls. That which is generally adopted places the manger, hay-rack, and water-trough—if the latter form part of the fixed fittings—directly against the back wall; but some prefer to have a feeding passage at the head of the stalls, between them and the back wall. Two advantages are claimed for this arrangement: first, the convenience of feeding the animals direct from the passage, without disturbing the animals in their stalls; and, second, the giving of a freer ventilation at and above the space where the animals breathe. Much can be said in favour of this plan. Where the number of horses kept is considerable, there is no doubt that a large saving of time will be effected in the feeding of the horses, as the food can be taken directly from the apartment in which it is prepared, in trucks, which may be either hauled along the floor of the feeding passage, or upon a light railway specially laid down. Horses, like other animals, do not like to be, and are not the better for being, disturbed when once they have been bedded down; and disturbance will certainly be the result at every time of feeding where the other plan of arranging the stalls already described is adopted. After all, it is a point which will be best decided by the farmer, according to the ideas he entertains as to the best way of feeding his horses, although we may state that the balance of circumstances is decidedly in favour of the feeding-passage system. The next point to be decided on is the width of each stall, measured from the inside of the travis divisions bounding each side. It is a great mistake to make the stall too narrow; one has only to observe the habits of the horse in the field, to notice that he loves to have abundance of room in which to lie, so that he can give full stretch to his limbs, and assume the variety of positions which alone secure the thorough rest and repose which are so conducive to the maintenance of his comfort and general health. It is painful to witness the way in which some horses

are cramped up in narrow stalls, in which it is impossible for them to have the freedom above alluded to. If, indeed, the health and comfort of the animal be truly considered, the stall system can lay no claim to be considered superior to that of the loose-box, which gives the nearest possible approach to the natural freedom of the field, combined with the conveniences, such as they are, of the stable. Such, indeed, are the advantages of the loose-box system, other than that already alluded to, such as isolation during times of sickness, etc., that we should, where the highest style of accommodation is aimed at, have no hesitation in recommending it to be adopted where space is no object; and certainly mere space, in rural districts, where land has not the high value that it has in others, is a point not to be set against the far higher consideration of the health of such valuable animals as farm-horses. Even in cases where the stall system is adopted, —which, for many and obvious reasons, will continue to be the rule for a long time at least yet to come,—we would advise, at the very least, one loose-box to form a part of every work-horse stable. As to the width of the stall, the minimum should be 6 feet, and that inside measurement from one travis division to the other. The length of the stall, measured from the front line of the hay-rack to the inside line of gutter, should be not less than 8, but would be all the better for the horse if 9 feet. In the construction of the stall it has long been a point much discussed, whether the floor should be on a level, or have an incline from head to foot. An inclined floor is certainly convenient, inasmuch as it admits of the water which is used for cleaning purposes, as well as the urine of the animal, being passed off as quickly as possible to the gutter. But some writers object to the inclination of the floor on physiological grounds, as tending, they say, to exercise an injurious influence on the muscles of the hind legs when the animal is standing. There is possibly too much stress placed upon this; and then reference is made to the fact that horses, when left at liberty in the field, prefer to stand on level ground where that is within their reach. That there are exceptions to this, any close observer of the habits of the animal will readily enough admit, as a horse in a

field is seen standing pretty frequently on inclined ground when he certainly has the choice of level. The truth is, that it is difficult as well as dangerous to try in such cases to set down a hard and fast line from which there is to be no deviation; and taking into consideration at once the conveniences of construction and the health of the animal, a medium course will be found to be the best; this being probably met in the best way by giving the floor a fall of 2, but not exceeding $2\frac{1}{2}$, inches from the manger to the gutter. There can, of course, be no objection, but, on the contrary, every reason to give an inclination to the floor of the stable opposite the stalls—that is, running along the front wall, and which is usually designated as the cleaning or dunging part. The inclination should, however, be no more than just sufficient to carry off the water used for cleaning the floor to the gutter. As regards the materials of the floor itself, much wider choice is now offered than was formerly the case, when, almost as a universal rule, small stones or pebbles were used. It need scarcely be said that this material gives the very worst possible form of floor for practical purposes, inasmuch as the interstices formed between the pebbles form spaces into which dirt lodges, and from which it is exceedingly difficult to get it removed. The smoother the surface of a floor the better, care of course being taken that it is such as to give the horses a firm foothold. The reader will find in the chapter on the 'Construction and Fitting of Farm Work generally,' ample details as to the best way of constructing stable floors, and the most economical materials to use. Another point in the arrangement and fittings of stables, which has given rise to considerable discussion, is the position of the hay-rack of the stall, some advocating a low, some a high one for it. Those who hold that the manger should be low, object to its high position, first, on the physiological ground that the animal is constrained to eat the food in an unnatural position, which tends to strain the muscles of the neck, the natural mode of eating being that in which the animal depresses its head to the surface of the ground; the other objection being that the hay seeds are apt to fall into the eyes and ears of the horse as they drop between the bars of the

manger. On the other hand, those who prefer the high rack object to the low one, as the animal's breath is more likely to contaminate the hay, the saliva to drop in amongst it, and, lastly, that it is more likely to be pulled out of the rack by the horse. If nature is to be a guide in cases such as this, certainly the low position is the best for the rack, and this in all improved fittings is the one adopted; and certainly the hay or grass can be more conveniently and quickly applied to a low than a high one, more especially where a feeding passage is placed behind. Another point in the arrangement of stables which has also given rise to discussion, is the kind of roof to be adopted. The one generally used is close-ceiled, and this in order to admit of a hay-loft being placed above. The other form of roof is that technically known as an open one, in which all the timbers are exposed. Where the health of the animals is truly considered, there can be no doubt that the open is preferable to the ceiled roof, inasmuch as it admits not only of thorough ventilation being carried out, but of that being done in the most economical manner. No doubt a ceiled stable may be warmer than an open-roofed one, but excessive warmth is not required; indeed, correct physiological principles would seem to indicate that the healthiest condition for an animal to be in while confined in the stable, is that in which, while the air is pure, it is also comparatively cool. It should not be forgotten, in arranging and constructing a stable, that its confinement is antagonistic in great measure to the condition, which may be called the natural one of the animal, in which he lives, exposed to air of varying temperature, which in this climate is on the average low; while he is obviously supplied, for breathing purposes, with any amount required. While some advocate a large supply of light to the stable, others, and they may perhaps be said to be the majority, prefer to have very little of it, on the ground that horses are quieter in a dark than in a light building, and consequently rest and sleep better. Here, again, if nature is to be taken as a guide, and the physiological principles which it indicates are to be followed, what may be called the common-sense system is the best, namely, giving an abundance of light, which is well known to

exercise a healthy influence upon animal life; while the *natural* intervals of light and darkness are obviously obtained in the same way as they would be were the horses pastured in the open field. Moreover, a well-lighted stable not only helps the quick doing of its work, but is much more likely to be kept thoroughly clean than a dark one, seen dirt having a better chance of being removed than that which is concealed.

In some parts of the country, and in districts where breeding is carried on extensively, horses, while not pastured in the fields, are not kept in steadings in close stables of the ordinary description, but are provided simply with open sheds attached to yards. In Plate 10 we illustrate, from designs on the 'detached system' prepared by us for the farm buildings of an estate in the south of England, in fig. 1 the elevation, in fig. 2 the section, of a horse shed, the front of which is quite open, save by the posts or pillars, *a a*; the range of mangers, *b b*, is at the back of the shed, hay and straw racks, *c*, as in fig. 2, being also provided. The stalls of stables may be arranged on one or other of the modifications adapted for cow byres, as shown in figs. 8 to 13 in Plate 3.

In Plate 9, fig. 1, we give, as suggestive of a stable on a large scale, the plan of a double-stalled stable recommended by the Royal Commissioners to inquire into the condition of cavalry stables; in which the stalls, *a a*, *b b*, are divided by the feeding and dunging passage, *c c*; the shallow surface-drains at the feet of stalls run in the direction of the arrows to the gully traps, *e e*; an open litter shed, *f f*, is placed at one side. In fig. 7 we give the plan of a stable on the ordinary mode of arranging the stalls, *a*; the dunging and feeding passage, *b*, in front; *c* is a litter shed. In fig. 13 we give a section of this. Figs. 4 and 5, Plate 9, illustrate the two usual modes of fitting up the stalls; in fig. 4 a feeding passage, *a*, is placed between the back wall and the hind post, *b*; on this the hay-rack, *c*, is placed above the manger, *d*. In fig. 5 there is no feeding passage to the hay-rack, *a*—in this case in the low position—being placed against the back wall; this either stretching across the whole width of stall, or only partly, the remainder of the space being filled up with a manger and drinking

trough. Instead of the travis boards, *bb*, between the head posts, *cc*, and the heel posts, *dd*, in cavalry stables a plan has been adopted of dividing the stalls merely by a bar, *a*, as in fig. 10, Plate 9; this being suspended by a rope or chain, *b*, and secured in such a way that, should a horse get his leg over the pole or bar, the pressure he exerts looses a catch which allows the bar to fall to the floor. Fig. 11 is the plan of fig. 10.

In some cases, parties prefer to keep horses in loose-boxes, which are simply small apartments, as in figs. 9 and 12, Plate 9; section of fig. 9 is given in fig. 8, of 12 in fig. 6. In some cases, loose-boxes are not provided with mangers, etc., or if so, are so arranged that they project into a space behind the wall, from which by a simple arrangement they can be brought forward when required; in other cases they are fitted up with racks and mangers, as in fig. 12. Where the number of horses kept is large, it is very convenient to have a small shoeing shed and stall in contiguity to the stables, an arrangement perhaps better than using the general smith's shop of the steading. A double forge is shown in fig. 3, Plate 9, at *aa*, *bb* being the shoeing shed; a section of this is shown in fig. 2. For these arrangements we are indebted to the report of the Royal Commissioners already alluded to.

Cow-houses or Byres.—We now come to consider the arrangement of this important department of farm buildings; and here, as in stables, considerable diversity of opinion will be found on the different points. Taking first the arrangement of the stalls, we find that there are several modes proposed and carried out. These will be found illustrated in Plate 3, and it will be seen on examining the drawings, figs. 8 to 13, there, that there is very considerable difference between them. The arrangement in fig. 8, Plate 3, is that most generally adopted, and has been in use from what may be called 'time immemorial.' In this the stalls, *aa*, are placed with their heads right against the back wall, *bb*; the gutter, *cc*, at the foot of the stalls divides the dunging passage, *dd*, from the front wall, *ee*. This arrangement is, in the opinion of many, improved by a feeding passage, *aa*, placed between a partition, *cc*, at the head of stalls, *d*, and back wall, *ec*; the gutter, *ff*,

and dunging passage, *gg*, are placed in the same relation to the front wall, *hh*, as in fig. 8. In fig. 10, Plate 3, a new principle is introduced, the laiving in the cow-house or byre, and under one roof, two sets of stalls, one of which, *aa*, is at the back wall, *bb*, the other set, *cc*, being placed against the front wall, *dd*. Here the dunging passage, *ee*, naturally comes into the centre of the house, being placed between the gutters, *ff*, *gg*, of the two sets of stalls, *aa*, *cc*. In fig. 11 of the same plate this principle is altered, by giving at the heads of the two sets of stalls, *aa*, *bb*, feeding passages, *cc* and *dd*; the dunging passage, *ee*, being, as in fig. 10, between the gutters, *f*, *g*. In fig. 12 another principle of arrangement is adopted, two sets of stalls being used, as in the preceding figs. 10 and 11. Here an essential part of the arrangement is the feeding passage, *aa*, placed centrally between the two sets of stalls, *bb* and *cc*, the feeding being done right and left; the gutters are at *d*, *e*, between the stalls and the dunging passages, *f* and *g*, and front and back wall, *h* and *i*. Each of these plans of arrangement has its advocates, but probably that illustrated in fig. 12 may be taken as the one which is the most esteemed by advanced farmers. The only objection which can be made to the double-stall system, or rather we should say the chief objection, and which is purely a constructional one, is the width of roof which it demands, and wide-spanned roofs are always more costly than narrow ones. There is this further constructional objection, that the house being wider than the other apartments of the homestead, taking them at the general average, it breaks the line of building where the cow-house forms part of the range. There can be no doubt, however, that for convenience of working, this plan in fig. 12 is the best of the methods of arrangement shown, as it provides both feeding and dunging passages, and these in positions most likely to facilitate labour. The stalls of cow-houses are of two kinds, single and double, and no small amount of discussion has been raised as to which of the two are the best; but if one considers the habits of cows and the circumstances under which they are placed when confined, circumstances essentially different from those fattening cattle which are stall fed, there

can be little doubt that the single is in every way preferable to the double stall. Mr. Stephens, the eminent authority on agricultural matters, and one whose opinions were invariably distinguished not only by sound practical knowledge, but by a common sense which was very marked, strongly advocated the single stall; and this for the reason that the cow is an animal remarkably capricious and uncertain in temper, and is therefore apt to be troublesome to the other animal alongside of which she lies in the double stall; and further, that a cow has generally a preference for being milked from one side, and that in case of a double stall may cause inconvenience and loss of time in milking. To these considerations we may add another, namely, that the cow at calving time requires to be kept quiet, and indeed for some time before it; and also to have plenty of room during that trying period. These points, however trifling they may be considered by some, are truly of great importance, when we consider the value of the animals concerned, and how necessary it is that everything should be done which can secure their health and comfort, and to enable them to carry out all their important functions under the best possible circumstances. The value of cows is often greatly deteriorated, and not a few of them lost, simply by having them so treated as to make the performance of these functions a matter of difficulty. These considerations evidently point to having the stalls, whether they be single or double, of ample dimensions. As a rule, stalls are made far too narrow; we have seen double ones of a width a little more only than what was required for one animal; the condition of the two under such circumstances may be easily conceived. For a single stall, the width should not be less than 4 feet 6 inches from travis to travis; that of a double stall, 7 feet 9 inches to 8 feet, a little less being required for two, or supposed to be required, although why, it is somewhat difficult to say. The remarks made in the last section, under the head of stables, will apply with greater or less modification to other points of arrangement of cow-houses; but the following details may be taken as a general description, applicable to cattle-fattening stalls as well as to those for cows. The more

minute details of fittings, etc. will be found in Chap. IX.

The divisions or 'travises,' *aa*, in fig. 8, Plate 3, between the stalls, are made either of stone, iron, or wood; we prefer to use wood, as it is more comfortable for the animals. The length of the travises should not exceed 6 feet, and the height between 4 and 5 feet. They are sometimes made as low as 3 feet, to allow the animals all the advantages of companionship without being incommoded by one another; the length of the travis measures from the front of the manger. The head and heel posts which support the boards forming the travis are 4 inches by 3 inches, let into mortice-holes made in a curb-stone fixed in the ground; the travis boards, half batten thickness, are let into grooves made in the inner faces of the head and heel posts; the lower board of the travis being placed in a groove made in the upper face of a stone curb running along the whole length of travis on the ground. The construction as here described, although the usual way, can be much simplified if concrete is used for the formation of the floors—as described under par. headed 'Floors'—for the stone curbs may be dispensed with, the travis board resting upon the foundation of the concrete, and being embraced therewith at the floor of the stall. The manger should be raised on brick piers, 5 bricks, 'on bed,' in height; and if of earthenware, which is the best material, cemented to the upper surface of the same; if of wood, the dimensions of the manger are 3 feet in length, 1 foot in depth, width at the bottom 10 inches, sloping outwards to 15 inches at top; thickness of stuff, 2 inches. The water-trough should be placed end on with the manger, and long enough to fill up the space left by manger. If possible, water-pipes should be laid to supply the troughs, and waste-pipe to carry off the foul water. The hay-rack is placed above the manger, and should not be high. Some dispense with hay-racks, and feed the hay as the other food out of the manger. The feeding is best performed by means of a feeding passage, *a*, fig. 9, Plate 3, made at the back of the stalls, the width of which may be from 30 inches to 3 feet. Sliding doors should be made in the back division of the stalls, through which to fill the mangers without disturbing the animals

in front; all the water-taps—if supply at pressure is obtained—being placed so as to be within easy reach of the servant as he walks up the feeding passage. The gutter is placed at *c*, fig. 8, in front of the heel post, and is usually made of stone, about 12 inches wide, and some 2 to 3 inches deep. This can be very easily formed if concrete is used for the floor. The dunging passage is at *d*, with doors at end wall.

In Plates 4 to 7 we give plans for various arrangements of cattle-fattening sheds, and for cow shippens, which we designed to be constructed of wood for a county of England in which that material is much used for farm structures. In Plate 4, plans are given of a 'bullock shed' on what may be called the 'composite' principle—that is, in which part of the shed is constructed as a closed building, as at A A in fig. 3, Plate 4, and part as an open shed, as at B B. Fig. 2 is a section on the line *a b c d*, fig. 3. In fig. 3 the lines *c c* indicate the direction of small grooves or channels made in the concrete floor, leading the liquid to the gutter, *f f*. In fig. 1, Plate 5, there is an alternative arrangement on the closed system, in which a straw shed, *a a*, is placed at the end of the cattle-house, *b b*, which in this case was designed to be built of brick. In Plate 6, the plans of a cattle and cow shed, designed to be built of concrete, are given, in which fig. 1 is the elevation; fig. 4, the plan;

fig. 2, a section on the line *a b* in plan, fig. 4; fig. 3, a section on the line *c d*. In this plan, double stalls and single ones are combined; the cows in full milk being kept in the single, while those drying off are kept in the double. In fig. 8, Plate 7, the plan of another bullock shed on the composite principle is given, in which *a a* is the dairy cow-house with stalls, *b b* a closed bullock shed, *c c* a root store. In fig. 9, another plan is given, with the root store, *a*, centrally placed between the house, *b*, and that at *c*. In *b*, the bullock-house, stalls are provided. In fig. 10 is part of the plan of a cow-house designed by Monsieur Tisserand for one of the farms of the late Emperor of the French. In this the root and food stores are placed centrally, and also the dunging passage, along which a railway runs. In fig. 6 we give the cross section of a cattle-feeding box of a single row, designed for the steading in Plate 1. Fig. 7 gives part of a section of cattle-boxes designed as a double range.

Sheep Shelter-shed.—The subject of *shelter for sheep* has been very much discussed of late, and, like almost all other agricultural questions, has brought out exceedingly diverse and contradictory opinions—some maintaining that sheep do best without, others that they do best with, shelter. It is, it must be confessed, somewhat difficult to see how these physiological principles,

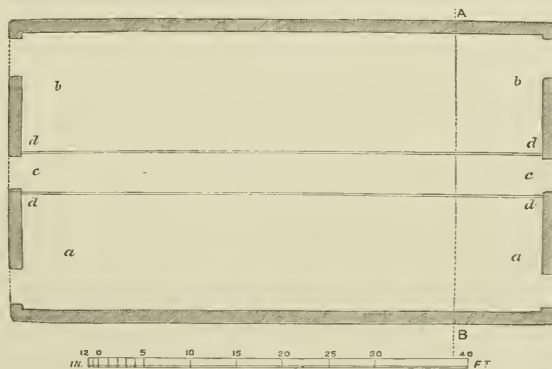


Fig. 9. Plan of Sheep Shelter-shed or House.

which are now universally admitted to be true as applicable to other stock, should be inapplicable

to sheep. The question is so wide, and involves so many considerations, however, that we cannot

even glance at its different bearings; suffice it to say, that there is a growing conviction that, if cattle and other stock are the better for being provided with shelter from cold and wet, sheep are also; and we may express the hope that this will be one of the subjects which will be taken up by our leading agricultural societies, and fully experimented upon, so that we may be favoured with some authoritative expression of opinion which may serve as a useful guide to practical men. In fig. 9 we give the plan of a sheep shed—two sheds, *a a*, *b b*, being enclosed in this, with a feeding passage, *c*, between, and provided with racks, *d d*, and mangers at each side of the feeding passage. Fig. 10 is a section of this, not

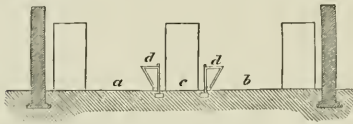


Fig. 10. Vertical Section of lower part of Sheep Shed in fig. 9.

showing the roof. The side walls should have numerous ventilating openings in them, or, in place of being solid throughout their whole height, may have part of the height made up of lattice or louvered boarding. The floor should be

hard paved or concreted. A hard floor is a desideratum for sheep, preventing affections of the feet. It is quite a mistake to keep the floors of sheep sheds or courts littered deeply. If a sheep has a choice between a hard and a soft ground to lie or stand upon, it will invariably choose the hard place. The shed should have an open court attached, to which the sheep can go for exercise in the open air.

That a necessity exists for some improvement in the methods of keeping sheep, as practised in this country, is evident from the fact, as stated by a well-known farming authority, that a loss of 5 per cent. of the sheep stock of the kingdom represents no less a number than a million and a half of animals. Some idea of the extent of the loss may be conceived when 15 per cent. represents that of many districts. Amongst the preventible causes of such grievous losses, our authority puts protection from the weather, which may be done either by erecting rough shelter-sheds in the fields, or having a sheep-house as forming part of the steading.

The Piggery.—Shelter is usually given to pigs in their styes, but their courts are usually left exposed to the wet; this brings about a state of filth and damp. We therefore strongly advo-

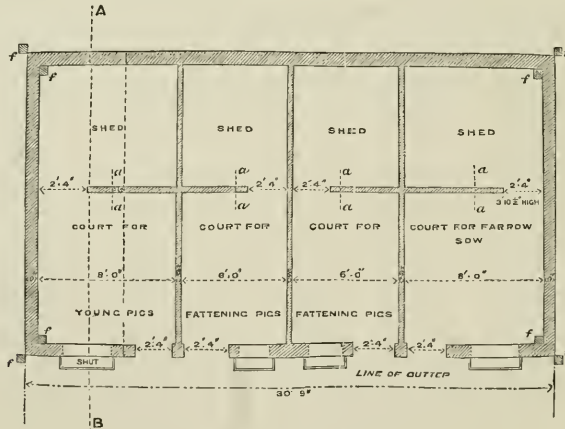


Fig. 11. Plan of Piggery. Scale in fig. 12.

cate the covering in of the courtyard of piggeries, but in such a way that ample ventila-

tion will be secured at the sides and ends. We believe that all the requirements of a good pig-

gery are met in the design illustrated in figs. 11, 12, and 13, which is that of one we have recently erected in concrete. Fig. 11 is the plan, fig. 12 the front elevation, and fig. 13 the cross section.

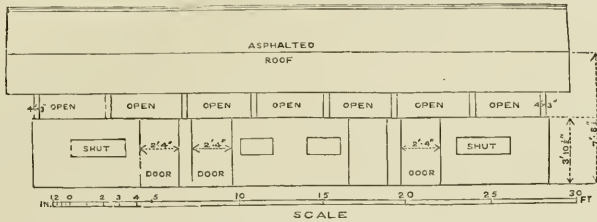


Fig. 12. Front Elevation of Piggery in fig. 11.

The shed is ventilated by openings at the points *a a*; the food is delivered to the troughs, *d d*, being made in the wall of shed and in front wall to deliver the liquids to this; the floor is concreted, and has grooved gutters leading to drain, *e*.

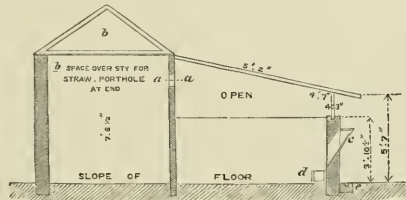


Fig. 13. Section of Piggery on line A B in fig. 11. Scale in fig. 12.

The concrete frame-posts, *f f*, fig. 11, are shown in the position they occupy when the concrete walls are being run up. Fig. 4, Plate 4, is the plan, fig. 5 a longitudinal section, and fig. 4, Plate 10, front elevation of a piggery erected on the same principle, but of timber.

CHAPTER VI.

DAIRY BUILDINGS—THEIR ARRANGEMENT AND GENERAL FITTINGS.

General and Preliminary Considerations.—In our introductory chapter we have made reference to this important subject or department of the farmery, as one the details of which have been very much modified by the results of recent investigations, and a wide series of careful experiments instituted by practical and scientific authorities, these having been undertaken mainly on the Continent of Europe and America; although it is only just to say, that our own scientists and practitioners have contributed largely, and in an important way, to the general mass of information thus and now placed at the command of the dairy farmers of the world. In addition to the facts which have thus been made public, a very considerable modification in what may be called the requirements of the trade has been necessitated in consequence of the changes alike of the habits of certain classes of the community, and of their improved circumstances. These have given rise, not only to an increased demand for dairy produce amongst the classes who have always been able to pay fair prices for it, and who have, as a rule, considered them essentials in domestic expenditure; but the improved circumstances of classes of the community who occupy a lower rank have given rise to a demand amongst them for this produce, considered also as a regular part of the daily food of their households, who in former times, if they used them at all, did so only on occasions of sickness, or as a very great luxury, or at odd times, as that of family rejoicings and the like. The result of these circumstances, which, conjoined, form a remarkable development in the social history of our country, has, as already hinted at, given a wonderful impetus to dairying as a branch of farming,—an impetus which has

not been met in like proportion either by the increase of special dairy farms, or by the improvement in details of management of those farms in which dairying constitutes a part of their system; great as have been the improvements which have assuredly been made within the last decade or two in every other branch. Of the increased demand for dairy produce, to which we have thus specially alluded, circumstances have confined it largely, and in many districts specially, to milk and butter, and of these chiefly the former. It is unnecessary to detail the reason why this is so; suffice it to say, that it has to a large extent revolutionized the system of milk conveyance from the farms to the various centres of consumption, and also the details of management of the farms themselves. But while this demand for milk is a marked feature of dairying as now practised, that for butter is not less so; and although prices for it are now obtained with ease at which the forefathers of our present dairymen would have been astonished, yet delighted, there is such a manifest ease in sending the milk only to market, that many farmers, who were at one time noted for their skill in butter making, produce now only such weights as supply their own domestic demand, or those of a few favoured customers, and send nearly all their milk directly to town. This, as we shall see, has also introduced specialties in the details of dairy practice; and if the circumstances we have named have brought about a change in the departments of milk selling and butter making, the change is the more striking in that of cheese. Whether it is from the social circumstances which we have above named, or not, it is unnecessary to inquire; but the fact remains, that the skill in cheese making for which,

as dairy farmers, we were at one time noted all the world over, has to such an extent left us, that the trade has largely decreased, and has passed from our hands into those chiefly of the American dairymen, for whose produce there is an increased and increasing demand, with a like result as regards the prices they obtain. That the decrease in our trade is not caused by the lack of demand for English-made cheese as such, is shown by the fact that the highest prices are still obtained for first-class produce, it being only in the case of the inferior qualities that the falling off is the most marked. One practical result, and for us alike fortunate and unfortunate in its influences, is, that the dairymen of America, and in like manner, although of the same kind, but not in like degree, those of the Continent of Europe, have paid for many years such marked attention to the practical details of dairying in all its departments,—not of one merely,—and have enlisted the services of the ablest of their scientific men, that it has assumed the position of a science. Fortunate on the one hand, as we have above hinted, inasmuch as there is for us a vast mine, so to say, of scientific and practically useful information; unfortunate on the other, that, having thus taken the lead in finding out the best way of doing the best work, they have, in the department which distance alone compels them to compete with us, namely, cheese making, done our trade a vast injury; and in view of the new method of bringing over and landing here supplies of animal food, the probability is that the competition will be extended also to butter making in its fresh condition. In fact, as we pass this sheet to press it has already extended. No evil is there, it is said, but what has connected with it some good; and the good in the case now engaging our attention is, that our dairymen have been so influenced by the state of matters we have just described, that great efforts are now being made by them to restore the balance of the trade, which, even according to their best friends, has been lost through their indifference and neglect. The result of these efforts has been to a large extent, and will yet be to a still greater, that all the departments of dairying have been recently so much improved, and so many of the new plans

of the American and Continental systems introduced, that the trade bids fair in a short time to display few or none of the characteristics of the old systems. What these new features are, we shall see as we proceed.

Arrangement and Construction of Dairy Buildings.—One of the most peculiar features connected with dairying, and which influences not merely the details of arrangement and construction of the buildings, but, as we shall presently see, the transportation of the milk to a distance, as well as its making into butter and cheese, is the extreme delicacy of milk, and its liability to become tainted and deteriorated by various causes, such as the presence of decaying matters, or those which give rise to unpleasant odours, around or near the apartment in which it is kept. Further, by the action of fungi, the amazingly minute germs of which may be said to be present everywhere, and which are constantly acting with greater or less potency, and act even, as the latest investigations show, at a stage or stages which none would reasonably expect,—that is, actually while in or before it is taken from the udder of the cow, being generated therein by the very food which the animal consumes, nay, the very water which she drinks. At one period, the only precaution which was (and, we may here state, in too many cases still is) taken to obviate the difficulties connected with the treatment of milk thus created in so many and in such insidious ways, was simply to secure as far as possible the perfect cleanliness of the vessels in which the milk was put up, and of the milk-house or apartment in which these vessels were kept. But so serious were the losses from the too well known tendencies of milk to become deteriorated, that scientific men began to give their attention to the whole subject; and the result of their inquiries has been the making known of a variety of facts previously unknown, or at most but very vaguely suspected, which have, as it may be said, completely revolutionized the whole system of the treatment of milk. And it is only right to state that these scientists were greatly aided, and their investigations rendered more valuable, by the help of experienced dairymen, practically acquainted with many minor details not always known by scientific

men, or, if known, apt to be overlooked by them.

Plans of Dairy Buildings.—In a few sentences we purpose glancing at the leading points of what may be called the new system of dairy-house or milk management,—a system which, as already hinted at, begins, curiously enough, with the milk before it is absolutely passed from the cow, and incapable, therefore, as we would suppose, of being placed within the details of any system. We have referred to the peculiarity which milk possesses of acquiring or taking up taints which may prevail in the atmosphere around it. This peculiarity is very marked, and although long known, little attention was paid to it, or desire shown to find out its cause. At last, and for the reasons already named, investigations were entered upon; and one of the few things proposed was the isolation as completely as possible of the milk-house from the cow-house or byre or shippin, for by all these names is known what might be called the cow-stable, as perhaps more clearly or popularly indicating its use. This was done, it being found, as might have been expected, that the smells from the excreta were absorbed and retained by the milk, giving to it a peculiar flavour of a highly disagreeable kind, and, what was as bad, imparting to it a strong tendency to become spoiled with great rapidity.

This isolation of the milk-room of the dairy from the cow-house can be secured in two ways: first, by having the dairy department proper, of which the milk-house forms a part, wholly and completely distinct from the farm buildings proper, of which the cow-house forms, on the other hand, a part. This system, however, involves this disadvantage, that time is lost in conveying the milk from the cow-house to the milk-room, as, in order to make the isolation as complete as possible, the distance between the two should be of some decided extent. And this in many instances is likely to be a serious disadvantage, inasmuch as the workpeople engaged in the milking will be greatly tempted to allow the milk as drawn from the cows to remain standing in the milk-pails in the shippin or cow-house, very likely also in the worst position, just at the dunging or cleaning passage. And this will be done to save the labour and trouble of

carrying comparatively small quantities of milk to the milk-room. This temptation is not a fancy one, as those who have had much to do with workpeople well know. The difficulty may be overcome by making the communication between the cow-house and the milk-room by means of a small rail or tramway, carriages being provided and so constructed that the milk-pails can be hooked on to certain parts, and thus allowed to sway freely, and consequently be subjected to little disturbing motion. And further still to facilitate the quick transmission of the milk-carriages along the rails, these may be laid with a considerable incline from the cow-house to the dairy buildings or milk-room, so that the carriages will run down gently by gravitation, the return journey being comparatively easy, as they will then only have the empty pails to carry. Where this system is objected to, and the dairy apartments proper are arranged to form part of the farm buildings, the necessary degree of isolation cannot be so well secured, and that for obvious reasons, as in the first system just described. A compromise, therefore, between what would be the best, but which cannot be had, and what can be obtained, so as to approach as nearly as possible the highest standard, is therefore the only thing at the command of the designer. There are various ways which will suggest themselves to him by which this can be carried out. One, and perhaps the best plan, is to have the dairy buildings or apartments proper, while they are under the same roof, virtually isolated from the cow-house by a passage as wide as can be conveniently made open to the external air. A current will generally be present through this in one direction or another, tending to blow the bad smell away; or, if this be absent in certain states of the wind, there will be free exit upwards for any bad-smelling air coming from the cow-house. And in order to protect the attendants from rain, a narrow part of the passage between the two doors may have a light roof given to it. In addition to this separation of the two, the cow-house and milk-room, it need scarcely be said that the most complete means should be taken to secure the thorough ventilation of the cow-house itself, so that all foul air and bad

smells may be carried off from its interior as fast as created.

In cases where there is a small dairy attached to or forming part of the farm-house, the only isolation which is demanded is that from the working-rooms of the house from which bad smells are likely to arise, as the kitchen, scullery, or wash-house. A cellar milk-room will generally secure this, and it will give other advantages, such as a more uniform temperature throughout the year.

A good deal not only of the isolation from sources of taint to the milk, but of convenience in working, will be obtained by a judicious arrangement of the dairy buildings themselves, however and wheresoever placed with relation to the farm buildings, etc. For in all dairies there is of necessity a good deal of extra work going on, such as washing of the vessels, boiling water, etc. Now, while this cannot be dispensed with, and as it will obviously to a greater or less extent cause a deterioration in the atmosphere of the apartments in which it is carried on, all means must be taken to prevent this deteriorated air from gaining access to the milk-room. For, even granting that the air arising from the operations is not deteriorated in the sense of having bad qualities imparted to it, the damp with which of necessity it is impregnated is of itself a source of evil, and has a wonderfully bad influence upon milk. There is, indeed, scarcely anything against which the designer and builder of dairy buildings has to take such precautions as that of damp. The most careful constructive arrangements have to be adopted to secure perfect dryness, both in walls and floor. With these, however, this work does not concern itself; we can only refer the reader to works which treat of construction generally, and of agricultural buildings specially, in which the fullest details will be found. All we can do here is simply to note the importance of the point, and that attention must be paid to it if thorough efficiency in dairy buildings is desired. We have, in Chap. IX., on 'Constructive Points connected with Farm Buildings,' discussed the subject of ventilation in a way which, although brief, will be found sufficiently explicit and detailed for general purposes. The isolation above referred to as being absolutely essential to be maintained between the milk-room

and what is called generally the wash-room, in which the utensils are cleaned, and the vessels placed in which the cleaning is done, etc., may be carried out in a variety of ways. Of course it is necessary to have these apartments close to one another, as, if far separated from each other, much time would obviously be lost. As a store-room, in which various materials, spare utensils, and the like can be kept, is always a useful place in a dairy, and tends to maintain that order which in itself is a great help towards the securing of cleanliness, and consequent sweetness of atmosphere, it will be a good plan to have this placed between the milk-room and the wash-room; of course it is scarcely necessary to say that nothing should be kept in this store-room calculated to give out bad odours. Failing the adoption of this arrangement, a passage may be made between the two rooms, thus securing isolation, ventilation, and yet convenient contiguity at one and the same time. If this 'open to the air overhead passage' be objected to,—though why it should we fail to perceive, any more than in the case previously described, where it is used between the cow-house and the milk-room,—the doors of communication between the milk-room and the wash-room ought to be double; the free space between them being of width ample enough to admit of the easy movement of the work-people carrying vessels, etc. to and fro, while the process of closing one door and opening another is being gone through. The doors, indeed, should be double hung, so as to swing freely either way on slight pressure from the body, thus leaving the hands free to hold the vessels, etc. Nor will the convenience of a shelf on either side of the space be found a bad thing in facilitating the work. Moreover, as darkness is always to be avoided in dairy buildings, and, indeed, in all farm apartments where work is going on, the double doors ought to have panes of glass framed in, so as to light the central space between.

The isolation thus secured will be so far efficient; but in order to have all sources of milk tainting reduced as far as possible to a minimum, if they cannot be wholly got rid of, it will be essential to have both the milk-room and wash-room thoroughly well ventilated—that is, supplied with abundance of fresh or pure air, as well as with

means to carry off all foul air, impure or used air. The wash-house boiler chimney will afford a powerful and effective means of withdrawing the steam or vapour from its interior which arises from the operation of washing the utensils, etc. As soon as washed, they should be removed to the exterior of the building, which ought to be provided with a verandah, under which they will be sheltered from the weather, yet freely exposed to the fresh air.

Having thus described the methods for the keeping of milk from deteriorating influences, so far as this can be secured by the arrangement and construction of the buildings which are immediately connected with it, it will be a useful conclusion to our remarks if we give here diagrams illustrating one or two arrangements by which the suggestions we have given may be carried out.

The diagram given in fig. 13, Plate 3, is an illustration of a cow-house arranged on the double-stall system, in which the cows are placed 'tail to tail,' a milking, dunging, and cleaning passage, *a a*, 6 or 7 feet wide, being between them. At the heads of the cow stalls, *b b*, a feeding passage, *c c*, is made, 3 feet wide. The food is kept in store-rooms, *d d*, which may be situated, as in the diagram, central to the range of stalls, so that it can be distributed right or left; or if more convenient, it may be placed at the end of the cow-house, each side, however, having its own food store, so that no time may be lost in going round to one side or the other. To facilitate the distribution of food, it is sent along a small rail in properly constructed trucks; and is passed from these to the mangers through openings, which may or may not be provided with sliding shutters made in the division at the heads of the stalls. The stalls are or should be single, each cow having her own stall, as we strongly object to the double-stall system, for physiological reasons chiefly. Those who pay any attention to the habits and peculiarities of cows, cannot fail to observe that each cow has got its own peculiar idiosyncrasy, so to say, if so grand a term, applied generally to human beings, 'the lords of cows and the creation,' can be applied to them. This induces habits, one of which is very generally developed, that of being quiet if left

alone, but inclined to pick a quarrel if in too close contiguity with a neighbour. Another habit is a determination at times not to give milk willingly if alongside of another cow; to which may be added this consideration, that as repose is of all things essential to cows in milk or in calf, that cannot be regularly maintained where they are subjected to the caprice or ill-temper of a neighbour; all the more as this is likely to be called out by the far too limited space which, as a rule, is given to the double stall—a space for two very little more than that really demanded by the physical necessities of a single cow only. One has only to watch the way in which a cow comports and comforts herself in the field, where she has ample space at her command, to see that the wretchedly confined space of all stalls, as a rule, single and double, but specially double, must cause them great discomfort. And where discomfort is, there is loss. This may be taken as a rule in dairy management to which we know of no exception. The same abundance of resting space for the cows should be given to those who attend upon them; the milking and cleaning passages, therefore, ought to be wide, for, as a rule, cramped space invariably gives occasion to work being carelessly done. There can scarcely be a greater mistake made when designing farm buildings and laying down dimensions, than to cram spaces in which work is to be done. The difference between plenty of room and scant space is just the difference between that work being well and ill done. Ground in towns is valuable, and this may be pleaded as a reason why dairies, etc. built there are cramped in space of all kinds. It is not so valuable as to make this plea available; although we maintain that the true principle everywhere to be followed is, that the points which are known to be necessary in the conduct of any business must be attended to, at whatever cost; if that cost precludes a profit, the business clearly ought not to be entered upon, for it can only be profitably carried on where all the buildings and appliances necessary are provided.

Referring to the plan, fig. 13, Plate 3, last given, it will be observed that a rail, *e e*, is placed in the milking and dunging passage. This, in the arrangement now under consideration, leads to the dairy buildings proper, which are

on the isolated principle already described, and which, placed on a lower level than the cow-house building, gives the rail an incline which should be just of that angle, that when the trucks are loaded they will run gently down. To prevent accidents, however, a simple break should be attached to each. The diagram in fig. 14, Plate 3, gives a rough indication of the arrangement of the dairy buildings proper.

This shows an arrangement of a dairy of the simplest character, in which there is only a milk-room and washing-room, separated or isolated as described, by a double door, or by a passage as shown in the diagram to the left. In this, *a a*, fig. 14, Plate 3, is the washing or cleaning room; *b b*, the milk-room; the communication between them is kept up by double doors, the space for which is at *c*. The isolation thus secured between the milk-room and wash-room is but partially complete; the better plan is to have a narrow passage between the two, as at *d d*; *e e* being part of the milk-house, and *f* that of the wash-room. The passage may be rendered dry, so far as the two rooms are concerned, by having a small roof of zinc or wood, as shown by the dotted lines. But as this will only be an arrangement for very small farms, or where there is no butter or cheese made at all, it will be necessary, to make our remarks complete under this head, to show an arrangement in which apartments are provided for the making of those two articles. This is done in the above Plate 3, fig. 15, a third type diagram, which is designed on the isolated or separate system; the rail, *a*, communicating with the cow-house of the main farm buildings, shown in the first diagram, fig. 13, Plate 3—*a'* being the rail corresponding to *a* in third diagram, fig. 15, Plate 3. In this it will be observed that a comparatively complete isolation of the wash-house, *b*, from the milk-house, *c*, is obtained, not only by the passage, *b b*, but still more effectively by having the wash-house, *b*, at the extreme end of the building; while the distance to be traversed in conveying the utensils of the milk-room, *c*, to the wash-house is not great, and may be done directly under the cover of the front verandah, *d d*, the end of which is shown by the dotted lines; while the churning and cheese-room—*e e* and *h*—utensils may be taken by the internal passage, *g*.

The fourth diagram, given in fig. 16, Plate 3, illustrates the arrangement we have already described, in which the milk-room and other dairy apartments are connected with and form part of the main farm buildings and cow-house; the isolation being effected between the cow-house and milk-house by the passage, as shown, while the wash-house is kept at the extreme end of the dairy buildings proper. The cow-house is arranged upon a different principle from that shown in the first diagram, fig. 13, Plate 3. In this the cows are placed head to head, with a feeding passage between the two rows of stalls. The cow-houses are at *a a*; the feeding passages at *p p*, entering from the central passage, *b*. As the food is cooked in the cooking-house, *c*, from which the necessary supplies of food are obtained from the root and food store, *d*, it is taken along the feeding passages, *p p*; as the cows are milked, the milk is taken to the milk-houses, *f f*, between which is, or may be placed, a small cream-house, *g*, if that be used occasionally or regularly for butter making. When ready, it is taken to the churning or cheese-making room, *h*, the cheese being stored up in the store-room, *k*. The wash-house is at *l*. A broad verandah, *m, n*, is in front of wash-house and milk-room. The 'offsets,' *k, l*, may be two-storeyed to afford additional cheese-storing room, etc.; while that of *c, d* may be fitted up as rooms for the workmen. The main building, *a, a, b, j*, is single-storeyed, and is mainly lighted from the roof. A small steam-engine and boiler in *i* may be economically employed to work the churn in room *h*, while a light running rope, shown by dotted lines, may take power to the cooking-room, *c*, to work the root-cutters, straw-cutters, etc. The manure from dunging passages, *o o*, may be taken off by the trams, *q*. In addition to the plans of arrangement we have here shown, the reader will find, in connection with the designs for farm-houses given in other parts of this work, sketches showing the dairy apartments in connection with the out-houses. This arrangement, as a rule, and for the reasons we have already stated, we do not approve of, unless the dairy be well isolated from the other apartments. It is right, however, to state that those out-house arrangements are chiefly, indeed wholly, designed for farm-house work, not to

supply produce for the market; and on the principle involved in the old and well-known saying, that a 'shoemaker's children are the worst shod,' anything in the way of farm produce may be supposed good enough for farmers, especially those of the small class.

The plans we have given may be either isolated buildings, or form part of the general arrangement of the farmery; but in view of the considerations affecting the keeping of milk in good condition, the designer must decide which of these two systems he should adopt. In Plate 11, fig. 1, we give a plan illustrative of a more complete arrangement than any of those just given, this being the design of a thoroughly practical dairy farmer, specially prepared at our request. In this arrangement there are two cow-houses, marked *a a*, *b b*, separated by a wall, *c c*. Each cow-house contains twenty double stalls, the two affording accommodation for eighty cows in all. Stalls are arranged so that the dunging passages, *d d*, are placed in the centre between them, the feeding passages, *e e*, being at the head of the stalls. It might be an improvement in this plan if doors were placed at the points *f f*, at the end of those passages, so that there might be a through communication from the lower end of the building or front, to the upper or back, at which turnip stores, as at the points *g g*, might be placed, these being in addition to the general food stores, *h h h h*; these latter being supplied with steam cooking-vat, *i i*, in which mashes are prepared by means of steam, this being supplied by the boiler in the engine-house, *j j*. The food stores, *h h*, have their supply of turnips from the root store, *k k*, in which also the root-cutting and pulping machines are placed, as well as the straw-cutters; it might be a convenience if to this plan a straw and hay room was added, between the turnip store and machine-room, *k k*, and the churning-room, *l l*. The feeding passages, *e e*, are supplied with a small tramway or set of rails, by means of which the food is conveyed on trucks from the machine-room, *k k*; the dunging passages, *d d*, are proposed by the designer to be paved with one broad flag, stretching from side to side or from gutter to gutter, *m m*; but we should prefer, for reasons stated in another chapter, Portland cement concrete, as being better and

cheaper. The churning-room and cheese-pressing house is at *l l*, the cheese store or curing-room at *n n*; the milk-house is at *o o*, and is provided with a fountain at the central point, *p*. The washing-up house is at *q q*; the space, *r r*, left in the corner, at the right hand of plan, might be usefully filled up with a calf-house, or, in place of this, with an open court for the cows to be turned into; and beyond this, and at as great a distance as possible, the piggery, say at the point *s s*. A feature of this plan is the addition of a cattle-house, or rather of a series of hammels, *t t*, placed under two spanned roofs, with an open feeding and dunging passage, *u u*. The hay-house is placed at *v v*, the turnip store at *w w*, while the barn or straw-house is placed at *x x*.

Our remarks and illustrations on the subject of dairy buildings would be somewhat incomplete, if we did not, at least in brief fashion, notice the factory systems for making butter and cheese, now occupying so large a share of agricultural opinion. The system was introduced in America some quarter of a century ago or thereby, and has been so remarkably successful there, that it has been introduced into this country, mainly, however, for cheese-making purposes. We do not require here to concern ourselves with a detailed notice of the commercial and business features of the system, it being sufficient to state that the main idea or leading principle of the system is to collect from the various farmers of a given district the *milk* which they produce, this being taken to a centrally-placed 'factory,' where the collected milk in large bulk is worked up, on a regular system, either into butter or cheese, or in some instances into both substances. By having regular supplies and a large bulk of milk to operate upon, all the appliances are made with a view to economize labour to the utmost, and not only this, but to keep up a constant and progressive improvement in all the working details, the management of the milk, the appliances by which it is worked up, and the processes through which it passes. The result of the system has been an enormous improvement in the processes of butter and cheese making, securing these of the highest quality and at the lowest price for working, while, at the same time, some very valuable facts have been elicited as to

the nature of milk, its production in the cow-house, and as to the general arrangements of the whole system of dairying, from the selection of the animals, their breeding and feeding, up to the manufacture of the products of butter and cheese.

The butter and cheese factories were not originally established as such, but grew out of or were the result of the working of what are called in America 'creameries,' so named originally from the fact that the first were established to supply the New York market or merchants with a certain bulk of cream at stated intervals, this being obtained from the milk provided by various farmers. Great care is taken not only in preparing the milk to be forwarded by train to its destination, but also in packing it, if the expression may be allowed, so that no deterioration in quality shall arise from the disturbance caused by the transit. Milk is found to keep much longer if deprived as rapidly as possible of the contained animal heat imparted to it by the cow. To cool milk, a great number of appliances, more or less ingenious and effective, have been designed for use in the creameries. The milk is put into cans in comparatively small quantities, and these cans are placed in a 'pool,' so that they are surrounded by fresh, cold, spring water, care being taken that the milk does not stand at a level higher than that of the water surrounding the cans in which the milk is placed. Previous to placing the milk in the cans, it is strained immediately after milking; and while in the can it is occasionally stirred, to prevent the cream from rising. When cooled, it is put into the carrying or conveying cans, each of which holds about 40 or 50 gallons, and the covers of which are so arranged that there is no free space left between the surface of the milk and the lower surface of the cover. The following is a plan of a 'creamery' given by Mr. Willard, lecturer at the Maine State Agricultural College, in a paper on the 'American Butter Factories and Butter Manufacture,' published in the *Journal of the Royal Agricultural Society of England*, and to which we are indebted for the above details of the system. In fig. 1, Plate 12, *a a* is the 'horse-walk' for delivering the milk-cans; *b b*, the 'milk-cooling pools'; *c c*, the 'wash-room'; *d d*, the 'kitchen or lunch-room'; *e*,

the 'office.' We have said that the butter factories arose out of the creameries, and this in consequence of the desire of those interested to be independent of the milk dealers, when fair terms could not be made with these; hence originated the idea of at once manufacturing the milk obtained from the farmery into butter or cheese. The following plans, figs. 2 and 3, Plate 12, as given by Mr. Willard, will show the arrangement of the first butter and cheese factory, as designed by Mr. Slaughter, of Orange County, New York State; and the arrangements and appliances of which were so well considered, that they are, as stated by Mr. Willard, deemed by many, even at this late date, both convenient and economical. The main structure is of two storeys, built in a very cheap yet substantial manner; the lower storey of which is devoted to the 'pools for cooling the milk,' the 'cheese-making room,' and the work-room; while the upper is taken up wholly as a cheese-drying and store room. In fig. 3, Plate 12—the ground plan—*a a* is the 'cheese-making room'; *b b*, the 'presses'; *c c*, the 'milk-vats'; *d d*, the 'wash-house'; *e e*, the 'storing-room'; *f*, 'pool' or 'tank' for the water to cool the milk-cans, supplied from the 'spring' *g*, outside; *h* and *i* are two other 'pools,' connected by the pipe *j*. The 'storing-house,' which forms a wing at the end, is one storey high. The butter-making and packing-house is a detached building opposite to the storing-house, and separated from it by an alley, along which the teams or carts pass in delivering milk or carting away the butter and cheese. The butter-making building, as shown in fig. 2, Plate 12, is provided with a churning and packing room, *a a*; a horse-walk, *b*, for working the churn, *c*; an ice-house, *e*, and a store-cellar, *d*.

The following is an account of some American factories:—

'1st. Horr & Warner's factory, Huntingdon, Lorain County, Ohio. Average number of cows, 1000. Size of buildings: manufacturing-room, 30 feet by 40 feet; press-room, 14 feet by 50 feet; drying or curing-house, 30 feet by 100 feet. Two storeys high, besides basement. Cost of buildings, 2000 dollars; machinery, 1800 dollars. This includes vats, presses, boilers, etc. Capital invested, about 6000 dol-

lars, 1000 dollars of which is in land. Work-people employed: four men at 9 dollars per week, and four women at $3\frac{1}{2}$ dollars per week, besides board. The maximum distance from which milk is brought to this factory is 6 miles, average about $2\frac{1}{2}$ miles. Factory not owned by the patrons. Charge for manufacturing and furnishing salt, bandage-cloth, colouring material, curing and selling cheese, 2 dollars per 100 lbs. Whey fed to swine at the factory.

'2d. Peter Colbetzer & Co.'s factory, in Spencer, Medina County, Ohio. Average number of cows, 700. Size of buildings, 20 feet by 100 feet; two storeys high, with lean-to for press-room, 14 feet by 40 feet; and milk-receiving room, 10 feet by 12 feet, which also serves for an office. In this, *a*, fig. 2, Plate 11, is the press-room, 40 feet by 14; *b b*, the cheese-presses; *c*, the milk-vats; *d*, the water-tanks; *e*, the cheese-curing room; *f*, the hall, with stairs to upper storey; *g*, the milk-weighing house; *h*, the engine-house. This is a very convenient factory. The floor in the manufacturing and press-room inclines to the rear 14 inches, where a gutter is placed in the floor, which also inclines 4 inches, and discharges at *O*. The upper storey is all devoted to curing cheese. Cost of building, 2200 dollars (£440); machinery, engine, boiler, and other furniture and fixtures, exclusive of land, 2350 dollars; capital invested, 6000 dollars (£1200). Work-people employed: one man at 14 dollars per week; three men at 8 dollars per week; one boy at 5 dollars per week; two women at $5\frac{1}{2}$ dollars per week. Milk received, 2,130,508 lbs.; cheese made, 228,200 lbs. Maximum distance of transporting milk, 5 miles; average, a trifle less than 2 miles. Charge for making and furnishing salt and bandage-cloth, 2 cents (1d.) per lb. The factory not owned by patrons. Whey fed to hogs. Gross earnings of factory in 1868, 5300 dollars (£1060), net 2800 dollars (£560). In fig. 2, Plate 15, we give the section, in fig. 3 the plan, of the dairy buildings above alluded to. In fig. 2, *a* is the press and drying room; *b*, the cheese-room; *c*, the cheese-curing or drying room; *d*, the engine-room, placed in a small offset or shed. In fig. 3, *a a* is the press and drying room; *b*, a row of cheese-presses, the dotted lines, *c*, representing the cheese-racks;

d d, the tramway leading from the dairy, plan of which is shown in fig. 4 at *ec*; *f*, cheese-vat; *g*, the milk-vat, holding 5000 gallons; the milk-weighing machines are placed at *h*, while the workmen's room is at *i i*.'

An important part of these factories, as will be seen, is the spring or source of water supply, and the connected 'pools' in which the cans containing the milk to be cooled are placed. In the first factories erected, the springs are within the building, tanks enclosing these, and which tanks receive the water. These are in length 12 feet, in breadth 6 feet. The tanks are made in the solid soil, this being dug out, and the sides lined with masonry, and are so arranged that the water-level is the same as the level of the floor of the spring-house. Racks are placed near the bottom of the 'pools,' on which the milk-cans rest, the water flowing upwards through the racks till it reaches a point or level of 17 inches above them. The cans are 20 to 22 inches deep or long, and 8 in diameter, and are placed upon the racks close together, so that the holding or rather cooling capacity of each pool is equal to 2040 gallons. The milk in the cans should not be above the level of the water in the pools. In cases where a spring cannot be obtained in the spring-house, the water from the spring is led by means of pipes into tanks excavated below the level of the floor of the spring-house, the bottom of the tank being cemented and covered with flagging or oak planking. For details of the processes of making butter and the skim-milk cheese, we must refer the reader to Mr. Willard's paper already alluded to, which will be found in vol. vii. (2d series) part i. No. 13, of the *Royal Agricultural Society's Journal*. The factory system of dairy working had been carried on for a long time in America before it was introduced here, although it had attracted the attention of our leading agriculturists. This led in time to the introduction of the system, and the first cheese factory was erected in Derbyshire, at Langford, under the auspices of a most influential committee. The building was designed by and arranged under the superintendence of a Mr. Schermerhorn, who had been requested to come over from America by the committee, and who had a most intimate

practical knowledge of the system as there practised. The following, fig. 4, Plate 12, is a rough sketch of the arrangements of the building, adapted from a plan given in a paper by Mr. Gilbert Murray in the *Journal of the Royal Society*, in which *a* is the receiving shed, *b* receiving-room—store-room, *d d* milk-vats, *e* water wheel, *f* dry vat, *g g* cheese-presses, *h h* sweet whey tanks, *i i* waste whey tanks, *j k* engine and boiler, *l l* warehouse, *m* stove to warm ditto.

But important as are the influences which well arranged and constructed dairy buildings have upon the maintenance of the good qualities of the milk,—that is, supposing this is in the first instance obtained from the cows, a suggestive point of great importance, and on which we shall have somewhat to say presently,—there are other precautions to be taken, and other work to be done, in order to secure this in the very highest degree of efficiency. To these we now beg to direct the attention of the reader, premising that the matter here given is from a report which we drew up as to the plans and arrangements of a dairy on the very largest scale, proposed to be erected on a farm where some hundreds of stock were kept.

The Milk-room.—In designing this, two very important points are before us, very materially influencing not only the size of the milk-room, but the disposition and nature of its fittings. These points are, first, whether it would be advisable to make the butter from churning the whole milk; or, second, to make it from the cream. Although holding a very decided opinion that the best results are to be obtained by churning from the cream, not only in the superior quality of the butter, but from its better keeping qualities, and having, moreover, by far the largest weight of evidence from experienced workers in favour of this mode, it is nevertheless fair to state, that inquiries which we have recently made have resulted in getting an opinion from dairymaids of large and extended experience, to the effect that better butter is made from the whole milk than from the cream, while the making of it is more convenient. It is to be understood that the cream on the one hand, and the whole milk on the other, are to be 'soured' or 'lapped' before churning,—a point

of importance, and which of itself demands a specialty in the dairy. So far as the use of the products of the butter-making is concerned, the 'skim-milk,' and 'butter-milk,' and the 'whey'—it does not matter which mode of working is adopted—may be sold off or consumed by the stock. But so far as the size of the milk-room and the churning-room is concerned, the point is one which brings with it very important considerations. First, as to the size of the milk-room. Assuming that the milk is set up in vessels to be 'lapped' or 'soured,' which experience points out as the best mode of working from the whole milk, these vessels will contain a very much larger quantity of milk than vessels which are used to contain milk from which to get cream. A much less space, therefore, in the milk-room will be required. And a cream 'souring' room will also be dispensed with. Another advantage obtained would be the comparatively easy regulation of the temperature of the milk-room, especially in summer, when the whole milk in a soured condition would be churned from. We now come, however, to the arrangement of the churning-room, and the labour connected with the churning. So large a mass and weight of material as would be the result of the system of churning from the whole milk soured would obviously involve a much larger space in the churning-room, and much more complicated arrangements for churning, than would be necessary if the butter were made from cream. In the first place, from the increased size of the churns, increased space would be necessary; and, what is of much greater importance, greater power would be required to work the churns. In cases where steam power was available, this would not so much matter; but in some cases working by hand is preferred. It is obvious, however, that hand-power working of the churn would be quite out of the question, if the whole milk was used from which to make the butter. On the point under discussion, the results of very extended inquiries, as well as our own experience, convince us that the finest quality of butter is made from the cream; and so far, therefore, as the churning department of the dairy is concerned, a greater simplicity of operation will result if this mode of making

butter be adopted. It is scarcely necessary to say, however, that a very considerable diversity of opinion exists as to which is the best of the two methods here discussed; and according as the one or the other is preferred, so far as the milk and churning rooms are concerned, so will be the arrangements of the dairy.

Prevention of Damp in the Dairy Building.—A feature of essential importance in the construction of a dairy building is the keeping of the walls and floors thoroughly free from damp. This applies with especial force to the milk-room. The plans generally adopted to secure this freedom from damp are little better than mere palliatives, and should only be looked upon as fairly good adjuncts to that plan which alone is to be relied upon, but which has been overlooked hitherto to a very remarkable extent in building practice; we refer to the drainage of the site upon which the building stands, and to the mode of erecting the foundation. Provision for this site drainage should be made, circular drain-tiles being used. If these cannot be obtained, horse-shoe tiles may be used, or stone-fitted drains, but in any case the drains must be to the full depth to secure thorough drainage of the site. These drains will follow the fall of the ground and lead out to any convenient drain. As a further precaution against damp, a layer of concrete of 6 to 8 inches in depth is laid under the floor, and it is to be specially noted that this continues *under the footings of the walls*, and is carried up on the *outside* of the same to the level of the ground-line.

Floor of the Milk-room.—The floor of the milk-room slopes from the walls to the centre of the room, at which point there is a drain or gutter, open, but which may be closed with flat tiles or stones easily removable. Water-pipes are laid along the walls under the milk-shelves, and provided at short intervals with taps, to which short lengths of hose and jets are attached. By these, water in any quantity, and directed to any part, may be used to clean the floor, the water flowing and being swept towards the central drain, which has a fall throughout its length, and communicates with the sewage drain.

Walls.—The walls throughout, at the lower part, to be of brick, hollow or cavity in the centre,

and to be carried up at least five courses of bricks high above the level of the ground, the upper and outside course to be splayed or angled; and where timber is abundant and cheap, the upper portions of walls may be made of it, with hollow or cavity space also in the centre, which may be filled with some non-conducting material which is not likely to decay and give out bad smells. The walls in milk-room to be lined, as also the cream-room, with white glazed tiles, or with plates of enamelled iron, which may be had of any dimensions, and will be easily fixed. This lining to extend to a height of 30 inches at least above the level of milk-shelves. *The whole of the corners of the milk-room and cream-room to be rounded off*, to prevent, as much as possible, the accumulation of dust.

Double Entrance-door; Windows.—The *entrance-door* to milk-room to be double, or, what will be better, a porch to be provided with self-closing doors, the inner door also to be self-closing. The windows to the milk and cream room to be double, with as wide a space between them as the thickness of the wall will admit of. The windows to be in two halves, opening horizontally; the corresponding halves in the outer and inner windows to be connected with swivel bars, so that when the inside half is opened or shut, the corresponding half outside will be opened or shut also. By opening or shutting the lower or upper half of the windows, the current of air may be directed above or below, or horizontally, as desired, and the ventilation of the room much facilitated. Venetian blinds or jalousies to be provided to the outside of each window.

Ventilation of Milk and Cream Rooms.—This is to be provided for by the combined operation of ventiducts for the admission of fresh and the withdrawal of used air. No ventilation can be complete and satisfactory where these two provisions are not carried out. The system recommended for adoption is what has been called the 'natural,' as opposed to the artificial, in which special means are provided to create currents. Natural ventilation we have always found to work well where judiciously carried out. The means which we propose are as follows:—

1. *Appliances for supplies of Fresh Air.*—Outside the building small wells are to be sunk in

the ground part of wall of milk-room. These wells are to be lined with stone or brick, and to have their floors sloping from the wall outwards, and to be provided with small drain-tubes leading to the main drain-tube, to carry off any water which might collect there. The wells are to be provided at their upper part with a ledge to support the deodorizing boxes, containing animal charcoal. This deodorizing material has, in one instance where tried, been applied with marked effect in hot, confined weather. We have consulted a practical chemist, who highly approves of the plan, and who, at our request, is instituting a series of experiments on some points to which we have directed his attention. The deodorizing boxes may be, in extremely hot weather, supplanted by ice boxes, which would cool the air before entering the building. When neither the deodorizing nor the ice boxes are in use, a grating with small meshes or apertures should be used to cover the upper portions of the wells, to prevent the ingress of vermin. The admission of the air through the apertures in the walls communicating with the fresh-air boxes is regulated by a proper valve. A few of the fresh-air ventiducts may be taken under the floor, to open out into gratings placed under the central ranges of milk-coolers, dividing or diffusing by this means the supply of fresh air to the room. These central ventiducts to be regulated in supply by valves specially designed, but of simple character.

2. Appliances for withdrawing the Used Air.—

To withdraw the used air, a ventiduct or shaft of timber is used, with a valve for regulating the egress of the air. The chain is passed over pulleys in the shaft, and over a small pulley placed above an aperture made in the ceiling near the line of wall, and terminated at a point within easy reach by a weight. This weight is provided with a projecting part at the back, which slides in the slit of a face-plate. By sliding this weight up and down, the valve will be moved up and down correspondingly, the weight counterbalancing the valve. The valve is arranged to be fully open when its distance from the aperture of the shaft is equal to the diameter of same. The diameter of the valve, *a*, fig. 2, Plate 20, is considerably larger than that of the shaft, *b*; this

is done to direct the currents of air so as to create a draught along as wide a surface of the ceiling as possible.

An alternative mode of withdrawing the used air is by making, in place of a solid ceiling, one composed of parallel strips of wood, or, better still, with blocks between at intervals, so as to form air-spaces. These open into the air-spaces in the roof, and in this case the ventilating shafts will be cut off near the ridge, the arrangements for regulating the egress of the air being the same as already described. (For additional remarks on ventilation and description of appliances, see Chap. IX.)

Arrangements for Warming the Apartments and for obtaining a supply of Warm Water for Cleaning purposes.—In this country it is not usual to adopt means for raising artificially the temperature of our milk and cream rooms. The best authorities, however, believe that great benefits would arise from the system, as there would be means at ready command for regulating the temperature of the milk, and thus facilitating the operations of the dairy. If artificial heat is decided upon, it is essential that the method adopted by which to obtain it shall be capable of such regulation in its working, that any desired degree of temperature may be obtained. This facility in the regulation of the temperature can only be had by the adoption of one or two methods, namely, the use of 'steam' or of 'hot water.' Hot-air stoves are, as a rule, incapable of being regulated so as to ensure accuracy in the degree of temperature they give to the air of a room which they supply. But with the use either of steam or hot water as the heating medium, an accuracy of regulation can be secured to a great degree of nicety. Of these two modes of heating, hot water possesses the greatest number of advantages; but, at the same time, steam, while very available for the purpose of warming the air of the buildings, is also available in another and extremely useful direction in which the hot-water system cannot be made available. We refer to the use of steam in raising quickly and conveniently large bodies of boiling water for cleaning. Another use to which steam may be put, and which is, we believe, for the first time here described, is the purifying of vessels

by subjecting them to a stream of steam. This can be easily done, by making a special chamber in which the vessels to be purified are put. The utility of this need not be here enlarged upon, in view of the advantages to be derived in dairy operations from the use of thoroughly cleansed vessels, as churns and the like. In view of these considerations, the best and most efficient plan would be to have a 'hot-water apparatus' to supply the heating pipes for raising the temperature of the rooms, and a small boiler to raise steam for the purpose of creating supplies of warm water, and also for raising the temperature of cheese-vats by being led into spaces made outside of them. Where a steam-engine is on the premises, it may be said that steam may be obtained from the boiler of it. But it must not be overlooked that the boiler of the steam-engine may not be in use, while steam may be required for the dairy; and it would be a waste of resources to fire a steam-engine boiler of large power to obtain a quantity of steam which might be obtained from a lesser-sized one.

Arrangements for Lowering the Temperature of the Rooms in Hot Weather.—In hot weather, the ventilation will have to be kept up to its maximum capability; but it is just at this time that the difficulty is greatest in maintaining ventilating currents, these depending for their existence upon the difference that exists between the temperature of the air in the room and that outside. In summer it often happens that the circumstances are reversed, or nearly equalized. Hence the difficulty of ventilating a building at this season. To aid the lowering of the temperature therein at this season, it is the practice in some dairies to have cold water running in troughs under the milk-shelves. As this expedient is founded upon the fact that evaporation produces cold, Mr. Horsfall, the great dairy authority, has very ingeniously extended its operations by wetting the calico blinds of the windows by projecting water upon them. We propose to place this method under more complete control, by having endless belts of calico stretching from floor to ceiling behind the milk-shelves, and supported by and passing over rollers. These will afford large evaporating surfaces, and which surfaces will be very quickly wetted by having the lower

roller to revolve in a trough of water. Where water-troughs are used, in place of having them fixed, we would recommend them to be placed on brackets cast upon the pedestals which support the milk-shelves or coolers.

Fittings of the Milk-room.—The milk to be creamed is set up in two kinds of vessels,—the ordinary milk-dishes, which are placed on the shelves, and the milk-coolers, which are fixtures. The cheapest form of efficient milk-shelf is cast-iron grating of a simple pattern. This kind of shelf has given great satisfaction where used. It is easily kept clean, contracts no taint, and the perforations admit of a free current of air under and around the milk-dishes. If this kind of shelf is not adopted, although we are inclined to recommend its adoption, marble would be the best material, or slate; wood is not to be recommended. It might, by way of carrying out experiments in all directions, be admissible to fit up part of the milk-shelves in various materials. But whatever be the material employed, one point in erecting them we would most strongly insist upon, and that is, keeping the whole line of shelving throughout at least *two and a half inches from the wall*. The advantage of this is obvious on consideration. Corners are always difficult to clean; and the corner formed by the junction of the milk-shelf with the vertical wall we have invariably found the most difficult to be cleaned, no matter how careful the dairymaid may be. But by keeping the *shelf clear from the wall*, the cloth used in cleaning can be passed completely round the edge of the shelf, and under it also. As regards the *materials of the milk-dishes*, of breakable materials, glass is the best; only, if not well annealed, it is liable to break in the scalding. Good earthenware, white glazed, will be found very good and serviceable. Of non-breakable materials, tin is the best, but it must be of good quality. Lead we rank second, zinc third; but such is our opinion of it (zinc), that we think it should never be used, the lactic acid in the milk setting up an action prejudicial, if it be not actually poisonous, to the milk.

The Milk-coolers.—Were it not for the difficulty of finding room for and handling such a very large number in large dairies, as we are now describing, we would recommend milk-dishes to be

used throughout ; but this is not easy to be done in so large a dairy. Coolers are, therefore, almost a necessity. The only material which we think available, under all the circumstances of large dairy working, for the construction of the milk-coolers, is the best tin, unless they can be made of enamelled iron at a moderate cost. The coolers must be rounded off at the corners, to facilitate cleaning ; the corners or angles in the inside also rounded off. They must be provided with appropriately-arranged tubes, to draw off the milk and cream. The coolers are all to be placed in a trough, so as to admit of hot or cold water being passed along the side and under the coolers in water. Some of the details connected with the milk-shelves, milk-coolers, and of the water-troughs for both, are given in Plate 12, figs. 8 and 9. The coolers being fixtures, the most complete arrangements will be necessary in order to supply hot water for scalding them. This will be led by pipes from the upper boiler in the scalding-room, and which, being supplied at pressure, will enable the coolers to be thoroughly washed by means of jet and hose, if deemed best, or, if not, by the ordinary vessels, which will also be supplied from the boiler. It would be easy also to place pipes running along the length of the coolers, with taps to each cooler, from which both cold and hot water could be supplied. The coolers are not continuous, but have intervals of three or four inches between them. This will enable them to be cleaned thoroughly all round, as well as allow the trough-water to circulate round the ends. In place of a trough for hot water for heating the coolers, an alternative plan may be adopted of having the coolers double-cased, steam being admitted into the space behind ; see fig. 9, Plate 12. We prefer the trough system as the simplest, and as being also available for passing cold water in summer.

Cream or Souring Room.—This is a distinct apartment, fitted up very much in the same way as the milk-room, but with shelves only. Remarks have already been made upon the heating of this. The room is arranged for twenty-four seven-gallon crocks, in which the cream is set for souring. It may, however, be set up in vats of larger dimensions, although the crocks will be found the most convenient for the system of

working adopted. But in whatever way set up, it will be essential to mark in some distinctive way all the vessels, or the positions in the cream-room of the vessels, so that each portion of cream set up will be known from another, and thus each be taken at its proper time for churning. The dimensions of the cream-room will depend upon the mode adopted for working the dairy,—whether the churning is done at long or short intervals. In the design connected with these remarks, the cream-room is arranged to hold the cream of two days, taking twenty-four crocks of seven gallons each. As a safe rule for practice, the smaller the quantity of cream put up to sour the better, as the risk of loss arising from taint is lessened ; for if a taint attacks a crock, the less it contains the better, for the loss is the less ; and loss assuredly there is, or at least ought to be, wherever a taint is in the cream. Where this is the case, it should not be used for butter-making. It is a frequent source of annoyance to the dairymaid to see how often and how mysteriously a taint affects the cream. As a rule, also, the smaller the dishes are which the dairymaid has to handle, the less risk there is of breakage, and the more quickly, too, is the work got through with.

The Churning-room.—Little need be said of the fittings of this, as these will depend upon the mode of working adopted. The butter 'making-up' table will be placed in this ; it will best be made of marble, hollowed out for a considerable length, and with rounded corners. The ends should be flat. A full supply of the purest water obtainable should be supplied to the table, and means provided for running off the water when united with the milk proceeding from the butter making-up process.

The Scalding-room for Washing the Dairy Vessels.—In this room an arrangement of 'copper' furnace, with scalding-vats combined, is specified. It consists of two coppers and two vats placed opposite to each other. The walls forming the central space between these are carried up some two or three feet above the level of the boilers, and support a tank or open boiler. The two flues of the copper unite in this centre space, and pass through the tank in the form of a cylindrical tube of iron. The tank is kept supplied at a

regular level with water, and the heat from the flue is thus utilized to a large extent. Provision, however, should be made to use steam from the independent boiler already alluded to, to heat the water in the tank when the copper furnace is not in use; so that the vats, etc. in the milk-room may be supplied from it. Steam should also be supplied to the scalding-vats in the scalding-room, to obtain a supply of hot water independently of the tank. Means must be provided for carrying off the used water from the scalding-room. As a large amount of vapour is produced in this room, it is essential that the ventilating system should be complete, in order to carry it away as formed. To do this, the same kind of roof as already alluded to may be used; but advantage should be taken of the 'draught-power' available in the chimney of the copper furnace. This will pass right through the roof; and if it be surrounded with an outer cylinder, a considerably powerful ventilating current will be established between the outside of the chimney and the inside of the ventilating tube. The upper ends of the two tubes are provided with caps, to prevent down-draughts, or one will do for both. A good deal of heat will be created in the space, and a rapid current from the room will be the result. The air which passes from the room through the spaces in the ceiling should be withdrawn from the space in the roof by ventilators placed at intervals.

Cheese-making Rooms; Vat-room and Press-room.—In the vat-room two vats are placed. These are made with jackets, or one vessel is placed within the other, leaving a space between them. In this space warm water or cold iced water may be put, according to the season, and to the temperature of the milk in the vat required. Means must be provided for carrying off the water from the spaces or jackets, and the whey, etc. from the vats. The hot water for supplying the spaces or jackets, and for scalding and cleaning the vats, may be supplied from the tank in the scalding-room by a special pipe led from it or from the coppers. Or steam may be used to boil the water in the vats themselves, the cold water being obtained through a special pipe. In place of fixed vats, Keevil's or other form of cheese-making apparatus may be used.

Of the press-room arrangements little need be said. From this, immediate access should be had to the store-room.

The Butter-store and Cooling-room.—This may be made inside the ice-house; see section on this subject. There is nothing to prevent this, the best possible position for it, being obtained. A very simple constructive arrangement is all that is necessary to be carried out. If this plan be not adopted, a separate store should be provided, means being taken to keep the temperature of this at a low point in summer by special means, as noted in another paragraph, or by using masses of ice, placed on tables in the room, or by having ice-safes in it. None of these modes, however, will give such satisfaction as placing the butter-store within the ice-house. Another mode is to construct a special cooling-store, much on the same principle as the ice-house already described, with hollow walls and roof filled with non-conducting material, and with a space in the floor which is to be covered with a grating, and under which ice is placed; or ice-boxes may be placed in the ventilating boxes or shafts by which the cooling-room is supplied with air. On the advantages of a supply of ice for the various operations of the dairy it is needless here to enlarge, this having been done in another chapter. In figs. 5, 6, and 7, Plate 12, we give 'block plan' diagrams, illustrative of different methods of arranging dairy buildings on the large scale worked on the ordinary farming system, but in which the constructive details and appliances are on the most carefully considered system; of which the preceding remarks or 'specification,' as it may be termed, may be taken as affording an example. The method of arranging and working the machinery may, of course, if thought best, be on the same system as adopted in the butter and cheese making factories, some of which we have illustrated and described in preceding paragraphs; but the plans of arrangement of the buildings may, nevertheless, be such as we have shown in Plate 12, figs. 5, 6, and 7, or with such modifications of these as may be deemed best. The interior arrangements of the various block plans will depend upon local circumstances or the opinion of the farmer, but the principles upon which these are founded, and which we have

already described, should be kept carefully in mind in portioning out the internal spaces. In all the plans the letter N indicates the north sides of the buildings. Possibly the plan in fig. 7 will be found the most convenient in working, as all the operations may be carried consecutively on in three directions only, first straight, and then right and left. But that in fig. 6 may afford the best-sheltered building; this is easily capable of affording twice the space by simply adding the part as shown by dotted lines.

The Piggery of the Dairy.—A part of all dairy establishments conducted even on the smallest scale, and one which is daily increasing in importance, is that of the 'piggery.' Nor need this be at all matter of surprise, for, apart from all considerations of necessity as connected with the consumption of the refuse or 'waste' materials of the dairy, as the butter-milk, the produce of the butter, and the whey, that of the cheese-making departments, the increased and increasing demand for meat of all kinds has raised so enormously the prices obtained for pig meat in its various forms of joints for the butcher, and for cured parts as bacon and hams, that an additional inducement of no small value and importance weighs with the dairyman now to make the most of his refuse by pig breeding and fattening, as compared with former times. It is true that it is one of the disputed points of practical farming, Do pigs pay? and much has been written to prove that they do not; but it is hard to see why they should not do so,—perhaps, let us admit by way of argument, in less degree than other live stock; but whether they do or not, many dairymen are so circumstanced that no other means of using up their 'dairy refuse' is open to them than by the keeping of pigs, so that a piggery is with them essential, if only as a means of 'reducing a loss and preventing waste.' Hence the necessity for us to point out a few facts connected with the piggery as part of a dairy establishment, which we shall do under the idea that this is one on the large scale, and therefore requiring a piggery of a corresponding character.

The great objection to piggeries *per se*, as forming part of dairies, is the odours they give rise to, and which, as again and again we have pointed out, are to be avoided by all possible means, con-

taminating as all odours do the milk of the dairy. It is quite a possible, and, as we conceive, a very probable thing, to conceive that much of the evil connected as an ordinary rule with piggeries, arises from defective plans of arranging and constructing them, and of the mode of keeping the pigs themselves; and that this evil is not therefore a necessity of the system of pig-keeping, which cannot be got rid of by any means within the command of the dairyman. But as prevention is better than cure, it will be the wisest plan to make the piggery or piggeries, structures isolated wholly, and placed as far from the dairy buildings as may be compatible with convenience of working. If placed on a lower level than the dairy buildings, and not at a very great distance from them, the whey may be conveyed from these to the piggery by means of a timber shoot; or a small rail may be laid down, on which trucks may run gently down by gravitation, these carrying the filled whey-pails. By either of these arrangements the chief labour of the piggery, so far as the dairy is concerned, will be materially lightened.

The piggery buildings for a large dairy should comprise within themselves conveniences for the working of the whole, without having occasion to waste time in going to and from the farmery, in order to get such materials as may be required. As embracing what we deem the chief essentials of a piggery on the large scale as regards accommodation or arrangement, and chiefly as giving a suggestion upon those points, we give in Plate 13 a plan in which the accommodation is for a piggery on the large scale, and the extent of which can be enlarged or diminished as circumstances may dictate, without destroying the integrity of the arrangements. The pig-sties are arranged rectangularly in plan, enclosing a space in which are placed the food store, *a*, and the cooking or boiling houses, *b c d e*, one of which is appropriated to each range of pig-sties. This central group may be modified according to circumstances; in some cases it may be found better to give only one boiling-house, with trams radiating to the sides and corners of the interior space, or two may be used. In the plan, the food store, *a*, is lighted from the top; and by doing this by means of an ornamental lantern crowning the

central group, some degree of architectural effect may be given 'even to a pig-sty.' In the ranges of the sties, the corner ones are made larger and appropriated to the farrowing sows, as at *f, g, h,* and *i*. The upper and lower ranges of sties, as *jjj* and *kkk*, are appropriated to the store-pigs and to fattening-pigs, while the side ranges, as *lll*, are devoted to young pigs. Of course these arrangements will be modified according to cir-

cumstances, the sties being portioned out as the pigs of one class happen to exceed those of another. The 'boar' sties are placed in the position as indicated at *m* and *n*. Tramways are used to take the food from the boiling-houses, as the tram *oo*, while lateral ones, as *pp, qq, rr*, run in front of the sties. They will also be used to lead off the manure to the entrance or exit gates at the points *ss*.

CHAPTER VII.

MATERIALS CONNECTED WITH THE VARIOUS STRUCTURES.

The Materials employed in the Construction of the Farm Buildings.—These are stone, brick, concrete, slate, and timber. Some of these may be had on the property, if not indeed all of them. Timber and slate or tiles are used in every building, and must therefore be had, even if brought from a distance. But as regards stone and brick for the building of walls, the choice of either of them will be guided by circumstances. If stone abounds in the immediate neighbourhood of the farm, it will be the better way to use it, unless there be special difficulties in the way of quarrying it. But if the farm is not provided with a quarry, or one be not moderately near to it, so that the stones have to be carted from a great or considerable distance from some far-off part of the property, then the expense of this, added to that of quarrying and working the stone for the building, may be such as to make it so dear as to be precluded from use. In this case bricks may be used, these being either bought from the nearest maker, or, if a good clay-bed be already opened and partially worked for the making of drain tiles and tubes, its area may be extended and clay obtained for the making of bricks, and perhaps of roofing tiles as well; and thus, if well arranged and conducted, will be found a profitable source of building material, useful for a great variety of constructive purposes of the property. We name these points to show the importance of duly considering every detail connected with the buildings, so as to arrive at the most economical method of constructing them. A great deal of this depends upon what may be called the administrative department of building, and how it is carried out; this including the employment and the organization of labour, and the regular supply of material to them, so that

no stoppage of the works shall occur, as often does, from the lack of orderly method in bringing on the ground the various materials as they are required in due sequence. Time is economized and money saved by every department working steadily on from the beginning to the close without halt or break. Nothing is more indicative of the want of a managing head than to see men loitering about, waiting for material to come forward which ought to have been there, or turned over to help in some work where they are not required or with which they are not acquainted. More money is lost in building erections from lack of administration, not only as regards material, but as regards labour and other departments, than is generally thought of, or will be conceded by interested parties. We are now prepared to note the materials used in building in detail; and first, as to *Stones*. Building-stones are classed under one of three great divisions,—(1) the granites; (2) the limestones; (3) the sandstones.

Granites.—The difficulty of working granite with the tool, as well as of quarrying it and removing it from its bed, precludes its use as a building material for farm purposes, excepting for certain exceptional parts, or in certain circumstances, where it may be used if it can be got without involving heavy cost for transport. It is the most durable of all stones, and notwithstanding the drawbacks attendant upon its working, it is largely used in districts where it is plentiful—where, indeed, it may be said to be the only building-stone available. Granite is often found mixed with various foreign substances; if protoxide of iron is present, or, indeed, any one of the iron constituents, its lasting properties are considerably reduced. The trap-rock known as

green or blue stone, sometimes called whinstone, affords a hard and durable stone, not so difficult to work as the granites, and is often used for building purposes. A goodly variety of boulder stones may be met with in various parts of the property, many of which afford good material for the erection of fence walls, etc. A caution is here necessary, never in any instance to use stone taken from the sea-shore or its neighbourhood for use in buildings inhabited by human beings, or for sheltering live stock. They are always damp.

Limestones.—Of this, the second class, there are a number of varieties. These are generally put under one or other of three classes, the 'oolitic,' the 'magnesium,' or the 'shelly' limestones. Of the oolitic limestones, the best known and most generally used in the southern parts of the kingdom, especially the metropolis, are 'Portland' and 'Bath' stone. Of the magnesium limestones, the best known is that used in the Houses of Parliament, which was obtained from Bolsover, in Yorkshire. There are, however, other well-known quarries of it. As a rule, the 'oolitic' formation yields the best qualities of building limestone. In limestone counties, such as Derbyshire, there is a wide variety of stones for building purposes. Shelly limestone makes capital chimney-pieces, taking on a good polish, and showing a variety of tints and forms. Limestones are not very difficult to work, but they are not in this respect and others such favourites with the workman, who loves a stone so readily and easily worked up in any of the forms used in building, from 'rough' or 'random rubble' up to the most finished, and highly smoothed and polished, regularly set 'ashlar,' as

The Sandstones, which are plentifully met with over a wide range of districts, although, of course, varying in quality, from that of a poor, open, crumbling texture, up to the finest, hardest, and closest grained, such as the Darley Dale of English, and the Craighleith of Scottish quarries. Sandstones work freely under the tool, and the most of them take on a good, smooth, if not a polished surface, under proper working. The 'grey' coloured variety, known generally as 'freestone,' is the favourite sandstone; the 'red,' from its colour, not being so highly esteemed, and as

not possessing some of the good qualities of the grey. Yorkshire sandstones are well known and highly valued, as affording a supply of excellent paving and flagging stones, although, as is well known to those who know the county, they are also largely used for general building purposes, giving that grey cold look to the houses, so different from the warm and picturesque red colour of brick or red sandstone. We now come to

Brick.—This, as is universally known, is made from clay, tempered or weathered, well worked into an equal homogeneous condition, moulded into forms of rectangular shape, then burnt, in a 'kiln' regularly constructed, or in a more rough and readily made 'clamp' of old bricks and the new moulded bricks, till the mass becomes hard and partly vitrified. But it is not so well known that the quality of the brick is greatly dependent upon the constituents present in the clay. Thus a sandy clay with low cohesive powers yields bricks so soft that they scarcely repay the cost of making them; marly clay gives a better quality; loamy clay better still; while the best of all bricks are those made from clay in which a proportion equal to one-third of alumina and two-thirds of silica are present. Clays composed almost wholly, at least principally, of those two substances give those bricks known as fire-bricks, which, being capable of standing very high degrees of heat, are used for lining furnaces, etc. A good bed of clay of this kind, if found on the property, may be said to be a little mine of wealth. A good, well-burnt brick should, when struck, give out a clear, ringing, almost metallic sound; and when broken by the trowel, should display a fracture close, hard, and dense, material perfectly free from all extraneous substances, as small stones, etc., and also from air-holes and vacant honeycomb-like cells. The nomenclature of bricks, which need not be given here, is somewhat puzzling, being chiefly derived from local circumstances, etc.; but the best building bricks are generally classed as 'stock,' the second class being known as 'place,' while 'burns' or 'clinkers' are the most inferior of all. These classes, especially the stock, are again divided into sub-classes.

Comparison between Brick and Stone as Building Materials.—Local prejudices, as a rule, decide

the relative value of stone and brick as building materials. If stone is plentiful, brick is seldom used; and all speak in favour of stone as the best material, far away superior even to the best brick. Nor is the converse of the case less marked. But, setting prejudices altogether aside, there is surely some common platform, so to say, upon which their relative merits may be discussed, if they be not positively decided. That stone is peculiarly liable to decay from the action of atmospheric influences, especially if smoke or gases from chemical manufactories be present, is admitted on all hands. But some stones exfoliate more or less rapidly, even under the influence of ordinary atmospheres, such as some of the softer class of red sandstones, and some qualities of the limestones; and in all there is more or less uncertainty as to what their 'behaviour,' to use an engineering term, will be under certain circumstances. The facility with which the open pores of sandstone—all, indeed, more or less—take up and retain damp, and the well-known action of frost as a disintegrator, to say nothing of the chemical combinations entered into between the air, the moisture, and the constituents of the stone, all tend to increase its liability to disintegration and decay; while in some cases the readiness with which minute vegetable growths, as mosses and the like, attach themselves to, flourish upon, and greatly disfigure the appearance, is but too well known. Turning now to bricks of good quality, they are rarely affected by the atmosphere, save only that it may blacken or discolour, but scarcely ever disintegrates the surface. As to the working of the two materials, we find a remarkable difference between them,—one that even the most casual observer cannot fail to notice,—the ready handiness with which bricks are manipulated, and the quick way in which they are piled together in the building, with the slow process of stone walling, the lifting of heavy stones, the slow but necessary—if good, honest work is to be done—process of bedding them, and of bonding them together. The bricks are ready for immediate working, and their form admits of a thoroughly solid and well-bonded wall being obtained by them, which it is in general a very difficult thing for the workman to avoid securing, as the bricks themselves decide their position

in the wall, even if he has, as too often unfortunately is the case, the desire to do bad work. But in the case of stone, not only is there much time expended in the cutting, facing, and dressing the stones before they can be used, but there are many ways in which a wall anything but solid can be and is built. The through-bond stones belie their name, and do not always go through; bedding is also carelessly performed, leading to unequal settlement; while, if almost any building be examined, the walls will, to a greater or less extent, be found—and the thicker they are the worse the fault is likely to be—not to be of solid stone as a brick wall is of solid brick (unless it be a cavity wall purposely hollow), but a mass chiefly of mortar (or grout), with a packing of stone shivers. The very peculiarity of the class of bond employed in brickwork necessitates a solidity of wall, whereas in stone walling, bonding good and honest depends upon the workman; while from front to back a thoroughly solid wall of stone is seldom met with in ordinary work and practice. The following may be taken as a summary of the points of difference between the two materials, and an indication of the circumstances under which they should be used.

In districts where stone can be easily obtained, and obtained at a cheaper rate than bricks, it would be folly to use bricks, however valuable as a building material they may be proved to be, and are. But when the margin or difference between the cost of stone and that of brick is small, although even in favour of stone, we would certainly recommend brick to be used in preference; for as a building material it possesses many most valuable qualities. In the first place, the labour required to dress stone is not required in brick; when set up in walls, the joints are easily made good, and the walls are solid throughout, affording none of those vacancies and spaces for the harbouring of damp, or for the refuge of vermin, which stone walls, built as many usually are, do afford. This point, connected with vermin, as rats and mice, is of immense importance in farm buildings. Then, again, bricks are much less liable to atmospheric influence than stone or other walls: a brick building is not nearly so liable to be attacked by damp as a stone building.

This, although counter to the opinion of many, is, we believe, nevertheless strictly true; at all events, we have come to this decision after the inspection of a vast number of structures erected with the two materials, and we are borne out in this opinion by a large number of the highest authorities on construction. Not only is a good brick less absorbent of moisture than ordinary building-stone, but if it gets thoroughly wet it dries more rapidly than stone, which remains wet a long time, if, indeed, it ever gets thoroughly dry. And as regards solidity, a brick wall 9 inches in thickness, well built, will contrast favourably with a 2-feet wall of stone, if built, as is frequently done, in a scamping style, with the centre hollow and 'honeycombed,' from the number of small stones used to fill it up with, and the often poor quality of the mortar used to grout them with.

There is, however, one point which indicates the change of opinion as to brick, even in districts in which the prejudice against it was perhaps the strongest, and this is the rapidly extending employment of it. We now come to notice a building material, the most recently introduced, and which, from the many excellent qualities which it possesses, is becoming most extensively used, and is likely to become still more so the more widely it is known, especially in farming districts, as we believe it specially well adapted for build-ings, etc., there generally erected. This is—

Portland Cement Concrete (for ordinary concrete, see par. on next page).—The mode of building, or rather of constructing walls in earth, known as 'pise' or hard-rammed soil, and with which our readers are doubtless acquainted, probably led to the use of concrete as a substitute for the earth, as possessing a capability of being more easily worked, and a much greater strength.

Composition of Concrete.—Concrete may be defined as a mixture of gravel, stone chips from quarries or from the preparation of stones for building purposes, cinders, clinkers, broken bricks, and the like, with lime or cement. When lime is used as the material to bind the substances which form the bulk of the concrete, the concrete is used for the making of foundations; but where it is required for building purposes, a hydraulic cement is used to bind the broken bricks, gravel, etc., used as the bulk of the material. The

cement almost alone now used is that known as 'Portland,' which, in fact, is the most valuable of all such materials. It is made by mixing definite proportions of chalk and clay, mud, and carbonate of lime, with the argillaceous deposit of certain rivers, the waters of which flow over clay and chalk. In this country the Medway, or rather the bays and creeks on the sides of it, afford the best material. The cohesive strength of the cement made from these materials is very great, four times as much as that of the best hydraulic lime. When mixed with broken bricks, it forms a concrete which is stronger than Portland stone in the proportion of 2.280 to 1.480. In purchasing Portland cement, it is well to specify the weight per bushel. A good quality is that which weighs 110 lbs.; some authorities prefer a lighter cement, as 100 to 105; but the weight of experimental evidence is in favour of the heavier cement. We have named a number of materials of which concrete can be made, but to these may be added the nodules of burnt clay—clay can be burnt at a cost of 1s. 6d. to 2s. 6d. a cubic yard—broken glass and crockery, hard chalk and chalk flints, broken slag from iron furnaces, and, indeed, almost any materials which form hard, compact lumps or nodules, which do not disintegrate or crumble away. Where these vary in size, the large lumps may be used to pack the centre of the wall, the thinner concrete being used to bind the whole together. Concrete is an exceedingly good material for the construction of farm buildings, inasmuch as generally in these there are long stretches of solid walls, with comparatively few window and door openings, and with simple internal partitions; these peculiarities enable the appliances required to be made and used very economically. It is peculiarly well adapted to the building of enclosing walls, formation of tanks for water or manure, for floors rat-proof, all of which can be erected and laid down at a mere fraction of the time which ordinary methods take. Another point which renders the system peculiarly applicable to the construction of farm buildings, is that it can be carried out without the use of skilled labour. Such is the extreme simplicity with which concrete building can be carried on, that we have set labourers to work on it who never

had seen or heard of it, quite convinced that they would be able to do it satisfactorily, and the result has justified our expectations. We recently erected a concrete building of a somewhat complicated character, and yet it was done by the aid of common labourers alone. As in the case of 'pise' building, named above, moulds specially made are required. It is obvious that the more building required, the cheaper will it be made, inasmuch as the cost of preparing the moulds will be distributed over the greater surface of walling; but, the plan of the building being decided on, a little consideration will show how the moulds may be made in such a way as to be available without cutting or other alteration for the largest extent of building. There are several modes of forming the moulds and adjusting them for working, some of which, being patented, are available only by employing the patentees or by working their apparatus under a royalty.

Proportion of Materials used in making Concrete.—The proportion of the Portland cement to the broken materials used for making the concrete varies according to the practice of various practitioners. Some use so small a proportion of cement as one part in eight of the materials; others seven; but a safer proportion is one part of cement in five or six of the materials. This we adopt in our own practice, modifying the proportions, however, according as we require in some parts a greater strength than in others, as pillars or narrow pedestals, in which case we use as high a proportion as three parts of the cement to eight of the material.

Mixing the Materials used in making Concrete.—The best way of mixing the materials is to have a platform made of strong boards well clamped together, and which may be of any convenient dimensions—as 7 feet square. This is laid upon the ground in close vicinity to the place where the building is to be erected. The gravel, broken or crushed bricks—of size to pass through the meshes of a $\frac{1}{2}$ -inch sieve or screen—are then placed upon the board, together with the cement in the proper proportion, and the whole well mixed together in a dry state. When the mass is well mixed, water is sprinkled over it, gently at first—best done through the rose of a watering-pot—and applied till enough is given

to enable the cement to adhere to, or become incorporated with, the broken material; the whole being of that consistency as to be easily passed into the moulds, and to be pressed closely up to the sides and ends, and to embrace, as it were, the larger lumps put into the centre of the mould, and forming the packing, of which more presently. A little experience will soon enable the workmen to know the proper state of consistency in which the mass should be for using; care being taken to mix it well up before wheeling it off to be put into the moulds, as, if not well mixed, the cement is apt to settle to the bottom, leaving the upper portion, of course, weaker than the lower.

Ordinary or Lime Concrete.—This, which is chiefly used in foundation work (see 'Foundation'), and for filling in faults in the soil, etc., is composed of lime, sand, and gravel. The lime is in proportion to the sand as one to two or three of sand, the gravel being of the same bulk as the sand. The whole are well mixed together, and then brought to the consistency of ordinary mortar by the addition of water. If it is desired to have a quick-setting concrete, the lime used should be of the class known as hydraulic (see next par., 'Limes'), such as the 'Dorking,' Halling, or Blue Lias, of which the last is by far the best, and that generally employed in good work.

Limes.—The nomenclature, as well as the physical qualities and chemical constituents, and how they 'behave' towards one another, are all at present in a transition state, the science of the subject passing through that crucial stage in which the crude, hap-hazard conjectures of early times, fortunately for the science, have recently begun to give way to those in which the whole subject is being considered by some men of science in a thorough way, so as to place all its details upon a secure and trustworthy basis. What the result of these investigations may ultimately be, it is hard to say, but much good cannot but arise from them, and many notions, now widely accepted as correct, will be proved to be anything but so. Meanwhile, we may state that limes used for building purposes are obtained from the limestone formations, from chalky deposits, and from marl pits or quarries.

The limestones thus obtained do not present the peculiar appearance so well known as that of lime until they are burnt in kilns, when, chemically, they are known as the oxide of calcium, the fire having driven off the carbonic acid, and popularly 'quicklime.' When this has water poured on it, the lumps or largish pieces—in which form it comes from the kiln-burning—swell, crackle, burst, and fall into the condition of a fine white powder, a high degree of heat being at the same time generated. This powder is called a hydrate of lime, ready to be made into mortar of a class determined by the quality or nature of the lime. The qualities or classes of lime are two—common, or rich, fat limes, and hydraulic, or poor, meagre limes. The common lime hydrate makes a rich, fatty-looking paste, which readily slakes by the addition of water. The hydraulic hydrate of lime makes a thin paste, which does not slake. The common limes do not harden with water, or but very slowly, if not washed out at the first; hydraulic limes harden more or less rapidly, according to their constituents. Those which confer this valuable property on lime are silica and alumina, which are present in greater proportion than the carbonate of lime. The best of the hydraulic limes at present known is the blue lias, which contains as much as one-fifth part of clay in which the silica and alumina are present. Artificial hydraulic limes, or rather cements, can be made by burning any good marly clay; and when calcined into hard nodules, these are ground to a condition of coarse powder-like sand, and mixed with fresh-slaked lime in the proportion of one part lime to three parts of the powder, and adding water till the whole is of the required consistency. This cement or mortar is capable of resisting a high degree of heat. Hydraulic artificially-made lime of a lower quality than this may be made by mixing common lime with clay, burning the mixture, and grinding the calcined nodules.

Hydraulic Cements.—Those in use are obtained from nodules of conglomerates of limestone and clay, with in some cases a small proportion of silica or sand, which lie in large quantities along the shores of the tidal river Medway, on the Thames, and at the Isle of Sheppey, as also at Boulogne in France. The Sheppey Isle yields the

cement known as Roman, now rapidly giving place to the much superior Portland cement yielded by the Medway nodules. The nodules are subjected to a high degree of heat, and afterwards ground into fine powder. For a description of the qualities and uses of Portland cement, see a preceding paragraph on 'Portland Cement Concrete.' There are a considerable number of natural cements found at various places on the Continent, one celebrated source being on the Rhine, in the valley of the Bruhl. *Asphalte* is generally classed amongst the cements, although, properly defined, it is a mastic composed of natural or mineral tar, with bituminous limestone, which is the asphalte proper, being a porous limestone; this being finely powdered and mixed with the tar. *Asphalte* has long been used to form flooring surfaces, etc., but is fast being superseded by Portland cement concrete, which is not only greatly superior to it, but is very easily laid; whereas *asphalte* requires the aid of skilled workmen.

Slate and Tiles.—When the classification of stones is adopted which has three divisions, the 'siliceous' taking in the sandstones and granites, the 'calcareous' embracing the limestones, slate is classed under the 'argillaceous,' of which, indeed, it is the chief if not the only industrial representative. Slate is a hard and dense, compact and heavy substance, close grained, capable of being split easily into thin plates, which constitutes its principal feature, and makes it so valuable for various purposes. The colour is blue of various shades, from light to dark, and some varieties are tinted with beautifully-marked veins of a greenish colour. Slates are cut into various sizes, distinguished by name as countess, duchess, imperial, etc.

Tiles.—If good clay be found on the farm, or on some part of the property, roofing and flooring tiles may be made, as well as bricks and drain tubes and tiles. Tiles are either 'flat' or 'pan;' if flat, they are provided with a hole at the upper edge, by which the tile is secured to the roof battens by a pin driven through the hole, and linking on to or hanging from the batten. In pan tiles, which are double-curved, or ogee-shaped in sections, a projecting knob is made in the under side of the upper edge, by which the

tile is supported from the batten, on which the tiles rest.—Flooring-tiles may be square, lozenge-shaped, or rectangular. Tiles afford a warm-looking, picturesque covering for roofs; but being considerably heavier than slate, the scantling of the timber of the roof must be increased in proportion.

Timber, Varieties of.—Timber is largely used in the construction of farm buildings, chiefly, however, for the roofs and detached fittings, few of the apartments having joisted and boarded floors. Home-grown timber may be used for the construction of the roofs, wall plates, and work not requiring to be finely wrought. For the internal fittings, doors, window-frames, cow-house or byre and stable fittings, foreign timbers, which are easily worked under the tool, will require as a rule to be used. Where appearance may be sacrificed in these fittings, at least to a great extent, a clever workman will manage to make what he will call 'pretty good' or 'tidy' fittings out of home-grown timber. That of the cattle-boxes, cattle courts, or curtains, may all be made of this, as appearance is not much studied in these structures. Not that we should at all counsel heavy, clumsy work to be done; but while it may be coarse in one sense, so far as regards the rough appearance of timber, which will not work 'kindly' to a smooth surface, still the whole work, if well proportioned, will look neat. The foreign timber generally used comes from either North America or from the northern parts of Europe, hence called Baltic, Dantzic timber, and so on. The American pines are largely used in this country. The white pine-wood is used generally for ordinary joiner work. It is the cheapest, and works freely under the tool; it is generally of good quality, free from knots, shakes, and green wood; as its name indicates, it is free from all resinous or pitchy matter. For work of a superior class the yellow pines are used, while for the best work the red pines are employed. If the latter be employed for interior fittings, paint need not be used, as the veins of 'humour' arising from the disposition of the resinous matter with which this variety of wood is largely provided—hence its superior strength and durability—give a very finished and often beautifully-grained surface, more especially if

varnish be employed to finish off with. These remarks apply, with some slight modification, to the yellow pines of good quality. Baltic fir or pine woods are more thought of by our trade, and bring higher prices, than the same classes of wood which come from North America. The term 'Baltic' generally includes all the timbers which are known as Dantzic, Memel, Christiania, and Drontheim, frequently called 'Drum.' All these timbers are supplied to the trade in the form of 'bulks' or 'logs;' these being of considerable length and of large sectional area, the usual measurement being 18 inches on the side, afford heavy timber for beams, lintels, scaffolding, etc. When cut up for smaller work, the pieces are known as planks, battens, and deals. A deal averages 9 inches in breadth and 3 in thickness; 'battens' are cut from deals, and average in breadth 6 inches, but often as much as 7 and as little as 2 inches, and vary in thickness from five-eighths of an inch up to 2 inches. What are called 'boards' are cut from deals, the breadth being greater than $4\frac{1}{2}$ inches, and the thickness not exceeding $2\frac{1}{2}$ inches. Boards are designated according to the number of them cut out of a deal; if three boards are cut, it is called 'three-cut stuff,' and so on. A 'plank' averages 11 inches to a foot in breadth, and is of various thicknesses. The pieces used by carpenters are known as 'timbers,' while all pieces of smaller scantlings used in interior work are classed often under one general head, that being 'stuff.'

Diseases and Decay of Timber.—All timbers are liable to decay, some specially so. A disease to which flooring timbers, especially those on the ground floor, are exceedingly liable, is that known as the 'dry rot;' if this, which is a species of fungi, once takes decided hold of flooring joists, the only alternative is to pull them out and substitute good sound timber for them. The best preventive known of this dreaded disease in timber is keeping the joists thoroughly exposed to currents of air; ventilating bricks, therefore, as they are called, although now generally made of iron, should be inserted in the walls at intervals under the line of timber. The most durable of all timber, and not nearly so liable to decay as others, is oak—English-grown oak being preferred

to foreign, as of higher quality. There is no cause which so predisposes wood to decay as alternations of wet and dry. When timbers are exposed to this twofold influence, and used in parts where great strength is required, timber of the best quality of its class should be employed; oak, for the reason above named, being by far the best and most economical in the end. If pine be used, it ought to be Baltic red pine of the highest quality.

The Use of Timber grown on the Property, and its General Management.—The following remarks apply chiefly to this important department, although much will obviously apply to foreign timbers. The first practical point is the period of the year at which the timber should be cut down or felled. When cut for building purposes, it is necessary that the trees, at whatever period of the year they may be felled, should not be allowed to stand so long as to exceed their average period of growth. This is important, when we consider that timber allowed to be too old before it is cut is likely to have what is technically known as ‘star shakes.’ Star shakes in old timber are cracks in the wood, which radiate from the centre to the circumference of the tree, having their greatest width or extent of opening towards the centre of the tree, or that part where the timber is most valuable; whereas in young trees the star shakes, while radiating as above, have their widest opening at or towards the circumference of the tree, or at that point where the least valuable part of the wood is met with. This point bears, then, upon the value of the timber; but it also appears that the value is influenced by the season of the year at which the timber is felled. The best season would be that immediately preceding the period when the ‘sap’ movements begin in early spring-time. Practically, however, the felling season extends itself from the period when the sap movements or active vegetation ceases in the autumn, to the period before it begins in the spring, or, in other words, between the months of October and April. As the sap movements in timber exercise a most important influence upon its value, it will be interesting here to glance briefly at a few points connected with them. The sap of trees, which is composed of

oxygen, nitrogen, hydrogen, carbon, and sulphur, and which forms a considerable proportion of the bulk of the green or fresh wood, is, as may be supposed, a varying quality, and that according to the season. At first sight, from the fact that the sap movements are most active in the spring months, it might be supposed that the amount or quantity of sap in trees would be greatest in spring. Accurate experiments show that this is not so, and that the greatest quantity is met with in the months of December and January. It gradually diminishes in the months of October, November, February, and March; next in April, May, August, and September; the minimum being in the months of July and August. Of course, these general statements must be modified by circumstances, such as dry and wet seasons, but the rule, as a whole, stands as we have put it. After being cut down, the sap, as a rule, evaporates gradually; it is only in some cases that the sap is got rid of by its flowing or exuding from it, and this flowing out is greatly dependent upon the state in which the timber is after being felled; for if the bark is stripped, the flowing out of the sap from the wood is much quicker than in cases where the bark is allowed to remain on. With bark stripped off, the weight of the sap gradually diminishes; but with the bark on, this fluctuates, moisture evidently being absorbed from the atmosphere by it.

We now proceed to the *seasoning* of the felled timber. This is a department in the management of home timber of which it is impossible to overrate the importance, yet one which is frequently neglected, and concerning which many erroneous notions are afloat. Before proceeding to the description of the practical methods in use, it will be of some service to our readers if we glance at a few of the points connected with the natural peculiarities of timber trees bearing upon the practice of seasoning.

There is considerable difference in the natural properties of wood. This difference is attributable partly to the physical construction of the fibre or ‘lignin,’ and partly to the nature of the sap which has nourished it whilst growing. The physical construction of the fibre includes not only its form, but its substance also. This point is important, inasmuch as the evaporation of the

watery portion of the sap of the wood, which is vitally necessary, is either facilitated or retarded, according as the fibre is open and spongy, or close and compact. And again, in woods where the fibre is close and compact, such as oak, beech, etc., the proportion of sap to fibre is much less than in the more open and spongy woods, such as fir, willow, etc. But although the porosity of wood is important, as being the medium of evaporation, the nature of the sap is a point of greater importance, for the following reasons:—

When a tree is cut down, it is charged with that quantity of natural moisture which has been necessary for its vegetable existence. Now it is an established physiological fact, that the very moisture which has been necessary for the perpetuation of either vegetable or animal life, becomes converted into a primary element of decay and decomposition the moment that vitality ceases. The verification of this fact is simple and conclusive; remove the natural moisture from either vegetable or animal matter, and you effectually protect it from decay. The second cause of the difference in the properties of wood, before alluded to, is the nature of the sap which has nourished it whilst growing. It is scarcely necessary to state that the sap of all the trees is not alike. This difference is caused by the various proportions of different chemical substances which enter into its composition. For instance, the sap of some trees is more or less resinous, as that of the pine; galling or astringent, as that of the oak; or mucilaginous, as that of the cherry tree. And according to the increased proportion of these substances which the sap contains, there is less liability to rapid decay; whilst, on the contrary, the more water the sap contains in its natural state, the less durable is the wood when deprived of vegetable life. The decay of wood of all kinds dates from the time that its vegetable life has been destroyed by cutting down. From that moment the work of decomposition begins, and is expedited or retarded according to the nature of the wood, and the length of time that may elapse before the watery portion of its sap is evaporated. If, then, such moisture is allowed to remain, decay soon becomes perceptible; but, on the contrary, if it be expelled,

the process of decay is so slow, and so gradual in its operation, as to be imperceptible for centuries in some descriptions of wood, and hence the necessity for using well-seasoned wood. The chief cause of decay in wood is the fermentation of the nitrogenous substances contained in the sap; this fermentation being developed under the influence of the action of the oxygen in the atmosphere with the moisture in the wood.

Seasoning by Immersion in Water.—This plan proceeds upon the principle, that by lying in water the sap is washed out of the pores, and the water takes its place; which, when the timber is afterwards exposed to the atmosphere, is much more easily and quickly expelled by evaporation from the timber, than the sap in its ordinary or natural condition. To obtain these results in the quickest way, two things are essential,—the placing of the timber in running water, and the highest degree attainable of purity. But where strong peat or moss water can be had, it may be used advantageously to preserve or season wood in small pieces, such as those used for fences and the like purposes.

Where estates are in the neighbourhood of the sea, the timber has been recommended to be seasoned in the sea water. It is much more difficult to work under the tools, and is, moreover, subjected to the atmospheric changes which bring out the dampness occasioned by the presence of the salt particles left in the pores. Steeping in lime water is a most effectual method of seasoning or preserving timber, and on the efficacy of this method a provincial newspaper quotes a case which came under the notice of the editor: ‘Several ash trees were felled and cut into scantlings of various dimensions. The timber, after a few weeks, was put out of the way into a dry pit, in which a considerable quantity of lime had been stored for the purpose of making mortar, some of the refuse of which, together with a portion of good material, still remained. By an accident, water was let into the pit, and filled it to nearly half the height of the stacked timber, which, however, remained *in situ* for twelve or thirteen weeks, when it was used. In less than three years, nearly every piece of timber that had remained above the lime water in the pit

was completely tainted or destroyed by dry rot, while that portion of the wood which had been well soaked in the lime solution remained sound, and continued to do so as long as it remained under our notice, which was some three or four years afterwards.' Mr. J. Bailey, Denton, in a letter to the *Agricultural Gazette*, drew marked attention to the value of this method. He says the immersion of wood in a solution of lime renders it, by the cheap and simple process of absorption, equally durable when used above ground and under shelter, and will be found worth equal attention. That timber, when immersed for a short time in a solution of lime, undergoes much the same changes as when subjected to the action of metallic agents, or to the process of creosoting, will be apparent from the following statement of Dr. Voelker, who, at the request of Mr. Bigg, analysed three specimens of timber used. Pits or ponds may be constructed varying in size and position with the locality in which they are made, and the quantity of timber to be soaked. The simpler their character, the more profitable their use. A common pond, from which cattle can be excluded, is perhaps the best soaking tank that can be adopted. All that is essential is to have depth and size sufficient to steep and hold timber of all characters and dimensions that may be required upon the estate; and it is unnecessary to say, that a little outlay in the first instance, to make the tank sufficiently commodious, may be the means of saving in the end. Having secured a good supply of water in the tank, the next point is to immerse in it a sufficient quantity of lime to satisfy the water—that is, to feed it with all it is capable of absorbing and retaining, thus, in fact, impregnating the water completely with lime. To render this intelligible, we will assume that it is intended to make a steeping tank or pond 50 feet long and 20 feet wide; this, if filled with water 6 feet deep, will contain 37,500 gallons. As it requires only 88 grains of chalk or stone lime to impregnate 1 gallon of water, 46 lbs. of lime will satisfy this quantity of water, if equally distributed through its bulk; but as it is better to make sure of uniform effect, such a quantity should be used as will cover over the bottom of the pond. It would not require many bushels

to do this, and the mixture should be renewed at discretion as the pond receives fresh water. In the solution thus made, the timber, cut to the required scantlings, and sawn on all sides, is placed,—the larger pieces, intended for beams, etc., at the bottom of the bath; and the smaller timbers, intended for rafters, boards, and skirtings, etc., at the top. In this condition they remain for periods varying, according to the size of the timbers, from three to nine weeks. They are then taken out, and after being exposed for a few days to the sun and wind, are dry enough and ready for use. Natural seasoning may be simply described as the placing of timber in such a way that, while secured from rain, snow, and sources of annual damp, it is freely exposed to currents of air. This, of course, implies the use of covering-sheds, and the timber should be piled in such a way that the whole may be dried as uniformly as possible; for it is found that, when the side of a piece is dried more quickly than another, it warps. The shortest period to which timber should be exposed to natural seasoning is two years, and the process is judged to be pretty complete if the timber loses one-fifth of its weight. Another precaution to be taken in carrying on the process, in addition to that named above, is not to expose the timber too soon to the drying process of currents of air, more especially if the weather is very warm and dry. In this case the timber should only be partially exposed to the air, and this may be best effected by piling the planks pretty closely together at first, gradually widening the spaces between them as the process proceeds.

Preservation of Timber.—Timber which has been thoroughly well seasoned may in one sense be said to be in that position in which its good qualities will be preserved, so that the seasoning and the preservation may be said to be synonymous terms. But while this is true, it is also true that although we may, and in practice sometimes do, get wood thoroughly seasoned,—that is, give it properties by which it will be preserved,—still we find in practice, if we put that timber under conditions in which it loses those properties, it begins to decay. In other words, we by seasoning give it certain desirable qualities, which by preservation we enable it to retain; hence

the two processes are in practice essentially distinct. The most obvious mode of preserving timber from the causes which bring about decay is the old-fashioned one of painting its outer surface. That this is effective only under certain circumstances we all know, for paint itself, under the action of the atmosphere, rapidly decays, exposing the timber to the same. A very effective way of using paint on external woodwork, and rendering its effect much more lasting, is to go over the surface with a drying oil, and when this is wet, carefully strewing clean sharp river sand over the whole surface, and then finally painting this surface with ordinary paint of the desired colour. In place of the first coat of drying oil, the ordinary paint may be used. Coal tar, for the timber in constructions such as timber houses, is a good preservative. It is much more lasting when mixed with sharp river sand, which may either be mixed with the tar and the mixture painted on, or the tar may be first put on, and the sand strewed over the surface while the tar is wet. We prefer to use the two modes in conjunction,—that is, putting a small quantity of sand in the tar in the first instance, and painting the surface, and finally strewing the sand over the whole. An excellent method used in some places on the Continent is the employment of crushed shells, as cockle and mussel shells, which are strewed over tarred surfaces. A very pleasing effect is given to the surfaces so treated, by the varying colours of the shells. The preserving effects are said to be very lasting. In preventing the attacks of fungi on wood, a paint made of 100 parts of flour of sulphur, 15 parts of manganese, and 67 of manganese, is used on the Continent with effect. A surface preservative is highly spoken of. It is made up as follows:—Linseed oil, 15 parts; resin, 15; tar, 5; white lead, 12; any colouring material, 4; cement, 6; oxide of iron, glue, 2; hydrate of chalk, lard, 15; litharge, 2. The whole to be boiled and reduced to one-tenth of the original bulk, and applied hot.

As in the case of the other exterior applications already described, so in that of paint, it is essential that the wood be well seasoned before it is applied. No matter how good in itself the preservative coating be, it will not prevent, but rather promote, the decay of the wood on which

it is used, if that wood be moist in the interior. If a plank or other timber be fitted up, and one half exposed to the weather in its natural or ordinary condition without paint or other coating, and the other exposed half be painted, we find, on examining the timber, that the unpainted half, though surface-cracked and weather-beaten, is by far the soundest. The internal moisture or sap of wood is the first thing to be got rid of; then, this being done, outside preservatives may be applied with advantage. Timber is sometimes preserved by subjecting it to the smoke of certain combustibles. The effect of smoke, especially that of wool, as a fair preservative of timber, has long been known. The timbers of the open roofs of the middle-age houses, which were often exposed to the smoke of burning wood issuing from the open and otherwise defective fire-places, are found, in their blackened condition, to be at this day in the highest state of soundness, although doubtless much of this is due to the currents of air to which they were also exposed. The following is a description of a mode of adding to the durability of home-grown timber, or scantlings of small size of foreign timber, by exposing them to the smoke of burning tree twigs of birch and beechwood:—‘The action in this case is exactly that which takes place in smoke-drying fish, the creosote of the smoke coagulating the albumen of the wood with which it comes in contact. The simplest means of smoking the wood is to pile it loosely together in some old building, all the voids of which can easily be closed up. In a vacant space reserved for the purpose, a quantity of birch or beech spray should be set fire to, and, the apertures being all securely closed, the interior will soon be completely filled with smoke. After a day or two the door should be opened, and the process repeated according to the size of the wood; the smoking should prove effectual in its preservation, if from four to six strong applications are made. After the piles are arranged, very little labour is required in burning a fresh quantity of spray every alternate day or so. To secure the full effect resulting from this cheap and simple process, the wood should be air-dried during a summer previously; and in putting it into the building it will be advisable to lay it in a direction slanting slightly upwards, with the

butt ends a little off the ground; if the sticks are standing with the butt ends close on the floor, the entrance of the smoke into the pores of the wood will be somewhat obstructed.'

The old-fashioned method of charring the surfaces of the ends of posts subjected to damp is an effectual way of preserving timber. The charring or carbonization is carried to a short depth only, and only for a certain length of the timber subjected to it, as, for example, the ends of posts which we put into the earth. The carbon thus formed on the wood is thought by some to have such an effect as prevents the access of decaying principles to it. By others, the carbon is considered useful only as preventing the damp from the soil penetrating to the timber. If this is all that carbonizing effects, then the same purpose would be served to a large if not an equal extent, by protecting the end of a post let into the soil with such abundant materials as broken bricks crushed small, cinders, etc. That the carbonizing of timber serves more useful purposes than merely preventing damp from entering it, may be inferred from the results of the system of carbonizing timber over all its surface, when used for ship-building and other constructive purposes, as introduced very largely in France by M. Lapperant. The apparatus is ingenious, yet simple, by which the inventor applies a flame to the surface of the wood to be preserved. One beneficial influence exerted by the process is this, that the high temperature induced by the sheet of flame desiccates the timber to some distance below the charred surface. And while the charring and drying are going on, the vapour in the wood is forced out precisely in the same way as we see it forced out in a liquid condition when a log of damp wood is placed upon a good fire. No doubt the drying or desiccation of the wood is only partial, as it does not extend to the interior of the log or piece subjected to the charring process; but the inventor states that the dampness or moisture in the interior of the wood has not a like deleterious influence upon it as damp in the exterior. He says we have arrived too quickly at the conclusion held by the majority of practical men, that we are to judge of the effects of damp in the interior of a piece of wood from its effects on the exterior. All point to this striking fact as

a likely proof that we are wrong in doing so, namely, that the woods which retain their moisture longest last the longest, or those which part with it the most quickly, the most quickly decay; thus, for example, the oak is the most enduring of timber, yet it retains its moisture for the longest period. Then, again, that it is not moisture alone which is the cause of decay in wood may be predicated, says M. Lapperant, from one fact, that we can preserve wood any period by immersing it wholly in water. No doubt moisture in wood is one of the causes of its decay, but it is not, as some suppose, the only, indeed not the chief cause; but it is the presence in the air which comes along with it of minute infusoria, which is the cause of the fermentation which decays the wood. Another advantage derived from charring the wood by the action of a sheet of flame, as used by M. Lapperant (in addition to that of the destruction of those infusoria), is that a thin coating of charred wood is made, which rests upon an interior surface of timber not charred, but only tarried. This interior surface, impregnated with the essential oil of creosote, is antiseptic. The last advantage to be named of the plan of charring the wood by the action of flame, is that the process hardens the surface to a remarkable degree, and helps largely to preserve the timber.

In Bethell's process of preserving timber, the heavy oil of tar, in which creosote is largely present, is employed. The substance coagulates the albuminous matter found in timber, and, hardening it, partly increases the strength of the woody fibre; and as the oils are insoluble, they cannot be washed out of the timber. Further, their action is such that they effectually prevent worms from attacking it. Their effect also is to absorb the oxygen by which decay is induced. They also resinify the interior pores, preventing access of air; and they are obnoxious to all fungi and animal parasites. From the colour and objectionable smell which the oil imparts to the timber, the process is only available for outside work. The patented process is rather complicated, but for all the purposes of the farm, the plan of simply steeping the timber in the oil in a tank made for the purpose will be amply available. The timber should be dried before it is

put into the tank, in which it should be allowed to remain for twenty-four to thirty-six hours, according to circumstances. The oil should be made hot in a pan or small boiler. This process of immersion will be found very useful ; but where

it cannot be carried out, much of its advantage will be obtained by simply painting the surface of well-seasoned timbers with the oil. This will make them last longer than if this painting were not done.

CHAPTER VIII.

COVERED FARM STEADINGS—STEADINGS ADAPTED TO THE EMPLOYMENT OF LIQUID MANURE ON THE FARM—STEADINGS FOR HILLY OR MOORLAND DISTRICTS.

Covered Farm Steadings.—Much discussion has been given of late years to the arrangement and construction of farm buildings in which all the apartments are collected together, and placed under one large roof common to them all. As in other departments of the practice of farming and farm architecture, so in this, there is very considerable diversity of opinion on the points connected with this system. Some maintain it to be the most perfect both as regards the principle on which its buildings are constructed, and their healthiness generally for the live stock kept in them. Others just as warmly hold that the buildings on this system do not give either of those advantages—at least to such a marked extent as its advocates claim for it.

At first sight, the principle is apt to present itself in somewhat attractive fashion—in the very compactness with which the various apartments are of necessity arranged, in order to avoid the cost of extra roofing. There is something which commends itself to those who have ‘order’ largely developed. Again, time is likely to be saved in the working of a farmery so disposed; while the protection afforded from the weather by the common roof ensures a degree of cleanliness and gives an air of general comfort not seldom wanting in farmeries, so much of which is exposed to rain, with all its inevitable concomitants of mud and watery pools and half-drowned materials or fodder. But the advocates of the system claim for it other and much higher advantages than those, good and attractive as they seem to be. Take, for example, the manurial department of the farmery, where stock are kept in considerable numbers in open yards, as under the system

most generally, indeed we might say universally, adopted; and comparing this with the feeding-yards—if the latter term can be here appropriately used—covered entirely over and side-walled up to the roof on the new system, there are certainly very striking advantages gained by the latter. Both from the researches of science and the results of successful practice, it seems to be established beyond a doubt, that manure made under cover is better as manure than when made in open yards. This, be it noted, is a question altogether distinct from the preservation of manure collected from stables, cow-houses, or byres, etc., in which the stock are kept under cover, at least for a portion of each day, including the night season, as well as such manure as may be made in the usual open yard. This method of manure-preservation, although no doubt possessing many of the features which characterise the other, of manure made in covered yards, has points, however, peculiarly its own. What these are, and indeed the whole subject generally, will be found described under the special chapter (X.) devoted to it, in which ‘Covered Manure Pits or Dung Stances,’ and also ‘Liquid-Manure Tanks,’ are illustrated and described. What we are now concerned with is the making of manure under covered courts, which term is the most applicable to the system, as compared with that made in open and exposed yards; and, as we have already stated, it seems established beyond all doubt that the manure made in the court is greatly superior to that made in the yard, while there is this great additional advantage, that a very considerable saving of labour and material is effected. Taking the evidence of an able and well-known authority on the point,

we find, so far as the saving of labour is concerned, that in the open-yard-made manure it has, of course, in the first place, to be moved from the yard to the place in which it is stored up,—generally an open or exposed dung-heap, or at the best, in many instances, a dung stance walled in, but yet not covered over (see par. above referred to). While there, it has to be turned over at least once, and frequently twice, before it is taken to the land; whereas under the covered-court system there is no removal at all required, and no turning over, simply because, from the way in which the straw is given to the animals, and that in which it becomes thoroughly mixed and incorporated with their solid and liquid droppings, it is fit to be carted at once away to the fields where required. In the words of the authority we have alluded to, the very object of the covered courts is, that the 'cut or bruised straw should absorb all the liquid, and be also mixed with the solid manure, forming together a pasty mass, too greasy and solid to admit air or permit fermentation.' Another advantage possessed by the manure is, that there is nearly, if not wholly, an entire absence of that prolific insect-life which is at once the pest as it is the characteristic of manure made in open, exposed yards. The other advantage alluded to obtained by the system is, that it effects a considerable saving of material, inasmuch as it is better to give the straw to the animals in comparatively small quantities, spreading it out thinly over the surface of the court floor, rather than in the heavy, thick masses so often given in the open-yard system. The reason for this is obvious, at least from one point of view; for in the open yard, exposed as the animals are to cold and wet, a certain amount of straw is required to afford them some warmth and shelter from the wet and damp manure below; while in the covered, walled-in courts this is not required, shelter being otherwise obtained.

This last point, while for the present it finishes the subject of manure, brings us to another advantage of the covered-farm-building system; and this is the beneficial effect upon the stock, during the winter months especially. We have elsewhere, in another paragraph, fully explained the principles upon which warmth and shelter

given to stock is, to a certain extent, equivalent to a saving in their food. We therefore have simply to notice this here as one of the advantages of the system, referring the reader to the special paragraph named.

But while the covered-farm-building system is undoubtedly possessed of the advantages now stated, it is only right to state the disadvantages which it undoubtedly involves; and these, in the opinion of certainly a very large number of practical men of the highest standing in their profession, are so grave, and so difficult to—if indeed they can at all be—overcome, that they will always militate against its very wide, not to say aught of its general adoption. And it is, at all events, a feature strongly corroborative of this view, that although several years have now elapsed since the system was first introduced, it has not advanced in any striking manner; rather it would be the correct way of putting the matter, to say that its non-adoption in cases where new farm buildings have been erected, is the striking feature of the question as it stands. The first and perhaps the greatest disadvantage of the system is, that the very compactness and concentration which we have already noticed as forming in the minds of some its great attraction, are the source of evil of a very grave kind. This disadvantage consists in the too well known rapidity with which certain complaints and diseases prevalent amongst live stock spread and diffuse themselves, so to say, among the animals of the farm, even when they are what one would suppose to be pretty well separated and isolated from each other. Now, in a covered-in building, the roof, which is common to all the apartments, thus embraces them in what might be called a perfect unity; but it unfortunately leaves all the apartments open at a certain height to one another, the only isolation or separation of one from another being that obtained by the use of the dividing or partition walls. When, therefore, disease breaks out in one apartment, its virus or infectious qualities may be said to be common to all, as it has free course throughout the whole building. The only way to overcome this difficulty is by building the division walls right up to the roof, and making the junction between them as completely tight as possible. But this,

while it involves large expenditure, by no means overcomes the difficulty, at least only in a partial way; for by doors, windows, ventilating apertures, and the thousand and one chinks and crannies inherent in all buildings of any size, the communication between one apartment and another is kept up; and ventilation in such a structure, if it can be made complete, will offer in this very completeness facilities for the transmission of infectious vapours or odours. For, as in railway stations, which offer examples of the like principle of covered-in construction, so in the farmeries, the currents will often be found to sweep from end to end of the structure, in place of being divided and carried off by the special individual apertures provided for ventilating the different apartments; so that these strong and undivided currents will or may carry the noxious influences from one end to the other, and thus pass over in succession the apartments which ought to be perfectly isolated from each other. But reasoning from analogy, and noting carefully the results of the most recent researches and experiences of medical men connected with their treatment of the diseases of humanity when congregated in public buildings, hospitals, infirmaries, and the like, we are in a measure compelled to pronounce the covered-in farmery a mistake. For what is the experience here alluded to? Simply that, in place of concentrating a mass of individual disease in one huge building, the principle of dividing and isolating is now being rapidly adopted. By the arrangement of separate storeys and wards, it was thought that in large hospitals, etc., the required degree of isolation—in the necessity for which all were agreed—would be secured. But it was and is not so; so that we find the most recent system to be one in which the various wards are placed in buildings separated from each other by space as wide as circumstances of site and locality will admit of. And some of the most advanced of our medical authorities would go even farther than this, and carry out the principle of division and isolation to its utmost limits, till an aggregate of single rooms would alone constitute the characteristics of public hospitals for the treatment of disease, and these rooms not always, if at all, in the same locality.

Now, while of course by no means going the length of saying that hospitals and farmeries covered in are the same,—that is, that a farmery is not primarily a place in which disease is always present,—still there are, as our farmers have had too good reason to know in times past, occasions when, on disease breaking out in one part, it spreads to another, till at last, so far as the stock buildings are concerned, they may be said to constitute a huge infirmary of diseased and complaining cattle, etc. Experience, therefore, would point to the principle of isolation and division as a safer one to be adopted than that of concentration, which, as we have seen, is the chief feature of the covered-in farmery. But there is still another point of disadvantage to be noticed respecting this, and it is one connected with construction.

While large roofs possess many advantages, they are of necessity costly in construction, and the cost does not increase in proportion with the increase of the span or width of the building, but in a higher ratio. Again, other constructive peculiarities, which will be obvious on consideration, prevent the use of timber in the construction of large roofs, as the weight on the scantlings of the various parts requires to be increased in rapid proportion; iron, therefore, has to be employed, in one or other of its many forms, and this requires skilled labour. The cost of keeping a wide-spanned and a long length of roof in good repair is also an important item. Now, by having the various apartments of comparatively narrow width, the roofs, being of small span, can be and often are constructed of home timber, which on some large estates is very plentiful, and is, moreover, easily obtained, being near to the place where required. Again, narrow-spanned roofs have the scantlings of their timber so small, that the roofs are light, and their mode of framing simple, so that unskilled labour, or at least that degree of skilled labour easily obtained in country places, can be readily secured. All these things point to a greater degree of economy in the construction of small buildings than in that of such large structures as are likely to be covered in with one large roof, common to the concentration of apartments under it.

Now all the advantages of the large covered-in

building which we have already named, can, we think, be secured by a system which has been elsewhere classified by us as the 'detached' or 'grouped.' In this the apartments are separated by intervals more or less wide, according to circumstances, while the yards or courts may be also detached from one another, and yet wholly covered in and walled up; and the whole may be so designed, that the simplest and most economical system of construction could be adopted. Nor, even in the generally adopted system of constructing farm buildings, and of which we have given several illustrations, need the special advantages of the covered-in system be lost; for however closely connected the apartments may be, and however situated the cattle-yards may be in relation to these, the method of making manure by, and of giving proper shelter to, the animals, can still be carried out as efficiently as in the large covered-in farmery. Of course the yards or courts would have to be lessened in floor superficies, so that the roofs could be made of narrow span, and therefore made cheaply. But this would in no way interfere with the proper carrying out of the management of the stock; it would only be increasing the number of separate courts, making many small in place of a few large ones; and this would be an advantage rather than otherwise, not only for the reason already stated, but because fewer animals would be in each, which would bring the system more like that known as the hammel (see special paragraph treating of this), which is supposed by many to be the best of all for keeping stock in, especially young stock. But the advantage of the detached or grouped system would also be apparent in its greater safety than that possessed by the covered-in system. We allude here specially to the danger arising from fire. Now the more concentrated apartments are, the greater the likelihood that if fire breaks out in any one of them, it will spread rapidly, so as to take in the others. We thus see, that as regards not only the health of the animals, but also the increased safety secured to the buildings which shelter them, the system of division and isolation — an exemplification of the saying, 'Divide and conquer' — offers many advantages of a specially valuable nature.

Farm Steadings planned with a special view to Economizing the Liquid Manure of the Live Stock, etc.—Diverse as are the opinions as to the value of liquid manure obtained from towns, and which is known generally as *sewage*, when used for farming purposes, there is but one opinion as to that which is obtained from the live stock of the farm. These two classes of liquid manure are popularly understood to be the same substance, but that this is essentially erroneous any one at all conversant with the subject knows well enough. That too little attention has been paid to the thorough economizing of the liquid manure of the farm steading, we have endeavoured to show in Chapter IX., where *liquid-manure tanks*, as also *dung stances or manure pits, open and covered*, are described and illustrated. Meanwhile, as coming under the subject of the present chapter, we have to illustrate and describe the plan of a farm steading designed by Mr. James D. Ferguson, agricultural engineer, Glasgow, given by him in a paper published by the Highland and Agricultural Society of Scotland, under the title of 'Report on the Best Mode of Saving and Applying the Liquid Manure of Farm Steadings.' The reader is referred to this paper as containing much information on this important subject; it will be found under date July 1850. A good deal of discrepancy exists between the estimates made, and consequent uncertainty prevails as to the exact amount of liquid exuvie furnished by the animals of the farm; nor need this be wondered at, considering the varied and ever varying circumstances under which they live, the food they are kept upon, and the modes in which they are housed. Mr. Ferguson's plan, illustrated in fig. 1, Plate 14, is designed for an acreage of from 350 to 400 acres, arable or cultivated on the alternate husbandry system, on which is kept a breeding stock of 20 cows and 1 bull, 10 heifers or 'queys,' 20 one-year-old young stock, 18 fattening cattle, 16 horses old and young, and from 12 to 15 pigs. Partly fed in the house on green cut food during the summer, *i.e.* summer-soiled, these animals, exclusive of the calves, should, at the lowest calculation, produce *daily* the following quantity of liquid manure:—

20 Cows and Bull,	21		
Fatting Bullocks,	18		
		galls.	
	39 @ 3	galls. each =	117
Queys or Heifers,	10 @ $2\frac{1}{2}$	"	25
Year-old Cattle,	20 @ $1\frac{1}{2}$	"	30
Horses, old and young,	16 @ $\frac{1}{2}$	"	8
Swine,	15 @ $\frac{1}{3}$	"	5
			185

Which for the whole year would be 67,525

From this will have to be deducted the time the horses are working in the field, an average of 8 hours daily; this will amount to $\frac{1}{3}$, say, of their exuvial yield, . . . 973 galls.

Deduct also for the time the cows and young stock may be in the fields, say, on an average, 4 hours a day, for which $\frac{1}{6}$ must be deducted from their exuvial product, . . . 7,178

8,151

Leaving a balance of produce of . . . 59,374

As in its natural state this liquid manure will be too strong, it is therefore to be diluted with the same bulk of water, which will raise the total yearly produce to 118,748 gallons; to which, if the slops of the house, contents of water-closet, etc., be added, allowing for these a number of gallons equal to 10 daily, this will yield 3,650 gallons, which added to the above will make the total yearly produce of liquid manure = 122,398 gallons. Allowing 1200 gallons to be applied to each acre at a time, this will irrigate 30 acres three several times. The land here referred to is grass land. It forms no part of this work to enter into details as to the use of liquid manure,¹ or the crops to which it is most successfully applied, these belonging to the department of 'Practical Farming.' We conclude this paragraph by explaining the different apartments as numbered in the

¹ See *Outlines of Modern Farming*, vol. 5, for ample details on the utilization of town sewage and liquid manure, irrigation with ditto, etc., published by Crosby Lockwood & Co., London.

plan:—1. Corn barn; 2. Straw barn; 3. Sheds for turnip stores and for other roots, and for root-cutting machines; 4. Covered-in liquid-manure tank; 5. Open feeding sheds, hammels, with granary and wool-room over in second storey; 6. Hay, straw, and turnip sheds; 7. Corn box, filled by spout from granary above the hammels (in 5); 8. Covered yard for cow dung; 9. Cow-byre, cow-house, or shippens; 10. Quey or heifer house; 11. Open shed for young cattle; 12. Clean-water tank for mixing with or diluting the natural liquid manure; 13. Horse watering-trough; 14. Work-horse stable; 15. Sheds for mares, foals, and young horses; 16. Covered yard for horse dung (this being kept separate from the other dung, for obvious reasons); 17. Piggeries; 18. Turnip store; 19. Boiler-house; 20. Poultry-house; 21. Calf-house; 22. Potato-house; 23. Boiler-house for heating milk; 24. Cheese-room; 25. Ash-pit and privy; 26. Washing-house; 27. Implement shed looking south; 28. Cistern into which the drains are discharged; 29. Sleeping-room for men-servants; 30. Riding-horse stable; 31. Harness-room; 32. Gig-house; 33. Coal-house; 34. Tool-house and workshop; 35. Porch at scullery door of farm-house; 36. Scullery; 37. Pantry; 38. Dairy; 39. Passage; 40. Kitchen; 41. Back lobby; 42. Bed-room; 43. Dining-room; 44. Front lobby; 45. Parlour or sitting-room. From the last-named apartments it will be observed that the farm-house forms part of the farm steading. For the opinions on this point, the reader is referred to the chapter on the farm-house (XI).

In Chapter II, Division III, on 'The Laying out of the Fields,' will be found remarks on and an illustration of the important point of the disposition of these and the distribution of the liquid manure, and which is specially worthy of notice for hilly moorlands, being that adopted by the well-known authority, Mr. Robert Smith, of Emmett's Grange, Exmouth. We now give the plan of the buildings for this farm, in fig. 1, Plate 15, for which we are indebted to the pages of the *Journal of the Bath and West of England Society*, vol. v. New Series:—*a.* Farm-house, ash-house, privies; *b.* Calf-houses; *c.* Piggeries; *d.* Cart-horse stable, chaff and gear houses, with granary over for hay and straw, cut-

ting chaff, etc., with out door of stack-yard and barn, with spout to convey the chaff to the house below; *e*. Barn with water-power attached; *e*^a. Water-wheel; *f*. Implement-house (granary over the barn, and load the corn underneath); *g*. Cart shed; *h*. Open or close cattle sheds; *i*. Turnip-house; *j*. Cow sheds; *k*. Loose box; *l*. Nag stable; *m*. Gig and harness house; *n*. Coal and wood house; *o*. Entrance gates; *p*. Kitchen garden; *q*. Open yards for cattle, horses, or pigs; *r*. Stack-yard; *s*. Entrance paved; *t*. Sitting-room window, which commands every door, office, and yard in the interior of the buildings; *u*. Front entrance and garden; *v*. Shrubs; *w*. Entrance to the cart-horse stable; *x x*. Parts planted.'

As the work of reclamation of hilly moorlands is one of time, it will effect some saving if the buildings for the farm are not put down at once, but so planned that the additions required can be erected as the necessity for them arises. And as there are, as a matter of course, a good many points where there is rising ground, advantage should be taken of this so to place the buildings that masonry, etc., may be saved. 'In this case,' says Mr. Smith, 'the hill is cut away for the buildings, and a suitable road is formed at the back, upon a level with the granary, or granary barn floor, — a great convenience in practice, the chief merit of having two offices under one roof, the roof being the major outlay in the cost of all buildings.' The above plan is arranged to suit the

outlay upon a small farm, so that the buildings may be erected from time to time, as the tenant requires them for use, and as the receipt of rent comes in to assist the landlord's outlay. Thus, in the outset, and during the first summer, the house and adjoining offices, stable, etc., with the granary over (marked *a* in fig. 1, Plate 15), may be erected; and the square yard enclosed by a substantial wall, which will come into use when the subsequent buildings shall have been erected. Second year, the remaining south offices, stables, etc., with granary over, and granary barn with sheds under, situated at the north-western wing, may be erected (at the point marked *b*, fig. 1, Plate 15). Third year, the western cattle sheds, turnip-house, etc. (at point marked *c*, fig. 1, Plate 15). Fourth year, the eastern side may be filled up or not, according to the progress of the farm. The usual estimate for this class of buildings, 12 feet in the clear of proportionate height in the walls, roofing, etc., adapted to the usual average purposes of this class of farm, is about 23s. per running foot. The prices both of labour and material have risen so very much since the date of the paper, that 25 per cent. may with safety be added to this figure. Should men of capital and enterprise wish to try their hand at extensive enclosures, cultivation, stock farming, etc., even then the house and buildings can be erected to suit them at the same rate of outlay, and on the same plan of divisional erection.

CHAPTER IX.

CONSTRUCTIVE DETAILS OF BUILDINGS—VENTILATION, ETC.

Foundations.—The subject of foundations, treated technically, is such a wide one, embracing so many and such important details, that it is impossible to treat it anything like systematically or exhaustively, even if the scope of our work admitted of this, which it does not; not being a work on construction, all we can do is to give one or two hints which would be generally useful.¹ A thorough inspection of the proposed site of building should be made, in order to ascertain whether the soil is not of a treacherous character, causing afterwards undue settlement in the walls, which, if not leading to actual danger, will at least cause considerable expense in making good defects in walls, windows, door fittings, etc.

Attention to the condition of the soil upon which farm buildings are to be erected is not always given with the care which the importance of the subject demands; indeed, in some cases no attention is given to it at all, the buildings being put down at once upon a spot of ground which is deemed to be a good place, without any thought being given to the question as to whether the soil is a good one or not. We have had abundant evidence of this presented to us; and the wonder is that it should be so, in view of the important points involved. For these do not comprise merely those connected with the stability of the buildings which are proposed to be raised upon it, but also points connected with the health of the human beings or the animals which they are designed to shelter. On this latter point, it is certainly surprising how little of the careful attention which it requires has been given to it.

¹ The reader desirous of having full details of different kinds of foundations under varying circumstances of soil, position, etc., will find them in our large work, *The New Guide to Masonry, Bricklaying, and Plastering, Theoretical and Practical*, published by Messrs. A. Fullarton & Co., Edinburgh and London.

It is, indeed, only of late years that this notion has been acted upon, that the soil of the site of the house has an important influence on the health of the inhabitants; and this notion has not been as yet greatly developed and extended. We have said that it has only been of late that this attention—such as it is—has been given to the subject, but it would have been more correct had we said that it has only been revived of late, for ancient authors were very fully impressed with it. Although even a careful inspection will show what would appear to be a good and safe soil, still it ought to be remembered that some soils change wonderfully after being opened up and exposed to the atmosphere. Thus a shaley soil will be very hard on first being opened up, but becomes soft, and even, if left long enough, sludgy. Even good soils possess defects such as faults or fissures, so that although it may appear at first sight expensive, it will in the long run be found to be the most economical plan to dig trial-pits at various points over the area of the proposed site, especially if there be any doubt as to the goodness of the soil. In the succeeding chapter, 'On the Farm-house,' some remarks will be found on the importance of having the site thoroughly well drained; this chiefly as a precautionary measure on the score of the health of the inhabitants. This is of no less importance as regards the live stock of the farm. This drainage, therefore, should be thoroughly well done, and special care should be taken to see that the water be conducted to a proper outfall. If, indeed, a discharge on the average be constant, and the quality of the water good, enough may be obtained to keep up a small pond in the immediate neighbourhood of the steading.

Floors.—A good floor is a very essential part

of farm building apartments, especially those in which live stock are kept, as it adds much not only to the comfort, but also to the health of the inhabitants. The methods of constructing floors are almost as various as the materials used. Of the latter, stone, in districts where it is plentiful in the immediate neighbourhood of the building, is largely used in one of three forms: first, flags or pavement; second, of setts or small cubical blocks, such as are used for paving the causeway in public streets; and third, pebbles, or small rounded stones. Of these, the first is the most expensive; and from becoming smooth and slippery, and having a tendency to retain on its surface dirt or greasy substances, it becomes dangerous to the animals, which cannot secure a good foothold. To avoid this, some prefer to use it with its surface merely quarry-dressed, securing a rough surface; but where the flagstones are not of very large dimensions, the best way is to work the surface into a series of small ridges. This, of course, adds to the expense of the floor, and hence as a general rule, where stone is employed, the third system is adopted. This, however, gives perhaps the very worst form of floor, it being not only specially uncomfortable to the animals, but impossible almost to be kept thoroughly clean, the dirt lodging firmly between the interstices of the stones. The next material used for flooring is brick, this being generally set as brick on edge, forming parallel lines, but the bricks generally are disposed angularly. Unless the pointing between the bricks be done with the best mortar, or, what is better still, Portland cement, the dirt is apt to lodge between the interstices. The cement pointing may be economized by making the lower pointing to a considerable depth of the brick of good mortar; the cement pointing should stop short at the upper surface of the brick, in order to afford a firm foothold to the animals; a form of brick adapted for stable floors, etc., is shown in fig. 8*a*, Plate 21. Paving-tiles are also much used for the formation of floors; these are generally square, and disposed angularly. In the formation of floors the upper surfaces of which are as already described, it is essential to have a sound and uniformly laid bottoming; should this not be attended to, unequal settlement will take place, rapidly deteriorating the floor. What may be

called composition floors, that is, composed of two or more different substances, are much used in some districts, and some of them when well constructed form most excellent surfaces. We can only notice here two kinds, in which crude coal tar and Portland cement are the bases. The following is a description of the first of these; and although the first part is applicable to pathways and private roads, and which may be applicable to some parts of the steading, it is essential to give this in order to describe the plan as applicable to floors.

In the case of pathways: 'First prepare a suitable quantity of sand by screening free from stones, and mix thoroughly with the tar in the same manner as when mixing mortar, using as much sand as can be worked into the tar, which will then be in a proper condition to spread easily; dig a trench of the desired width, 6 to 8 inches deep, and fill easily with stones to within 2 inches of the level of the ground; then fill all the interstices with coarse gravel, forming a moderately smooth foundation, over which pour sufficient tar to fill up any spaces. The object is to cement the gravel. After this, cover with the tarred sand to a depth of about one and a half inches, and smooth to the required shape with the edge of a board. This must be rolled quite firmly, and a clean surface produced by sprinkling over dry sand, and rolling until the tar ceases to come to the surface. It may be occasionally sanded until the surface attains a permanently grey colour. The odour of the tar will gradually disappear, and after the first season will be scarcely perceptible.

'Private roads may be made in the same manner, by digging some three inches deeper, and using first a layer of large stones, and afterwards smaller stones, and then gravel, topped with tarred gravel, rolled and sanded as described.

'Floors, etc.: This plan may also be adopted for stable floors and cellar bottoms, but for such purposes is greatly improved by adding about one part of roofing pitch to two parts of tar, which are heated together until thoroughly blended, and applied hot. The sand and gravel which are used with it should also be heated, or they will cool down the mixture of pitch and tar so as to render it very hard to work—in fact,

impossible to be worked thoroughly. Well made, these are most admirable floors.' The next we describe, namely, the Portland cement in the form of a concrete, forms in our opinion by far the best form of floor, viewed from every point, which can be obtained.

This material, if the work be carefully executed, —and the work is so easily done that a common labourer may undertake it without any previous knowledge of it,—makes a floor quite equal to the best of stone; it forms a beautiful surface, easily kept clean, impervious to wet, and therefore a good means of preventing damp rising from the ground, and, by consequence, water used in cleaning out the house from soaking into it. Gutters can be made in it with the greatest ease, large enough to form the main gutter, as *ff*, fig. 3, Plate 4, and small enough for the small-grooved gutters made in the floor of the stall upon which the animals lie, converging thus to main gutter. *abcd*, fig. 14, represents the outline of stalls;

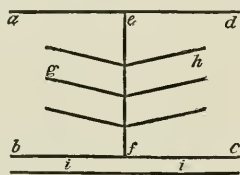


Fig. 14. Surface Drains for Stall Floors.

ef, central groove, some inch and a half wide, with an average depth of an inch, the side grooves *gh* running into it, these being in section smaller than *ef*; *i* represents the main gutter, 6 inches wide and 2 or 3 inches deep. These gutters are all formed with the greatest ease while laying the concrete, by simply using long pieces of timber, the edge of which is half-rounded, so as to give the desired width and depth to the groove. The main gutter is formed by a mould with the required curve at the side (see fig. 10*a*, Plate 21, for different forms of moulds). The whole operation of concrete floor-making is done with such ease, that we have employed a mere labourer to lay large surfaces, although he had no experience of it, and never, indeed, had heard of the material. Doubtless, a little 'nous' and care are requisite to ensure a flat surface, and to give the required fall or slope

to the gutters; but a very little experience will give the workman confidence in laying this concrete, which in every respect forms the best floor for all working rooms. The following is a brief description of the mode of making the concrete, and preparing the 'bottoming' of stones for the concrete to rest upon. The best material to use is crushed or ground brick or small clinkers, large enough to pass through a 2-inch or $1\frac{3}{4}$ -inch ring; if these cannot be obtained, good sharp sand, sea or river, will do admirably; we have used both with success. The broken brick, clinkers, or sand are well mixed with Portland cement, in the proportion of three parts of the material to one of the cement, water being added to bring the whole to such a consistency as to be easily spread upon the floor. Not much should be mixed at a time, as it sets rapidly. The spreading should be begun at one end of the space, and gradually brought down to the other end, so that what is done be not trampled upon. Where parts must be passed over before the concrete is 'set,' planks or wide boards should be laid down. In forty-eight hours the surface will be quite hard enough to be walked over without injury, and in a week it will be as hard as stone, and will present the appearance of a floor of that material, solid, without a crack or flaw throughout its whole extent. The danging passage, *ee*, fig. 3, Plate 4, should slope inwards gently from the front wall towards the gutter, *ff*, that water used in cleaning, etc. may flow from this part of the floor to the gutter. The floors of the stalls should slope from front of manger to the gutter, and also be grooved, as shown in fig. 14 (woodcut). Raised 'flags,' or stepping-stones, may be formed outside the door, of concrete. The concrete is made 2 inches in thickness, and is laid upon the rough surface of the 'bottoming,' which is formed of broken bricks or road metal of size sufficient to pass through a 2 or $1\frac{3}{4}$ -inch ring. The depth of this bottoming is 4 inches, and the upper surface should be carefully levelled before beginning to lay the concrete on top of it; the full depth of the floor is therefore 6 inches. A section of a floor as adapted to the manure pits, described in Plates 16 to 19 inclusive, is shown in Plate 34, fig. 8, in which *aa* is the bottoming resting on the ground *b*, *e* the concrete.

Ventilation.—The same principles which regulate

the ventilation of the apartments in which human beings are assembled, apply to the buildings in which the live stock of the farm are housed. These principles will be found described in the chapter on the arrangement of farm-houses; but it is necessary to point out, that in the case of those buildings the air is not only deteriorated by that which is expired by the animals, but that it is further rendered impure by the emanations proceeding from exuvie of the animals, liquid and solid,—a fact, we may parenthetically remark here, proving the value of carrying out the system of securing cleanliness, to which we have in another section alluded, and by which these exuvie will be frequently removed, and the stalls and litter be kept perfectly sweet and pure. As the reader will see by referring to the chapter above named, there is an astonishing diversity of opinion as to the best way in which the principles regulating ventilation can be carried out, although there is great unanimity as to principles themselves; so he will find, if he reads up the literature of the subject, or, what is better, has a practical knowledge of it, that a like diversity exists with reference to live-stock houses. A certain amount of air being deteriorated by causes more or less numerous, and a like amount of fresh air being required in place of it, it would seem but an easy matter to decide upon a plan by which the foul air could be withdrawn and the fresh air supplied. Yet, notwithstanding, this problem so simply stated seems apparently to be so difficult of solution, that the plans in connection with it are so numerous that they may be described as ‘legion.’ Further on, the reader will find the method described which has been recommended for the ventilation of stables by the Royal Commission appointed to inquire into the sanitary condition of military stables; but we here give an illustration and description of a plan proposed by the author of a prize paper on sanitary arrangements for stock, by Mr. W. Brown, jun., Elderstone Farm, Peebles, published in the *Transactions of the Highland Society* for February 1870. The inlets for the fresh air are proposed to be constructed as in fig. 7 (in section A), Plate 3, in which *a a* is the outside back wall, *b* the line of floor, *c* a recess made in the wall a little above the floor level, to which the external

atmosphere is carried by means of a tube, *d*, built into the wall and curved as shown. As all changes at right angles in the direction of currents of air are causes of loss of power, we should be inclined to recommend the tube to be curved from external atmosphere to recess, as shown at B in same figure. The author recommends the diameter of tube within the wall to be 6 inches, widened or flattened out towards the recess, *c*, so as to give an orifice, for the air passing inwards, 12 inches long by 6 broad; the opening should be provided with bars or a grating furnished with a moveable galvanized iron plate provided with orifices similar to those in the grating, so that by moving this to and fro the amount of air admitted can be regulated at will, or wholly shut off if desired. The openings of the tubes, *d*, should be about a foot above the level of the floor; but where the situation of the house is much exposed, and the temperature normally low, each alternate orifice should be as high as 4 feet above the floor level. By this arrangement the admission of air can be regulated according to the condition of the weather or the force of the wind, opening the higher orifices when this is strong, and closing the lower; and in calm still weather, when full ventilation is required, opening both lower and upper. The orifices are placed in the back wall, so that the entering air will not pass over the gutters and the litter and stall floors, contaminated with the exuvie of the animals, and deteriorating the quality of the air; and should there be any source of impure air, such as dung pits or cattle courts, at the side where the fresh air is admitted to the pipes, *d*, the author recommends that these should be made 8 inches in diameter, so as to afford space for the filling in of small pieces of charcoal, about 2 inches in diameter, for the purpose of disinfection. The foul air is proposed to be removed by means of ventilators placed along the ridge of the roof, one for every four cattle, with orifices 5 inches square; these to be placed between skylights made to open, the length being 30 inches and the breadth 18. The skylights are so arranged in connection with a rod running along the inside of the roof, and a series of cranks, that by tightening or loosening a rope the whole can be raised or lowered at pleasure. Many years ago, we proposed a

method of regulating the admission of fresh air (through apertures such as are described by the Royal Commissioners in their report); this is shown at *a a*, and on large scale at *b b*, fig. 4, Plate 20. In this a wooden box, *a a*, slides in and out of the aperture, *c*; this is provided at its outer end with a stop and handle, *c*, and with a series of angular holes, as shown at *b b*. The operation of this is so obvious that it requires no further explanation. The fresh air ventilator for apertures near the floor level, as devised by Professor Armitage, the well-known veterinary authority, is shown in fig. 6, in which is a diaphragm, *a*, behind the grating, *b*. Some prefer the fresh air to be admitted at the top part of the walls, being conducted to the lower level of the floor through channels formed therein, this being done in order to have the air as free from dirt, etc. as possible. In order to regulate the admission of air to the upper-level apertures, a contrivance such as is shown in fig. 7, Plate 20, may be used. The controversy has long been carried on, as regards the ventilation of stables, as to the relative advantages of the ceiled or open roof, but there can be little doubt that the latter must give freer space than the former. The Commissioners, to whose report we have more than once alluded, state as the result of their extensive investigations, that the open-roofed stable is infinitely the superior of the two, with ventilators placed at the ridge, as in figs. 9 and 10, Plate 20, at *a a*; beneath the eaves of the roof, an air brick, or rather a range of air bricks, somewhat in the position as indicated by the dotted lines *b b*, fig. 9, is placed. A point in stables at which the foul air lodges, and which it is difficult to remove, is the corner part at the meeting between the back wall and the floor line. The Commissioners recommend an air brick to be placed between every two stalls, at a distance of 6 or 8 inches from the ground level. Another plan to remove the air from this awkward point is proposed, consisting of a shaft in the wall, carried from end to end of the stable, opening at each end to the outer air; an air brick with a sliding cover is made to communicate with this shaft, the opening being in the centre of the stall. Where the aperture in the back wall is made as at *a*, in fig. 8, Plate 20, the

air brick being inserted therein, the external admission may be made at a point above the dust of the ground as at *a*, or curved as at *b*. In fig. 5, Plate 20, *b* shows the air grid in section, and in elevation at *c*; the dimensions of air brick, 9 inches by 6. As in some cases ceiled rooms to stables are necessary, as, for example, detached buildings connected with the residence, in which accommodation is placed in a second storey for the coachman, etc.; and as, moreover, in many instances, stables in steadings are already built on that principle, with hay-loft or granary above, ventilation, which is generally very imperfect, may be made very efficient by first providing means for the admission of fresh air at the lower part of the building, by one or other of the plans now described; and secondly, withdrawing the used air. By far the most efficient means of doing this is the passing of ventiducts through the space between the ceiling and the roof, or the apartments on second storey, as the case may be; these ventiducts, or shafts, communicating with the lower apartments and terminating at the ceiling by special openings, and provided at the upper part, at some 18 or 24 inches above the ridge, with a cowl or cap. This arrangement is illustrated in fig. 1, Plate 20. Figs. 2 and 3 illustrate methods of regulating the current through the ventilating shaft. In place of the ventilating 'cap,' as shown at *a* in fig. 1, or some other form of this, as the revolving 'cowl,' the upper part of ventiduct or shaft may be terminated by an arrangement as shown in fig. 11, Plate 20, in elevation at *a*, and in plan at *b*. In this the ventilating openings are on each side of the square shaft, and are closed by flaps or valves, *c c*; these are connected by jointed rods, the central part of one being opened out, as at *d*, to admit of the passing of the other rod through it. From whatever direction the wind blows, that flap is closed while the other remains open; thus, when the wind blows in the direction of the arrow, it closes the flap *c*, and opens the opposite one shown by the dotted lines. The ventilation of cow-houses is very much the same in its details, while, of course, it is precisely the same in its principles as that of stables. As they are almost universally open-roofed, we have designed a foul-air

ventilator, which, of course, is applicable to all similar structures, which experience has shown to be very efficient in getting rid of the used air, and assimilating that in the interior to much of the freshness and sweetness of the exterior atmosphere. This, as fitted up by us, is illustrated in figs. 15, 16, and 17. We make in the roof, on each side of the ridge, large rectangular openings, generally 5 feet by 3 feet; at top and bottom of these we fix, parallel to the ridge, light iron rails; on these run wheels which carry the 'ventilating' frames proper, these, being capable of being moved either right or left as desired, exposing the aperture, leaving it entirely open, or, it may be,

wholly or partially covered. When entirely open, if the size and number of the openings be properly proportioned to the size of the house, we find the air almost as sweet and fresh as that of the external atmosphere. In rainy and stormy weather the openings must of course be closed, but it is surprising how large a proportion of each day we find in which we can have them fully open. But while shut, the passage outwards of the foul air is still secured, for we make the frames to be at least two inches above the opening, so that there is a wide space all round both sides and ends for the foul air to pass out; while the former being made some inches all round

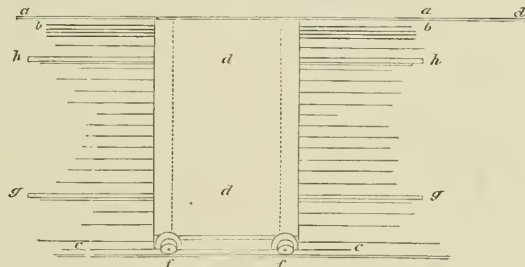
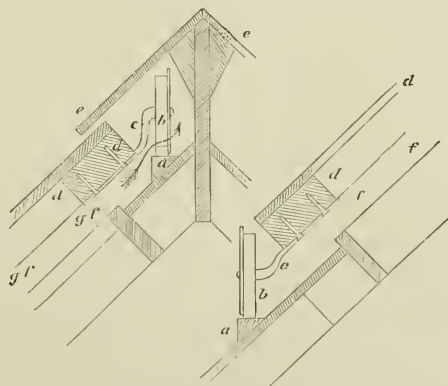


Fig. 15. External View of Ventilating Frame for Roofs of Cow-houses, etc.

larger than the apertures in the roof, rain, etc. is prevented from entering. In fig. 15 we give an

external view of one ventilating frame on this principle. The dotted lines show the width of



Figs. 16 and 17. Sections of Upper (16) and Lower (17) Sides of Ventilating Frame.

the opening in the roof, the frame being thus so much larger, as named above, than the opening;

a a, the ridge; *b b*, the upper line of rail; *c c*, lower ditto; *f f*, the lower wheels. The upper

wheels being under the frame, are not seen in the sketch. If more than one frame is used and close together, the frames may be united by a rod, *g g*, *h h*, so that the whole can be moved together; a ventilating space equal to half the roof surface may be thus gained. By a very simple contrivance of pulley, chain, and counterpoise-weight, the ventilators are moved along the rails with great ease. To enable any of our readers to carry out this system of ventilation, we annex, in figs. 16 and 17, sections showing the upper and lower portion of the ventilating frames and rails. The rails, *a a*, are laid upon triangular battens nailed to the rafters; *b b*, the wheels; *c c*, the central axles, which are fastened to the frames, *d d*. In fig. 17, the upper part, *e e*, is a small penthouse at the ridge, to prevent rain being blown down; *f f* shows the ventilating spaces when the frames cover the apertures in the roof. In the diagram, the frame, *d d*, is shown as made of wood; but we make them of galvanized iron, which we find to be lighter and stronger.

Window, Door, and General Work.—A few illustrations under this head will be of some practical use. Take the case of windows first; it is scarcely necessary to say, of stables and live-stock houses generally, that they are as a rule most deficiently lighted, not only as regards the amount supplied, but the way in which the appliances connected with the supply are adjusted and fitted up. Badly placed as they generally are, their small surface makes the amount of light admitted to the building less than it would otherwise be if more judiciously situated; in some cases narrow and long, but the length, however, not so great as it should be. We find them often jammed quite close up to ceiling or top of wall, and firmly fixed in their frames, which, to be sure, considering their situation, is of no great moment, as they cannot be reached to be opened or closed. It is safer, as a rule, to place a window too near rather than too far from the floor; a good height of a sill from the latter is 2 feet 6 inches to 3 feet. It is a great point in the lighting of all stock apartments, which should be kept scrupulously clean, to have the light thrown well upon the floor, as the nooks and corners are apt to be neglected.

This, indeed, may be said to be the rule in all badly-lighted apartments, which are as badly cleaned; men have excuses enough for not getting rid of dirt—a fertile source of foul air and unhealthiness amongst the stock—so that it is absurd to give them another in the absence of light. We are well aware that some advocate that darkness in stock-rooms—of course, we mean comparative darkness—is absolutely beneficial, and in case of fattening bullocks essential. Some, however, dispute this, and their number is daily increasing; and while we know that some of our best feeders approve of the yard and shed method,—the latter the housing,—it is difficult to see how the abundant light with which they are there supplied, and is not deemed bad for them, can be so when they are confined in close, walled houses. In addition to the purpose windows primarily serve, it should not be forgotten that they may be so fitted as to form most efficient adjuncts to such systems of ventilation as may be adopted. Various forms of what may be called ventilating windows have been introduced, one frequently used being the sliding window, which is made to slide backwards and forwards into a recess formed in the wall. The lower part of the window frame is usually made square, but it is better to have it rounded, as at *a*, in fig. 1, Plate 7, sliding in a corresponding hollow part, *b*. The sliding window works, however, more easily when the sliding is converted into a rolling motion by the addition of small wheels at top and bottom, or bottom only, of the frame. One form of roller is shown at *e*, the central groove of which runs on the rounded part, *d*. This window, however, acts but inefficiently as a ventilator, inasmuch as it admits of no regulation in the quantity of air admitted, so far as the extent of opening in its length is concerned, this being uniform, however widely or narrowly the window may be moved. To obviate this difficulty in some degree, and also to throw the air upwards towards the ceiling, which some approve of, the window, *a*, fig. 2, Plate 7, is hinged at its lower part, *b*, and by means of the usual cord and pulley at top of the window, it can be opened, as shown by the dotted lines, *d*. This form of window is sometimes hung in the reverse way to that shown in fig. 2, so that the air is admitted at the lower

part; by reversing the position of drawing, so as to have *b* at the upper end, this arrangement will be understood. The extent of opening is usually only of one degree, a simple hook and eye being used. To admit of various degrees of opening, the better 'fitting' is the quadrantal, with thumb-screw, the only objection to this being that the quadrant of necessity projects into the room. The best form of window, however, which enables the air to be admitted in more than one direction, is the swivel or swing form, shown in fig. 3, Plate 7. In this, the window, *a a*, is swung on a central stud at *b*; the usual cord and pulley attachments are provided as at *a*, fig. 4, Plate 7, by which the frame, *b b*, can be pulled into any position; two positions are shown in the drawing, the arrows indicating the varieties of currents which may be obtained by this form. The well-known form of ventilating board with vertical openings placed under the window, in a large number of stalls, might be modified, so far as its openings are concerned, in the way indicated in fig. 5, Plate 7. Indeed, it might be a good plan to have frames so made placed at different points of the building, by which the air could be admitted horizontally, as at *a*; upwards, as at *b*; and downwards, as at *c*; and although a trifle more expensive, each class of opening might have its separate sliding shutter, so that any one of them, two of them, or all, might be used as required.

Doors.—These, as a rule, are made quite narrow enough; the difference of an inch or two in the width makes a very great one in the ease or otherwise with which an animal enters or leaves the buildings; and farm animals are too valuable to allow of any risk being run from such a cause as this.

This likelihood of injury is still further increased, first, by the sharp angles left at the reveals or rybates at each corner. Indeed, as a rule, all stone and wood work at openings should be rounded off. Many a severe injury is done to a valuable animal by coming in contact with sharp corners, especially if these be of stone. In brick buildings, this rounding-off of corners need cause little or no expense, as 'bull-nosed' bricks, as in fig. 12, Plate 50, at *a*, or 'splayed,' as in fig. 13, at *a*, can be easily had at a trifle beyond the

cost of ordinary ones. The projecting or isolated parts of internal fittings, as head and heel posts, should also have their corners rounded off, as at fig. 6, Plate 21, in place of being angular, as at fig. 7. Or the 'arris' or corner may be taken off, as at *a*, figs. 6 and 7, in elevation at fig. 5; where the stripping-off of the arris does not extend the whole length of the piece,—which is said to be 'chamfered,'—but a square part is left, as at fig. 4, it is called a 'stop chamfer.' Fig. 3 is side view of fig. 4; fig. 2, a Gothic stop chamfer at *a*. All the iron fittings of doors should be made so as to have no projecting parts. In view of the dangers arising from the hanging of doors in the usual way, especially in the case of stables, sliding doors are sometimes used; these, passing into recesses in the wall, leave no projecting door against which a valuable animal might in sudden fright injure himself.

Staircases and Stairs.—Stairs being so often ascended, if their construction be so defective as to give rise to inconvenience and loss of time, it becomes a serious item in the working of the steading, when it is repeated, say, over the period of a year. Staircases should always be designed, if at all possible,—and few cases there are but what with a little thought may be so,—so that all the steps are 'flyers,'—that is, of the same breadth throughout their whole length, as at *a*, fig. 13, Plate 21, and not 'winders,' or angular, as at *b*, as the position of the feet, *c*, shows that in the 'winder,' *b*, a large proportion of the step is useless, and at the extreme angle, as *d*, positively dangerous. Figs. 14 and 16, Plate 21, show a staircase 'landing' laid out with 'winders;' fig. 15, with all the steps 'flyers.' A great convenience in a staircase is the 'landing;' in figs. 14 and 16 the worst forms are shown. In fig. 15, the landings, *a b*, are parallel; when divided by steps, as *c*, the parts *a* and *b* are called 'half-spaces.' For men carrying heavy weights, as in farm-steading work, well-disposed landings are great conveniences as resting-places. In outside stairs this is seldom attended to, but by a little contrivance it may be attained. A good broad landing at the top, as at *a*, fig. 17, Plate 21, is a great convenience, in order to enable the door, *b*, to be easily opened and entered. Fig. 18 shows two forms for the upper side of the hand-rails of

outside stairs, which are much easier in use than the square form sometimes used. There is a great deal in the way in which the steps are set in or formed in outside stairs. If placed parallel, as in fig. 22, or, worse still, with a set or inclination towards the outer edge of step, as at the dotted lines *a*, there is great danger, especially in wet weather, of the party sliding down or being thrown forward. Especially when a heavy weight is being carried down an outside stair, the feeling that one is to be thrown forward is in itself a cause of discomfort; the opposite being the case when the steps are set with an inclination backwards, as in fig. 21, or formed, as in fig. 19, with the thickest end towards the front. A firm foothold is a great matter in doing heavy work on stairs. This may be secured, if an iron stair be used, by corrugating the upper surface, as in fig. 20. Figs. 8 to 12 illustrate a capital invention of Mr. Hawksley for giving to steps a good foot-surface, and for enabling the surfaces to be renewed. This consists in setting blocks of wood, stone, or cement in iron frames having hollow spaces, as in figs. 11 and 12, and shown in section in larger scale at *a a*, figs. 8, 9, and 10. Fig. 9 shows the mode of fixing the frame, *a a*, to the stone step, *b b*, by means of a screw, *c*, leaded into the dovetail, *d*; *c c* are the blocks of stone or cement. Fig. 10 shows a method of securing the frame, *a a*, to the tread, *b*, and riser, *c c*, by the screws, *d*. Fig. 8 is another method, a wood cleat, as *b*, being secured to the carriage, *c*, of the stair, *d*, section of *b*.

Fittings of Stalls in Cow-houses and Stables.—

In fig. 1, Plate 8, we show the usual method of fitting up the travis or division between the stalls, in which there is a feeding passage behind, as at *a*. The manger and trough are of earthenware, and placed on the floor at *b*; some prefer to raise the manger from the ground on a brick or stone foundation, some 12 or 15 inches in height, and to form the manger itself of timber, the dimensions of the manger being 2 feet wide at top, *a*, as in fig. 3; width at bottom, as at *b*, 10 or 12 inches; the depth, *a b*, 12 or 13 inches. Wood, however well cleansed and cared for, cannot possibly be such a sweet material as earthenware, which, for mangers and troughs, we consider unsurpassed, cast-iron being the next. Indeed, if

this latter material be tar-glazed, on the plan introduced by Dr. Angus Smith for water-pipes, which gives an interior surface as smooth and almost imperishable as glass, then we consider it to be the best, as it is not liable to breakage, as in earthenware fittings; although, if these be soundly made, nothing but the most disgraceful carelessness can manage to break them. The tar-glazing above alluded to is simply subjecting the cast-iron object to a high temperature, and coating the surface with coal-tar. In fig. 1, Plate 8, the distance between head-post, *c*, and heel-post, *d*, is 5 feet 6 inches; the height from ground to top being 3 feet 6 inches or 4 feet; the scantling of posts, 4 × 3. The travis boards, *e*, are let into grooves made in the posts, which are fixed at foot into blocks of stone, as shown. For a short distance in front of the manger the floor of the stall is either boarded, as at *f*, or formed of some soft material; and this to prevent injury to the knees of the cows, who raise themselves upon them in getting up. The remainder of the stall floor may be paved, as at *g*, up to manger, *h*, as so also the dunging passage, *i*. If concrete be used for the floor, the stone blocks, *j j*, may be dispensed with, and the posts fixed at once in the concrete and soil below to depth of 9 or 12 inches. To prevent draughts, the stalls are boarded off from the feeding passage, *a*, and in the centre of each stall an aperture, as *a a*, fig. 2, is made, the length of which is 30 and depth 20 inches. This is provided with a sliding door, *b b*, so that when the mangers are filled with the food from the trucks running along the rails, *k k*, fig. 1, the sliding doors are closed by the handle, *c*, fig. 2. Some prefer to carry the boarding at the head of stalls right up to the roof, as shown partly by the dotted line *l*, fig. 1. In place of having the travis boards extending from bottom to top of posts, as in fig. 1, they may be left partly open, as in figs. 7 and 8, or as in fig. 3, Plate 8. This latter figure shows an excellent arrangement of travis-fitting adapted from that used by Mr. Blackford at Aldershot; and fig. 4 shows the way in which the division between the stalls and feeding passages is constructed: *a*, the head-post; *b*, the bearer carrying the manger, *c d* (*a b*, fig. 3); *e*, top; and *f*, part of cross rails stop-chamfered. Figs. 5 and 6 show

different methods of making and fixing the fittings by which the cattle are secured in their stalls. Fig. 6 is one very generally adopted;—an aperture, as *a a*, is cut in the travis board, *b b*, and an iron bar, bent as shown at *c*, fig. 5, is secured as at *c* in fig. 6. To prevent any projection, the upper end may be sunk, as at *d* in fig. 5. For single stalls, the iron bar is fixed to the left-hand travis-board, as at *d*, fig. 5; but for double stalls, one on each side of the travis-board, *c*, is required. In place of having two single bars, the arrangement as at *f*, fig. 5, may be adopted. In fig. 3, at *c*, the cattle-binder is secured to the post *d*, as shown. In place of having them perpendicular, the iron binders, if fixed at an angle, as at *a*, in figs. 7 and 8, Plate 8, the chains with which the cattle are secured will be found to slide easier up and down. As regards stable fittings, little requires to be said, the illustrations in Plate 9 sufficiently indicating their character, in addition to what we have previously stated regarding them. In cattle-boxes, as in figs. 6 and 7, Plate 7, the divisions between the boxes are generally made with simple hurdle fittings, as at *a* in fig. 6; as so also the gates, as at *a* in fig. 7. Generally, the manger and the water-trough are simply placed on the top of the manure; in other cases more elaborate arrangements are made, in which they are kept in one position at the back wall of the box, and made to slide up as the height of manure increases. A very simple arrangement is fixing two iron bars into back wall, the bars being bent so as to project from it, and leave a space up and down which the eyes of wrought-iron staples can slide, these being fixed at each upper end, and at the back of manger. This arrangement is shown in fig. 5, Plate 10. There is no need to have any pinching screws at the eyes of the manger staples, as its weight, with the food, etc., tends to cant it forward, as at *a* in fig. 5, Plate 10, jamming the eye, *b*, against the rod, *c*, and thus keeping it tight in any position.

Repairs of Buildings and Preservatives for Outside Work.—A word or two only of caution is required under the first of these heads, and they may be comprised in the proverb, that ‘a stitch in time saves nine;’ and probably the proverb receives no more striking exemplification

than in the case of buildings, which deteriorate with amazing rapidity, should even the smallest defect be allowed to remain unattended to. All buildings should therefore be periodically examined, in order to see whether defects in any parts exist; and if so, where the best interests of the proprietor are considered, they should be attended to at once. Under the second head, as materials exposed to the atmosphere deteriorate with great rapidity in a changing climate such as ours is, cheap, easily made, and efficient materials for the coating and preservation of outside work of all kinds on the farm are desiderata, and worthy of being well known or recorded and published. A very capital black paint—if it may be so called—is coal tar and lime. The lime should be well slaked and reduced to a fine powder,—any kind of building lime may be used but chalk lime, which is not suitable for the purpose in view,—and the fine powder is to be mixed with the tar, which should be kept boiling in a caldron or ordinary tar boiler for about half an hour. The lime should be added in the proportion of one part to each gallon of the tar; the whole well mixed together, and kept boiling for another half-hour. It must be applied to the woodwork while hot, and when cold it will have a hard, glazed, and shining appearance, and will effectually repel all rain. We should think it equally applicable to stone and iron-work.

Coal or gas tar applied cold to woodwork is rendered much more efficient if dry sand be mixed with it. It is essential, however, that the sand be sand; for as there are, as the French say, ‘faggots and faggots,’ so there is sand and sand. In other words, it must be perfectly free from all vegetable and decaying organic matter, etc., and soil of all kinds; and, as we have said above, it must be dry. Some prefer to mix the dry pure sand with the tar, and then paint the surface over with the mixture; but this plan is not a good one, and for this reason. To get the full benefit of the plan, the tar must be well rubbed in by means of the hard, sharp-pointed brush used for the purpose, so that the pores of the wood be filled with it; and to ensure this, the rubbing should be done in the direction of the lines of the fibres. Now the sand prevents this being

done, at least so efficiently as it ought to be. The best way, therefore, is to rub the tar well in first, and then strew the sand over the surface while wet. It is scarcely necessary to say, that the greater the number of coats of tar the wood-work gets the better.

The worst of coal tar used as a preservative, is the lugubrious tone or tint it gives to the surfaces covered by it. Various substitutes for paint of a more lively colour than tar have been proposed, and the following has the highest commendations given to it for cheapness and efficiency; it may be called a milk paint, as milk forms one of its chief ingredients; and which, although the fact be not generally known, is one of our best sizes. The milk used is skimmed milk, but where new milk can be afforded, the paint will be all the better. The ingredients are as follows:—Skimmed milk, 2 quarts; fresh slaked lime, $6\frac{1}{2}$ ounces; linseed oil, 4 ounces; and common whiting very finely pounded, 3 pounds. By the addition of a little yellow ochre, a warmer colour may be imparted to the paint; or by adding Prussian blue, the very pleasing tone or tint known as ‘French white’ may be given to it. The more care taken to mix the materials, the finer and more economical will the paint be; they are best mixed in a stoneware or earthenware vessel, and if small portions only be put in at a time, and well mixed, the better will the paint be. Put in a little of the fresh slaked lime, then add a little of the milk, sufficient to make the whole of the consistence of a thickish cream. When thoroughly mixed together, put in a little of the linseed oil, mixing again the whole thoroughly. Next put in more of the lime, milk, and oil as before, mixing well up; and when the whole has been put in, add the whiting, mixing all up most thoroughly. The paint is then fit for use. Like all paints, the less taken up by the brush and put on at a time, and the more thoroughly it is well rubbed in, the better will the work be, and the less the quantity used. Even some painters do not know how to use paint, but the above is the true and economical way to use it. This paint is for inside work, and it is quite equal to the ordinary paint, and lasts longer. To make it available for out-door work, to the ingredients named above the following are

to be added:—2 ounces of slaked lime, 6 ounces of linseed oil, and 2 ounces of white Burgundy pitch; this latter to be melted by a slow heat, and added by degrees to the mixture. This paint keeps its colour for a long time, can bear rubbing well, and does not change colour or get dark under smoke and gases like ordinary paint. Did space permit, we could extend our remarks on this and other points connected with repairs and keeping buildings in good order, but what remains of it at this point we devote to a single line or so on the subject of preservation and restoration of old or neglected buildings. There are many structures part of which may be fast going to decay, but which having been built at a time when the ‘inevitable British workman’ had a pride in doing the best work he could, and never dreamed of ‘scamping,’ as he often does now, the remaining materials will likely, and in many cases will be certain to be found so good that the expenditure of a few pounds in labour and in materials would make the place, ‘old’ as it is now, ‘amaist as guid as new’ then. We need scarcely say more, for a hint on this subject is nearly all that is required. We trust that, for the sake of their own pockets, those who happen to have old buildings of the kind described will take the hint we here give. We could point out not a few instances where it has been taken with great and good economical results.

Cleanliness throughout the Buildings.—We have in general terms referred to the keeping of farm buildings in a condition of good order as regards their fittings and their cleanliness, and it is the vast importance of the latter subject more especially that is our best excuse, if excuse be at all needed in such a case, for again referring specially to it. The influence of cleanliness upon our own persons is well known; indeed, Dr. Smith, one of our ablest sanitarians, states that the modern science of sanitary economy may be comprehended, as far as externals are concerned, in the words, ‘Keep yourselves clean.’ That this advice, so far as the body is concerned, is followed pretty universally may be true enough, but it does not always, as we too well know, apply to the habitation in which the body is housed; at the same time, it must be said that a very great improvement has been made in the latter,

amongst nearly every class; and although the practice may not be all that is desirable, the principle is no longer disputed. But it is a curious and suggestive circumstance, that while this is so as regards ourselves, and the houses which we inhabit, we do not think it necessary to apply the principle to the keeping of the live stock of our farms, although it is exceedingly difficult to explain why this should be so. A very limited knowledge of physiology would be sufficient to show, what we have elsewhere in this work explained, that the functions of our farm animals cannot be carried properly on unless the skin and coat be kept in a state of thorough cleanliness. This being so, all the animals should be kept regularly clean, supplied with clean litter, and have their stalls and other parts of the building in which they are housed attended to with the same degree of scrupulous care, in order to maintain this cleanliness. The authority we have quoted points out that there is an absolute necessity for keeping all parts of the interior devoted to live stock absolutely pure, from the fact that, arising from the presence of the animals, there is an organic substance deposited upon the woodwork and other fittings, walls, etc., of a highly offensive character, which, if allowed to remain, gives out emanations highly dangerous. Ventilation, however effective, does not and will not carry off these, because the organic substances become attached and adhere with what may be called great tenacity to all parts of the interior, and keep accumulating. Ventilation, no doubt, is essential, and goes largely to reduce the evil; but still, to have things as they should be, two things are essential, pure air and clean surfaces. It needs scarcely be said, that the vessels out of which the animals feed must also be kept in the same degree of cleanliness we have here advocated. There is, indeed, a greater necessity, so to say, for this being done in their case than in that of walls, etc., inasmuch as the contaminating materials, allowed to collect and remain in the vessel, not only give out the emanations we have shown to be injurious, but they exercise a deleterious influence upon the new or fresh supplies of food put into them,—an influence which tells upon the health of the animals in a way very much more prejudicial than most

farmers are disposed to admit, and which gives rise very often to complaints and diseases which are reckoned to be very mysterious, but which, if traced to their origin, would demand no great expenditure of time or knowledge to be easily accounted for, and comparatively as easily cured. In this as in other departments, the rule, 'Do what you do as well as you can,' if carried out well, 'every man,' as the authority we have named states, 'would find out that his business rose in his estimation, and his work would become an art, which would continually rise higher and higher, according to the amount of mind devoted to it. If a farmer, then you farm on the very best principles, and you would find it a noble occupation. This rule would tell him that his farm should be managed with all the skill that our experience and knowledge of nature shows us to be possible, and that his cattle should be kept with the same scrupulous care. It is fortunate for this theory that the greatest success would be assuredly attained by it; but even if a greater amount of profit were not gained, it is a sufficient gain to see the work more thoroughly done, and every animal kept by us happier and healthier. . . . But surely farmers do not require this advice more than others. None are prouder of their productions, their crops, and their stock, it is true; but it is for them to know that their neglect of sanitary laws is rapidly productive of evil and destructive of their property; whilst health is a subject daily demanding their attention, as they must to a great extent be physicians to the whole of their cattle. It is the unwholesome belief that anything is good enough for beasts that has so much degraded our stables and cow-houses, and the result has been severely returned to the owners in the shape of discomfort, disorder, and loss. We trust, then, that a reform in this department will be widely extended,—a reform I should be glad to see based, not on the greater profits that are to be expected, but on those higher principles which will make even the cleaning of a stable not merely a disagreeable necessity, but the cheerful accompaniment of a noble heart.'

Erections exterior to the Steading—Shelter-sheds, etc.—But while the fixed and permanent buildings of the farm, the farmory, farm steading, or by whatever name it may be called and known,

ought to be designed so that in point of arrangement and construction they are all which the truest interests of the landlord, as well as the practical requirements of the tenant, demand, the principle which is fast coming to the front in connection with modern farming must not be lost sight of. In view, indeed, of the important practical issues which it involves, it must be fully considered, so that its practical advantages may be obtained.

The principle here alluded to is that of not confining the buildings, or rather the structures, of the farm to one point only of the farm, but, by a judicious extension to various parts of it, afford to those, such conveniences in the way of structures as will best enable certain styles of stock-keeping, etc. to be adopted, so as to meet the requirements of a new and improved system of working certain departments of the farm.

Up till a very recent period it has been, and indeed, as a rule, it may be stated to be the custom now on farms on which stock is kept, to provide shelter for the animals only at the steadings or farm buildings; none, however small in point of accommodation and poor in point of construction, being provided at those outlying portions of the farm on which stock are pastured for a large portion, and in some districts for the whole, or nearly the whole, of the year. This, as stated above, is the system which may be said to be universally followed. Of late, however, this rule has found exceptions, and this at the hands of those who, taking into consideration the principles which modern agricultural science has shown to regulate the feeding and fattening of stock, have seen the apparent absurdity of so keeping stock, that at one part of the farm they are housed in accordance—or, on the whole, with something like a fair accordance—with those principles, and keeping the same kind of stock, on another part of the farm, in direct contradiction to them. What those principles are which regulate the feeding and fattening of stock, and the proper rearing and management of those animals which are not fattened for the butcher, as the horse and the dairy cow,—the latter being, as it were, only incidentally fattened as a secondary, not a primary consideration in

their keep,—will be found fully explained in the chapter which treats of the 'General Management of the Live Stock of the Farm.' It is here only necessary to point out, or to recapitulate, so to say, in a word or two, the leading features of these principles, in order to understand the causes which have led certain farmers, holding advanced and enlightened views of their important calling, to modify very materially certain departments of practice connected with their live stock. Briefly, then, as food creates heat, gives warmth to the system of the animal partaking of it, and at the same time helps to build up and maintain that system, so that all the vital functions may be performed regularly; so, conversely, may it be stated that heat or warmth acts in a certain measure as food, or, more correctly put, tends to economize that food by not permitting it to be drawn upon unnecessarily in the maintenance and conservation of heat or warmth. Hence the truth of the antithetical aphorism, in which this principle is conveyed in few but suggestive words, 'Food is heat, heat is food.' From which it follows as a natural consequence, that where animals are exposed to cold for any length of time, there is a corresponding, if not exactly a proportionate loss of food, that going to maintain the warmth of the system almost wholly, which, under other circumstances of a more favourable kind, and more in consistency with the principles we have named above, would go chiefly to the feeding and fattening of the animals, and at the same time the maintenance of a healthy degree of warmth. Hence will be seen the objection which some farmers have to that system of managing certain varieties of live stock which involves long exposure to cold,—in point of fact, to all the inclemencies of the seasons, which are so notoriously inclement as those of our country are. And where, from the peculiar circumstances under which they may be placed, or from an idea that partial exposure to the open air or pasturing therein, even in severe weather, is the healthiest method of managing live stock of certain kinds, they adopt the system of outlying pasturing or keep, they believe that true science demands that shelter should be provided there, in which the animals can either go at pleasure, or be housed at such periods of extreme severity of weather

or under such circumstances as the farmer may deem necessary. We see, therefore, how it has come about that in such systems of farming outlying shelter is necessary, and involves arrangements of a special kind; and it is to these that we in a future chapter direct brief attention.

By the exercise of a little ingenuity, very comfortable 'shelter-sheds' may be erected at remarkably little expense, and in very little time. The reader will find this department treated of in the third division of the work, Chap. I., 'The Outlying Structures of the Farm.'

CHAPTER X.

THE SAVING, STORING UP, AND GENERAL MANAGEMENT OF MANURE, LIQUID AND SOLID, AND THE APPLIANCES FOR THE SAME, AS DUNG STANCES OR PITS, COVERED DUNG OR MANURE SHEDS, AND LIQUID-MANURE TANKS, ETC.

Preliminary and General Considerations.—Farm-yard dung as manure presents to the agriculturist a means of both chemically and mechanically influencing the fertilization of the soil, and adding largely to the increase of the products drawn from it in the shape of crops, which excels any other natural substance or combination of substances at the command of the farmer, including, as it does, all the constituents of our farm plants. It is not strange, therefore, that no subject has been so much discussed in the range of agricultural literature as this, nor about which so much has been definitely learned as regards its nature and constituents, and the best mode of practically applying it to the soil. Yet, notwithstanding this, it may safely be said that in practice there is perhaps no department in practical farming so much neglected, and none in which wasteful processes are so frequently carried out, as in the storing up and preservation of what is afforded by our farm stock.

To what cause or causes this is to be chiefly attributed, we are not now concerned to know; but it may be permitted us here to say, that one reason why this widespread indifference exists, is that those to whom the planning and erection of our farm buildings are often entrusted, have not, as a rule, been careful to give prominence to structural arrangements by which manure could be best kept in accordance with correct principles, as indicated either by the researches of agricultural chemists, or the field practice of able farmers. It will be well very briefly here to point out what these principles are. Farm-yard manure, or 'dung' as it is usually termed, is composed of the excrements, solid and liquid,

of the animals fed in the farmery, together making up what may be called a natural manure, one of the characteristics of which is its large bulk. It has been called a 'universal manure,' inasmuch as it contains all the fertilizing constituents which our farm crops require; all the inorganic or incombustible substances found in the ash of our agricultural plants are present in the ash of farm-yard manure. Of the organic or combustible substances valuable as fertilizers found in dung, some are readily soluble in water, and contain a large proportion of nitrogen, which yields ammonia; while some are insoluble in water, and contain only a small proportion of nitrogen, which gives rise to the formation of acid compounds. But in addition to the influence which, through these substances, farm-yard manure chemically exerts upon the soil to which it is applied, it is found to act also very beneficially in a mechanical way, and this more especially and usefully in heavy clay soils, in opening them up and admitting the atmospheric influences to act upon them. The marked feature, however, of farm-yard manure is the small proportion which its fertilizing substances, or those which act chemically upon the soil, bear to those which act mechanically, and which last are in themselves of no or little fertilizing value, save in the above-named mechanical way. Thus, in a ton of manure in a well-rotted or short condition, there are of fertilizing substances only 48 pounds; while there is of water no less a weight than 15 cwt. 9½ lbs., and other materials of very inferior fertilizing value equal to 4 cwt. 1 quarter and 27 lbs. From the very fact that it contains so little of high fertilizing value,

as here shown, the importance will be obvious enough of any plan for managing manure by which the most can be made of it. Some look upon the whole bulk of their manure as fertilizing, whereas, as we have shown, the reverse is the case. Further, the largest proportion of fertilizing substances contained in the manure, small as their proportion is, are present in it in a soluble or readily soluble condition, so that when exposed to atmospheric influences, as rain, etc., they undergo changes which tend very materially to reduce the value of the manure as a fertilizer. In its fresh state, manure contains a comparatively small percentage of ammonia, the nitrogen existing chiefly in the form of insoluble nitrogenous substances; but as the age of the manure increases, and decomposition sets in, the amount of ammonia increases, and a large percentage of the organic matter of the manure becomes soluble. By exposing them to rain and dry weather alternately, a thorough disorganization of the constituents takes place, breaking up the equilibrium which keeps them together, allowing them to escape either into the atmosphere or to be carried away by the drainage of the heap, when that heap is kept, as it too often is, lying on the surface of the ground. The decomposition of ammonia arising from this condition of matters is, however, not the chief cause of the loss of fertilizing value which the dung sustains, the principal loss arising from the washing out of the soluble fertilizing matter by the rain. Hence the absurdity of the method of keeping manure, which we may say is general in some districts, heaped up in some corner of the farm-yard, at a roadside, or at the edge of a field, exposed to the rain, wind, and sunshine, and placed on such a bottom that the soluble matters either soak into the soil, or are allowed to run away to the nearest ditch or drain. As the plants to which manure is to be applied can only take their fertilizing constituents in a soluble form, the great point to aim at is to have the manure kept in such a way that none of the soluble portions be washed out of it and allowed to soak into the ground, or pass away to drains or ditches.

The simplest way to secure this is to have an open manure-pit, but of which the sides and bottom are made water-tight, or as nearly so as

practicable. This may be done in several ways, either by puddling the bottom with clay, lining it with bricks on edge set in cement, or asphalted or concreted. We have used concrete with great success, and prefer it to all other materials for lining tanks or pits for this purpose. We shall in a succeeding paragraph describe the way in which we use this material. The pit may either be made by excavating the soil to the depth of 3 feet below the ground level, as at *a*, fig. 1, Plate 16, or formed by building a low wall of brick or stone above the ground level, of 3 feet in height, and puddling under and around it, as at *b* in fig. 2. In this case an entrance should be made at an end or side, whichever is most convenient, so as to admit of the dung being wheeled into or taken from the interior of the space. As a medium between these two modes, another method is to make the pit half in and half out of the ground, as at *c*, fig. 3. In all these diagrams the dotted parts indicate the puddle, the asphalt or the concrete used to line the interior, and the letters *g l* the ground level. The bottom of the pit should not be level throughout, but be inclined in the direction of its length, so that the drainings from the manure will drop to the deepest part, from which it can be lifted up at intervals and thrown over the surface of the manure in the pit, or be taken away in a liquid-manure cart. To get easily at this liquid, a portion of the solid manure can be removed from the lower end.

But by far the best arrangement of an *open* pit is that used frequently abroad. The floor of the pit slopes from all sides towards the centre, where a grated entrance to a tank is made, into which the liquid from the dung flows, and in addition the drainage from the cattle stalls, horse stalls, and piggeries. The tank is provided with a small cistern or settling tank, into which the solid matter in the liquid settles, and which is removed from time to time. The liquid-manure tank, instead of being placed in the centre of the dung-pit above, is often placed at one end, the floor sloping towards the tank, as at *a* in fig. 4. We have named the loss sustained by exposing manure to rain; but it remains to be noticed that the sun, acting upon the mass, excercises—at least is said by autho-

rities to exercise—a more prejudicial effect upon manure than even exposure to wind and rain. In view of this, as well as the shelter it affords from the latter influence, the most modern and approved method of managing farm-yard manure is to place it in a pit, covering the same with a roof, but with open sides and end. The value of manure kept under cover in this way is proved beyond a doubt to be much higher than that exposed to atmospheric influences. One authority of high standing puts the value of covered manure at fully one-third higher than that made in open yards or pits. It is to Continental authorities that we owe the idea of covered dung-pits. Another point in favour of covered dung is the saving effected in working it; for it is so rich, and free from what is known as ‘weak outsides,’ that all necessity is obviated for carting the manure to the field or outside, and working it up in the heap, as is the ordinary practice in manure management. An objection has been offered to manure made in the covered dung-pit, to the effect that it is apt to become dry and mouldy. It is found, however, in practice, that the fertilizing salts are retained in the manure made under cover, and that these tend to keep it moist. But this objection, if it be not from this cause met and overcome, can most certainly be overcome by having in the dung-pit a liquid-manure tank attached, from which the liquid can from time to time be pumped and thrown over the dung-pit above. In fig. 7 we give a longitudinal section; and in fig. 6, Plate 16, a transverse section of a covered dung-pit, as used on the Continent: *a* is the liquid-manure tank; *b c*, the covered dung-pit; *d d*, the posts supporting the roof. The gates are at the sides, in the centre; the sills of the gates are at the ground level. In some rare cases it may be more convenient to have the gates at the end, and in others, gates at both sides are used. The dimensions of the pit will be proportionate to the number of stock kept, upon which point we shall give a note hereafter. In making the dung-pit, the soil is dug out to a depth of from 3 to 4 feet, according to circumstances, and the whole excavation lined with brick, well puddled with clay as a foundation, or concreted, which will be the best material to use. The brick wall is carried

up to a height of 3 or 4 feet from the ground; the wooden posts to support the roof are let into the wall, or may be let into a wooden sill placed on the top of the wall. The settling tank is at one side, and outside of the dung-pit; or the wall of the dung-pit may form one side of the settling tank, the dimensions of which may be 3 feet deep by 4 feet long and 3 broad. The liquid manure from the cattle stalls, etc. is led into this tank by a 3-inch drain-tube, which enters the settling tank some 5 or 6 inches from the upper edge. At the same height another drain-tube leads off the pure liquid to the main tank. The solid refuse settles in the settling tank, from which it is from time to time removed. The mode of withdrawing the liquid from the main tank is as follows:—With the bottom of the main tank a large 9-inch drain-tube is connected, and this is passed along horizontally till it reaches a point outside the dung-pit wall to any point desirable; it is then curved, and continued vertically up till it reaches the level of the ground, where it is covered with a stone cap, in the centre of which is a circular aperture to admit the barrel of the liquid-manure pump, the tube of which descends nearly to the bottom of the vertical part of the drain-tube. The liquid-manure pump is fixed on a platform raised a height above the ground to admit of a cart being brought up to it at the proper level, so that the manure can be pumped at once into the liquid-manure cart. The drainage from the manure in the dung-pit passes into the liquid-manure tank by the iron grating fixed into the man-hole door of the tank, and which is placed in the centre of the arch of same. To facilitate the drainage, the floor of the pit is dished, or slopes on all sides. The roof of the shed is supported by uprights.

The excavation for the tank should be made of such dimensions as to admit of the easy setting of the bricks and the puddled clay behind the bricks. The bottom arch or invert of the tank should be laid upon a puddled-clay bed of 12 inches thick; in a close, retentive clay soil, this will, of course, be dispensed with. The clay, both under the invert and behind the bricks, should be laid in thin layers, not in thick masses, each layer to be well rammed down before the next layer be added. In puddling behind the

bricks of the vertical walls of the tank, care must be taken to bring the puddle well up to the bricks. The bricks forming the invert or bottom arch of the tank to be carefully bedded in puddle, and the joints made in hydraulic cement. The walls of the tank should be carried up in courses not exceeding three bricks in height, and the back of each course puddled carefully with clay, as above described. The connection of the lower end of pump pipe should be carefully made, and well cemented all round the opening with hydraulic cement. The floor of the manure pit to be made of concrete, composed of three parts crushed brick, or clean, sharp, river sand, to one of Portland cement. The concrete is to be laid 2 inches thick, upon a bottoming of road metal of size sufficient to pass through a 2-inch ring; the depth of bottoming to be 4 inches.

It is not easy to give definite rules to proportion the dimensions of manure pit and tank, but the following statements will be of use in deciding upon these. A cubic yard of farm-yard manure from the cattle-boxes weighs one ton; if made in the open yard or in cattle stalls, 15 hundredweight. When taken fresh or long, *i.e.* with the straw new or nearly so, the manure weighs considerably more than when half-rotten, the loss of weight being estimated at one-fifth. When the manure is thoroughly decomposed or 'short,' the loss of weight is one-half. The weight of cattle excreta varies very much; one authority gives the weight of solid and liquid voided daily by an ox of average size at fifty-five pounds, twenty-five pounds of litter being used. Taking the depth of a liquid-manure tank at 10 feet inside measurement,—a greater depth is not easily made, this depth of tank requiring an excavation of 12 feet,—and the diameter 6 feet 10 inches, the contents are 2269 gallons, $6\frac{1}{4}$ gallons to the cubic foot. A diameter of 9 feet gives, with the same depth, 4538 gallons; a diameter of 11 feet 10 inches, 6507 gallons; and 13 feet 8 inches, 9076 gallons. In the illustration in fig. 7, Plate 16, a small settling tank marked *b* is shown at the bottom. Where liquid manure is brought from the buildings, it might in the first instance be allowed to enter a settling tank before passing to the main one, as shown

at *a a* in Plates 17 and 19. This tank allows all solid matter to be deposited, the overflow being comparatively pure, and passing away from the settling tank by a pipe, *e e*, at its upper part, this pipe leading directly to the large tank, *f f*, in which it is stored up until wanted. When a supply is required, either to moisten the dung in the pit above or to be led to the fields, it is taken out from the tank by means of a liquid-manure pump, which may either be a permanent fixture attached to the platform of the stage for pump shown in plan Plate 17, or it may be made so as to 'ship' and 'unship' as required. We have found the form of pump made by Richmond & Chandler, of Salford, work excellently in practice, and not liable to get out of repair. The liquid manure is led to the pump by the large pipe *d d*. Plate 19 is a transverse section on the line A B in plan, Plate 17. In Plate 46, G, fig. 3, we give front elevation of the woodwork at *a a*, Plate 18, being the part where the two bars cross to fill up the space between the vertical uprights of the rail with which the brick wall of dung-pit is crowned. In fig. 4, Plate 46, is an inside view of the edge or narrow side of the part in fig. 3, same plate.

We have given in Plate 19 a 'longitudinal section' on the line C D in plan, Plate 17, in which *a'' a''* is the dung-pit covered by the open roof, *b b*, and the retaining walls, *e e*, finished with the open trelliswork, *d d*, with concreted floor sloping from all points to the grated opening, *e e*, which leads the deposited liquid to the tank, *f f*, placed in the centre of the dung-pit. The liquid from the stables, cow-houses, etc., is led direct by means of open or covered drains, the latter circular and trapped, to a small collecting and depositing tank, *a a*, which is provided with a stone cover, *g*. From this the overflow leads to the small drain-pipe, *h h*, to the tank, *f f*. The liquid is led or pumped, as previously stated, from the tank by the pipe *d d*, which is carried forwards and bent upwards to the level of the ground at *i i*. *j j* is part of the wall of pit, and *k k* the plan of settling tank, *a a*.

There is, as many of our readers are aware, no science in which there are such diverse opinions as that of agriculture; and we therefore find that, while some are greatly in favour of

covered tanks and manure pits, there are others who strongly object to having the dung covered at all, maintaining that its value is best kept up, if not raised, by allowing it to remain exposed to the atmosphere. We by no means admit this to be the case; for it appears to be admitted by nearly all authorities, without exception, that the most valuable gases contained in the manure escape most freely and pass away in the atmosphere when exposed to it. Further, that the highly ammoniacal properties contained in dung are washed out of it, and conveyed to the surrounding soil, with all the greater facility if that be of a porous character, if the manure be exposed to rains and wet. If these things be so, then upon the whole it appears to be conceded on all hands, that the best way of preserving manure is to keep it from the atmosphere, and from being washed by the rains; and that, upon the whole, this can best be secured by compressing it within an enclosed space, and covering that space by a partially open roof, in a manner more or less modified, somewhat similar in detail to the design we have given. One of our most advanced agriculturists thus puts the advantages obtained by the employment of covered dung-pits such as we have illustrated. While the dung kept in the 'open heap has twice to be removed, and once turned over, the covered-yard manure needs no manipulation, but can at once be carried to and placed upon the land, with all its manurial ingredients unwashed and unwasted; no drippings of waste from it, for the liquid and solid voidances are all mashed into a

paste; and there is no unprofitable carting of rain water, as in the case of the open yards.' The best form of floor, the most solid and the most lasting, is that formed of concrete, of which, in Plates 18 and 19, we give a section showing its construction. In this the outline is not flat, or at right angles to the walls, but, as shown in the diagram, slopes away on all sides to the centre, at which point there is placed an iron grating, *c*, through which any liquid percolating from the solid manure above passes to the tank beneath. The total depth of the floor-covering in this mode of construction is 6 inches, of which 4 are filled up with broken stones about 2 inches in diameter, the remaining 2 inches being covered with the coating of concrete. The cement best to be used for this concrete is that known as 'Portland,' which, to be of good quality, should weigh not less than 105 lbs. to the bushel. This is to be mixed with sharp sand, or clean, small, sharp gravel, with water sufficient to mix it to the consistency of thin mortar. The proportion of sand or gravel to the cement may be, as already stated, three or four, or more, but the higher the proportion of cement the better the work. The sides—indeed, the whole of the tank—may be formed of the concrete; but in this case a mould will be required to retain the cement or concrete till it sets; no mould will be required, it is needless to state, for the floor, as the concrete is simply placed on the ground and levelled. The tank, like the retaining walls, may be made of brickwork set in the cement, special care being taken to have the joints made perfectly water-tight.

CHAPTER XI.

FARM-HOUSES, THEIR PLANNING AND GENERAL CONSTRUCTION.

Preliminary General Considerations.—Sanitary evils are generally written and spoken about as if they belonged to and were exclusively connected with the houses of towns. And, no doubt, those when so placed, so arranged and constructed as they too often are, it must be, and no doubt is, a hard thing for those living in them to live in them healthily. With rooms badly arranged in relation to one another, and these too often cramped in their dimensions, ill lighted, and worse ventilated, healthy living must be a daily struggle in them. But it may be objected to this view of the matter, that it is only applicable to houses in towns, and these only in their 'back slums' and degraded quarters, and that it does not apply to houses in the country, 'where all is fair to look upon, all is fine to know.' And the objection holds good to a certain extent, but only to a certain extent. For it is unfortunately too true, that the sanitary evils connected with house arrangement and construction are not confined to the towns, but are too often met with in the country,—not so obvious, doubtless, in many respects, but not the less dangerous because not known, or, if known, not cared for. Country hamlets may be fair to look upon, and may raise only pleasurable emotions in the mind of the traveller as he looks upon them from a passing train; but a nearer and closer inspection would show that it was only distance which had lent enchantment to the view, and that in many instances the work of the sanitary reformer was but too much needed there. Nor need the other objection be taken to our remarks in this view, that if there are sanitary evils existing amongst country houses, it is only amongst those of the poorer or the very poor classes, and that they certainly are not to be met with amongst those

in which the rich and the well-to-do live. Country houses—and we include in the term farm-houses as well as mere residences or seats—are only too abundant in which the evils arising from damp, the emanations of badly-dealt-with sewage and faecal matters, or from those not dealt with at all, from badly lighted and badly ventilated rooms, are existent to a degree of danger not dreamed of by many, even amongst those who live in them. It has, indeed, of late been pretty well seared into the minds of many who formerly took no thought upon the subject, and exercised no care to know about it, that 'halls,' as well as 'huts where poor men lie,' may, with all their completeness, be very dangerous places to live in, and that it behoves them, at all events, to see whether this thing be so or no. Sanitary construction, in point of fact, using the term in its widest acceptation, is a thing which, if it is to exist at all, will exist in the future; for, despite all that has been said and written about its importance, it is not a thing of the present. We doubt, indeed, whether many houses in the kingdom can be met with which, in their arrangement and construction, show that *all* the details indicated by the science—for science of a high order it is—have been thought of and carried carefully out.

But the considerations affecting the health of householders are not the only ones which should be kept in view. If houses are built to live in, people must not only live in them healthily, but comfortably,—that is, where all the conveniences of living well are carefully ministered to. And the necessities of living thus demand that not only great and important points be attended to as regards construction, but the many little things also as regards arrangement. Life, after

all, is made up of little things, and we incline to think that the want of little things, which minister to one's comfort and convenience, tries one's temper and tests one's patience more than the want of what we call great things of more seeming importance. What these little things, both in house arrangement and construction, are, we shall see as we proceed.

And, first, as to the *site* of the house. This involves three points,—the soil, the aspect, and the laying out of the site. The best soil for a house, according to the majority of authorities, is gravel; the worst, stiff clay. Although some recent investigations have thrown doubt upon the opinion that a stiff clay *is* the worst, we nevertheless hold with the majority that it is the worst soil for a site. Much can, however, be done in the way of bringing even this soil to a fairly healthy condition, by thoroughly draining it. Sandy soil is a very healthy one on which to build, although certain precautions are necessary in forming the foundations of the walls on it. Ague and other diseases prevalent in damp and marshy soils are rarely if ever present on sandy soils, and the same may be said of gravel soils. The position of the site is a point of no small importance, and should not be overlooked; we refer to its position relative to the surrounding land or to certain objects, such as a river, a pond, or lake. At first sight, an elevated position would seem to be the best, for from it not only is the best and widest prospect obtained, but it is certainly the healthiest, as affording the most readily availed of facilities for carrying off not merely the drainage water of the soil, but of the sewage matter of the household, and the air will be more bracing and drier than on a lower site. But, on the other hand, it should be remembered that an elevated site subjects the house placed on it to heavy gusts of wind and to battering rains; and as, moreover, in the case of a farm-house, the farm buildings proper are placed near it, a great deal of labour is expended in cartage and horse-work, which would be avoided on more level ground. A site moderately elevated should therefore be chosen, as the one best calculated to aid the daily work of a farm. A site near the base of a steep ascent is often chosen, with a view of obtaining shelter from certain winds; but it is not a

good one, as, although the house may be sheltered from the obnoxious wind blowing directly upon it, still winds blowing in the direction of the rising ground are often deflected and driven back upon the house, and forced down the chimneys. A house placed on such a site is almost always a smoky house when the wind is in a certain direction. And the site of the house, moreover, is generally damp, from the drainage-waters of the rising ground behind it finding their readiest access by the soil at a lower level on which the house stands. A site free from rising grounds in immediate proximity to the house, and yet moderately elevated, so that drainage from all sides will be easily secured, will be the best.

It is scarcely necessary to say that a site near marshy ground should never be chosen, although it frequently is. And although the objections to such a site do not often obtain with such force in the case of a lake, pond, or piece of ornamental water, still, even in such cases, the house should not be built immediately upon the margin of the water. Near proximity to a river, in fact, is found to be a bad thing where lung complaints, etc. are in existence in the household, especially when the river has a slow, sluggish current, and the waters stretch out into long reaches or bays. The case is worse where the waters of the pond or lake are nearly stagnant, and still worse where the house is so placed, as it sometimes is with relation to the water, that the site is actually on a lower level; in this case, drainage from the pond, etc. to the house is inevitable.

A sheltered situation, or what is popularly known as this, is considered the great desideratum for a country or farm house; but it should be recollected that the site may be too well sheltered,—so much so that the air may be stagnant round it, no healthy breezes being allowed to reach it. To carry out this notion of complete shelter, not only are houses often placed in low-lying places surrounded with rising ground, but trees are planted round it, not only in great numbers, but in close proximity to the houses. Now, while by no means objecting to trees, it is worth while to state that they may be so placed in relation to a house as to make that house positively unhealthy. They should never be so placed as to

exclude the sunlight and the free access of air. A gloomy house, into the rooms of which the sun can never force unfettered access, is not, cannot be, a healthy house. Moreover, when trees are so placed as to prevent the free access of the sun and light to the house, another evil arises from the dampness engendered and the unhealthy exhalations which often arise from ground overshadowed by trees.

Rather than have trees near a house, it is better far to trust to the security of shelter from the cold fierce winds by raising a belt of trees and shrubs, but these planted at some distance from the house. When this is judiciously done, it is surprising how a keen cold wind is tempered before it reaches the house, even although the trees be planted at that distance from it which we consider essential to health; and that, moreover, when the belt of trees is but of small breadth. The beneficial effects of leafage and branches in tempering winds is a point not much known.

The site of the house should be near a road, for reasons of convenience obvious enough; but, in order to avoid as much as possible the dust from the road entering the rooms, the house should be placed some distance from the road, and—if the dictates of good taste be thought of—hid, or partially hid, from the public gaze by a belt of ornamental trees and shrubs. The exclusion, to as complete a degree of practical efficiency as possible, of dust is a matter of more importance than at first sight it might be presumed to be; for dust is not only a dirty thing, but being foul in another sense not always thought of, it is positively unhealthy, and is one of the constituents of the unhealthy air which we breathe too often in our dwelling-houses.

The position of the site with relation to surrounding objects having been briefly considered, we come now to *the aspect of the site, or rather that of the house which is to occupy the site.* The best 'look out' or aspect of the principal rooms is the south-east. By principal rooms we mean those which are occupied by the family during the day; it being essential, where health is considered, that these should have as much as possible of the direct sunlight, and this the south-east gives. We are too well aware of the fact

that housewives do not like the sun to shine in upon rooms, the 'saving of the carpet' being with them the object in view. While we have some consideration for this economical view of the matter, we have none whatever for that which holds it to be the fashionable thing to do, namely, to have drawing, dining, or sitting-room shrouded in partial darkness during the day. Be the motive what it may, however, it is our part to point out the fact that sunlight and heat exercise a most important and beneficial influence upon health; but if carpets or fashion be deemed by some to be of more value than health, on this point we have nothing to say.

The relation which the house should occupy to its kitchen-garden is a subject upon which much could be written; but it is one to which, for obvious reasons, we cannot devote more than a sentence or two. The usual arrangement is for the kitchen-garden to be at the back of the house, and at as great a distance from it as possible, as if it were an object to be got out of sight, an inconvenience, or a convenience the existence of which is to be tacitly admitted, but not brought forward as one to be proud of, or to form part of the residence and its surroundings which are to be the seen or show parts of it. We believe this to be a mistake. While, no doubt, placing the smoothest lawn, the finest shrubs, and the fairest flowers so that they can be seen always from the best or most frequently occupied part of the house, we would not box up or wall in the kitchen-garden, as is nearly always done. To a gardener of good taste and thoroughly practical knowledge, there should be no difficulty in making the kitchen-garden play an important part in the general surrounding of the house—to make it a pleasant thing for the eyes to look upon. The relation, again, which the farm-house should bear to the farm steading or home stall is one upon which it is necessary to offer a few remarks.

The view of the surrounding country which a house should have, has always, and properly, been considered a point of importance; yet some have so far lost sight of this as regards a farm-house, as to go the length of actually recommending that the farm-house should occupy a site so near the farm steading, or rather should form so complete

a part of it, that the farmer may be able from its windows to command a full view of all the operations going on in it. With this view we need scarcely say we by no means coincide. The close contiguity of the farm-house with the steading, implied in the fact that its windows may overlook all that is going on upon it, and which is advocated by some, does not meet our views as to site. At first sight it appears to be right that the master's supervision should be constant, and to attain this, that his house windows should overlook the farm buildings, so as to take in the whole at once. This implies, at least, that he is always looking or often looking out of his windows—not a very dignified occupation for any one. All the fair requirements—fair for the master and man alike—of an honest supervision will be met by having the farm-house near the steading, within such easy reach that when so disposed the farmer may step down to the offices; and, to our way of thinking, more influence will be exercised upon the men to induce them to work faithfully by the unexpected or irregular visits which their master thus makes, than by personal overlooking, which partakes too much of the character of slave-driving, and too little of the quiet characteristics and mainly independence of modern farming, to be to our taste.

Plan of a Farm-house.—This brings us to the accommodation which the farm-house should possess. And here, at the outset, we freely express our disbelief in what are called 'model plans.' Practically, there can be no such thing as a plan which can be designed to suit the always varying requirements of different families and different circumstances of farming. It may be that now and then a plan which has been designed to meet the necessities of one will be found suitable for another, but the cases will be few—so few that, as said above, practically there is no such thing as a model plan. Each house must be planned to meet the requirements of the farmer who is to inhabit it; we know of no other rule for guidance in this case. Still, certain accommodation is required in every house, and cannot be dispensed with, such as the kitchen and working apartments, and the living and sleeping apartments. We have already said that we do not believe in model plans, and in giving

the plans we now do of a first or second-class farm-house or country residence, we do not put them forward otherwise than as suggestive plans illustrating the apartments required in a house, the means and position of the occupants of which are supposed to be such as demand arrangements calculated to minister to some of the elegancies as well as to the comforts of modern life, and these apartments arranged in such a way as to meet in a fairly successful manner the conveniences of a household. The plans, no doubt, are open to criticism; for that, indeed, they are here offered, and we ourselves could easily enough point out faults in them, or means by which their arrangements could be improved. It is right, however, to state that they are the result of much study, and have received the approval of a first-rate agricultural authority, whatever that be worth. Fig. 18 is the ground plan, fig. 19 the chamber plan, and fig. 20 the foundation and cellar plan. In commenting upon these plans, we shall take up the various classes of apartments in order, giving such remarks thereon as we deem likely to be serviceable in a practically suggestive way.

Working Apartments of the Farm-house,—Kitchen, Scullery, &c.—And first as to the 'working apartments.' These, it will be observed from fig. 18, are all placed in close and direct relation to each other, so that no time will be lost unnecessarily by traversing long passages in going from one to another. First in importance of these working apartments is the kitchen. This should be large and spacious, well lighted and ventilated. The fire-place should be large, and fitted up with one of the 'patent cooking-ranges' now so largely used. The boiler attached to this should be of as large dimensions as can be obtained in the space, as boiling or hot water is often and urgently required in a farm-house. To add to the means of supplying this when requisite, the boiler in the scullery may be used. The windows of the kitchen should be so placed with relation to the fire-place that a full light may be thrown upon the cooking and other operations going on at the range. For frequently do we find kitchen windows so placed that the cook works, if not quite in the dark, certainly in a shade not calculated to aid the work she may be engaged on. The worst position for the

window is in front of the fire-place, for then the cook stands literally in her own light; the best is at the side, as in the plan in fig. 18. Cross-lights are good, and the advantage obtained from having the windows which give them is that, when required, the kitchen may be thoroughly ventilated and 'air blown' through it by opening them. In the plan in fig. 18 this advantage cannot be obtained, in consequence of the position of the pantry and scullery; but it might still be obtained, although to a less efficient extent, by having a window in the corner next to the left hand (looking towards the fire) of the fire-place.

Ventilation should be secured by having a ventilating air-flue built up alongside the chimney-flue, and fresh air supplied by one or other of the methods described in a succeeding chapter. The flooring of the kitchen is always a disputed point with builders, some preferring stone flags, others tiles, and others flooring boards. There is not much dispute upon the point amongst good housewives, who almost invariably prefer flooring boards, not only because the floor surface is more comfortable, but because pride is taken in having it kept so clean that the 'boards are made to look as good as new.' If a hard cold floor sur-

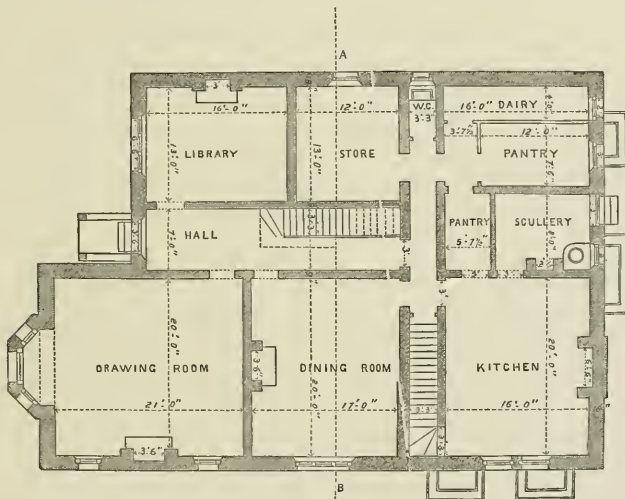


Fig. 18. Ground Plan or First Floor of Farm-house of a Superior Class. Scale in fig. 20.

face, however, be preferred, we unhesitatingly recommend Portland cement concrete to be used, in preference to stone flagging or tiles. The advantages of the concrete we have elsewhere fully explained. One advantage alone may be repeated here which no other form of flooring surface gives, namely, it is wholly without cracks or seams in which dust, dirt, or water can lodge. The kitchen should be placed near to the dining-room, and yet isolated therefrom as much as possible. This isolation will best be secured by having a passage between the kitchen and the dining-room, as in the plan (fig. 18), thus cutting

off the smell arising from cooking, etc., and also the noise attendant, or which seems to be necessarily attendant, upon the performance of all kitchen duties. To save the servants from much walking, we have given a door to the dining-room, opening into the passage near the kitchen, but this may be dispensed with if necessary; it will, however, be a great saving of labour, and if the kitchen be properly ventilated, the nuisance arising from the smell of cooking will be reduced to a minimum. An ample supply of shelving should be given to the kitchen, and an excellent cupboard may be made in the recess at the side

of the fire-place which is not occupied with a window as above recommended. A housewife who knows what work is, never objects to having too much accommodation for 'putting things away.'

The Scullery.—This apartment should be placed in immediate connection with the kitchen; it should be provided with a small fire-place and a copper or small boiler and furnace. A large and shallow *slop-stone* should be provided on which to wash the dishes and cooking utensils; it should be not more than two and a half or three inches in depth, and be rounded off at the corners, the bottom being curved easily up to

meet the flat border at ends and sides, the breadth of the border being not less than three and a half inches. This *slop-stone* will be easily kept clean, and be in every way much more useful than the deep abominations appropriately known as 'sinks.' At one end of the *slop-stone*, a flat surface of stone, at the same level as the margin of the *slop-stone* itself, should be placed; the breadth of this equal to the *slop-stone*, say twenty-eight inches, and the length say three feet. This stone shelf, as in fact it is, will be found very useful in cleaning up dishes, etc. The hot and cold water-pipes should be terminated above the *slop-stone*. The *slop-stone* and shelf should be sup-

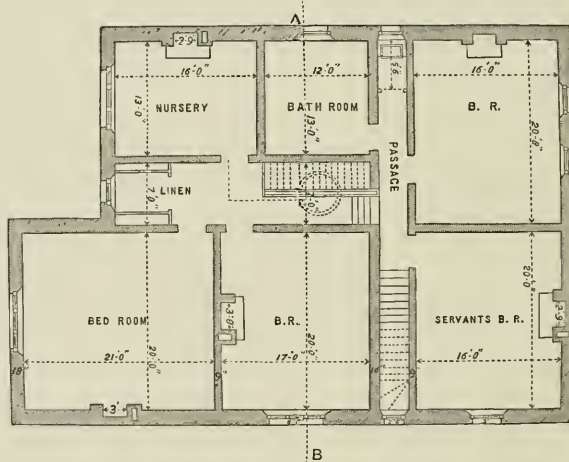


Fig. 19. Bed-room or Chamber Plan on Second Floor of Farm-house in fig. 18. Scale in fig. 20.

ported upon brick pillars, bull-nosed at front—that is, with the corners rounded off—so as to afford space below the *slop-stone* on which to put away various kitchen and working utensils. The scullery should be amply provided with shelving for dishes, and face-boards with hooks to hang vessels of various kinds from. A back door should be provided by which to gain access to the back-yard. The scullery should not be made a 'washing-house.' We would earnestly recommend this, together with the laundry, to be built in the yard close to the scullery, but yet quite separate from the house. The wash-

house proper should be provided with boiler and furnace, and wash-tubs, to each of which a cold and hot water-pipe should be attached. The laundry should be provided with racks to dry clothes upon, a furnace to heat the irons upon, and a large ironing table. Both wash-house and laundry should be well lighted and ventilated.

Pantry and Store-room Accommodation.—Abundance of pantry and store room should be provided in the farm-house. In the ground plan (fig. 18), the large store-room is provided for the storing up of what may be called the permanent provisions and materials, the small pantry next

Bed-room Accommodation.—This refers especially to the bed-room accommodation, which we too often see treated as if it were altogether a secondary consideration, the primary one apparently being to have large and elegant ‘show-rooms,’ as the entertaining rooms of a house have been by some wags, and with a good deal of pungent truth, ironically called. Let it be always kept in view, in the planning of a house, that the health of its occupants is the primary thing to be considered, and that this can best be consulted by having those rooms the largest and most conveniently arranged in which the occupants of the house spend the greatest portion of their time; and this is done in the bed-rooms. We are great advocates for making the bed-rooms the best rooms in the house; they should also be as numerous as possible. It is a great mistake to proportion their number to meet the wants only of the normal condition of the family. We should have in a farm or country house more than the mere conventional spare room; we should have spare rooms, to meet the sudden demands made upon the hospitality of the host, which occur so often in country districts. These spare rooms would also be extremely useful in cases of sickness. A hint may here be given as to the bed-room accommodation for servants, if, indeed, the term ‘room’ be allowable in writing of the accommodation too frequently given in this part of a house, which consists of some wretchedly-confined, damp, dingy, and dark hole on the ground floor, or some small closet at the top of the house under the slates, cold in winter and hot in summer, and not always wind and rain proof—accommodation which we have no hesitation in designating as disgraceful and degrading, alike to the giver and recipient of it. We would advocate no luxury in the bed-rooms for servants, but we would uphold, nay, insist upon the necessity for their being neatly arranged and cleanly kept, and, of course, large enough to be comfortable, and so fitted up as to be healthy. We have seen dog-kennels in the country quarters of gentlemen in every sense better rooms than the so-called ‘bed-rooms’ of servants.

In Plate 23 we give front elevation of the plans of the farm-house of which, in the woodcuts of this chapter, we have given the plans. Fig. 2

is an alternative design for upper part of bay window, having a ‘flat’ at top, on which flower vases may be placed. It will be observed that the plans are reversed in position in the text, for the convenience of lettering, etc.; the front of fig. 18, for example, being the end towards the left hand. To give variety to the elevation in Plate 23, the window of nursery (see fig. 19) may go up so far into the roof, the outside elevation being as shown in the dotted lines *a a*. We might multiply such examples almost *ad infinitum*; but all that we deem it necessary here to give are plans of the farm-house of a smaller class than that already illustrated. The elevation of this is shown in fig. 1, Plate 24, an alternative illustration being shown in fig. 2. In Plate 25, fig. 1, the ‘ground plan,’ *a* is the lobby; *b*, the dining-room; *c*, breakfast-parlour or drawing-room; *d*, the kitchen; *e*, the scullery; *f*, the wash-house, with back door; *g*; *h*, china closet; *i* and *j*, cupboards. In fig. 2, the ‘chamber plan,’ *a* is the landing with skylight over; *b*, the stairs leading from ground plan in fig. 1; *c* and *d*, front bed-rooms; *e*, dressing-closet; *f g*, back bed-rooms; *h*, servants’ bed-room; *i*, the water-closet. *The scale* to which these plans are drawn is 8 feet to the inch, or $\frac{1}{8}$ in. = 1 ft. But few words are required to be said on the subject of the ‘bailiff’s house,’ which may be defined either as a first-class cottage, or as a third, or perhaps a second-class farm-house, according to circumstances. Thus the plan just described may be considered as one applicable to bailiffs. In Plate 26, we give in fig. 1 the elevation, and in fig. 2 the plan, of a single-storeyed bailiff’s house. In fig. 2, *a* is the lobby; *b*, the sitting-room, with bed-room over and cellar under, the former being gained by the stair going in the direction of the arrow *c*, entering from the back lobby, *d*; the cellar being entered from the kitchen, *e*, in the direction shown by the arrow, *f*. Over the kitchen there is a bed-room, in line with that over the sitting-room, and lighted by a dormer window; *g* is the scullery; *h*, larder; *i*, wood and general store-closet; *j*, water-closet; *k*, bailiff’s bed-room, with a gun and odds-and-ends closet at *l*; *m*, bed-room. In Plate 27 we give two alternative elevations of another bailiff’s house, single-storeyed, but of a higher architectural class, to

suit special situations. The plan is shown in fig. 1, Plate 28, in which *a* is the porch; *b*, the inner lobby; *c*, the bed-room; *d*, the sitting-room; *e*, spare bed-room, or servants' do.; *f*, the kitchen; *g*, the scullery, in which a bed may be fitted up for the housekeeper at a 'pinch,' when the bachelor bailiff has a friend with him; *h*, the larder; *i*, the water-closet, which will be improved if made with an external set-off, as shown at *j*. The scale for this plan, and for elevation in Plate 27,

is 8 feet to the inch. In fig. 2, Plate 28, we give the plan of a single-storeyed bailiff's cottage, with more bed-room accommodation than the last, and which is drawn to a scale of 12 feet to the inch. In this, *a* is the porch; *b*, the lobby; *c*, the dining-room; *b*, front bed-room; *e*, small back bed-room; *f*, do.; *g*, servants' bed-closet, lighted by skylight over; *h*, kitchen; *i*, scullery; *j*, water-closet; with space for guns, etc. at *k*, and hats at *l*; *m*, china closet.

CHAPTER XII.

THE COTTAGES OF THE FARM.

THERE are few subjects connected with what is termed the economy of the farm, to which so much attention has been directed, and so much both written and said, as that which forms the subject of the present chapter; and, as may well be conceived, few on which such diversities of opinion have been promulgated, and so many plans and projects proposed. From this, therefore, it may be inferred that it will be impossible to give more than merely the briefest of outlines of the subject, which possesses also such a wide variety of details, many of which are of great importance. Into the discussion of the subject as a whole, a good deal of irrelevant matter has been introduced, as well as a warmth of expression which scarcely befits one which claims to be considered part of an important science. We shall therefore endeavour not to follow the examples thus set, but to keep as closely as possible to the purely practical details. As, however, the subject is generally treated under the two aspects of what may be called 'practically paying' and 'philanthropical,'—which last, as a rule, ignores all considerations connected with the first,—it will, however, scarcely be possible so to treat the subject as to exclude all points philanthropic, for these involve others which are of necessity closely bound up with the whole subject. In truth, the social and moral considerations connected with it are not only important in themselves, but they form what may be called the guiding motives which brought about the necessity for the improvements in cottage building, and largely dictated the principles upon which these have been carried out. Indeed, it might almost be said that, had it not been for the moral evils which arose from the condition into which the dwellings of our labouring population had been allowed through

a long course of years to fall, their improvement would in all probability have been retarded for a long period. These moral evils were so numerous, and acted so injuriously upon the population, and, by the natural course of events, also, although in less degree, doubtless on that part of it above them which had the good fortune to be placed in better circumstances, that they were compelled, so to say, to adopt methods by which those wretched dwellings were either wholly done away with or vastly improved. But not only were the moral evils numerous and lamentable in their results, but, as may well be supposed, the physical ones were no less so; and while they called forth the sympathies, they claimed the attention of those men of science who were best calculated to meet and overcome them. The result of the labours of the two classes interested in the amelioration of the condition of the labouring population, proves not merely that the removal of the moral and physical evils which had so long oppressed them, tended to raise their status in the rank of life, but that such improvement actually enabled a larger pecuniary profit to be made. It is needless to show how this was done, as it will be obvious on very slight consideration; but we have said enough to show how, as stated at the commencement of this section, there has been from the first, and must always more or less be, an alliance or conjunction between what we called the purely practically paying and the philanthropic considerations connected with this important subject. It would be easy, if the space and scope of our work admitted, to give what would be, under the best and most favourable view, a picture, so to say, of the condition of the dwelling-places of the labouring classes, which would be even then in one

sense melancholy in the extreme, from the circumstances which it would embrace; but our readers, if they have not already become well acquainted with the literature of the subject, will likely have seen enough in the course of their experience to render this labour on our part unnecessary. Suffice it to say that this condition was, as a rule, and is yet to a large extent, so bad, that it could, and can, scarcely be rendered worse. But while many will be disposed to admit that this is true of the dwelling-places in towns, on what is called their sanitary condition, they may not be disposed to admit that it was or is equally so in regard to the country; we fear, however, that but a very slight experience of facts, as they have existed and still exist, will rapidly dispel this illusion. We could easily cite instances from our own experience in proof of this, but we prefer to quote the evidence of a recent and high authority, who thus describes the condition of certain rural houses in a rural district: 'These, detached and in rows, so filthy in their surroundings, that we must step from stone to stone to obtain entrance. With many, too, I think almost a majority, the doorstep was broken or wanting. The walls were in a most wretched plight, and the whole set down at random on a piece of land, which, from the awkwardness of the place, seemed impossible to be intended for any purpose.' Well might the writer say that he imagined 'that such wretched places were temporary, and that the owners were only waiting for a convenient day of improvement; but such a hope,' he says, 'is gone by, and I now perceive that they are actually considered as finished and habitable. The people living in such places are not at all times degraded,' continues the eminent authority we are quoting, 'I am happy to say, but they are unfortunate in having too few wants,—a state which, in my opinion, is not philosophical, for I believe that the school of Diogenes did not deserve to live except among the self-indulgent.' While the last remark is true enough, so far as regards what may be called the better class of labour, or the small farmers, we fear it is but too often the case, as regards the condition of the majority of the ordinary labourers as a class, that his wants are by no means always attended to, however few they may be, as few they generally are; and if they

were, it would be well both for them as well as for their employers, to whom their right physical condition must of necessity be a matter of vital importance. What these wants are, we shall endeavour, as briefly yet as fully as possible, to explain in the succeeding paragraphs. But while saying this, and by implication putting the landlord or the farmer, whose duty it is to supply cottages for the labourer, and when supplied to keep them in habitable order, apparently in the wrong, we by no means join with those ultra-philanthropists who see all evil existing amongst these two classes, and all good amongst the labourers. Although less injury has been done to the agricultural than to the urban working population by the utterances, so to say, of the press and platform during the last two or three decades,—utterances which have impressed the labourers with a notion that they are very ill-used people indeed, and that everything was to be done for them, and they were to do nothing for themselves,—still it is unfortunately the fact that quite enough of injury has been done to the rural working people to lead them to suppose that all virtue was comprised amongst them; whereas the truth, and it is one abundantly evident on very slight consideration, is that human nature breaks out in its phases amongst them as amongst their superiors,—phases displaying evidences of what we have elsewhere described as remarkably spicy bits of evil-dispositioned human nature, and which, when they come in contact with similar phases amongst their employers, makes it a somewhat puzzling task for our philanthropists, as well as our practical men, to settle satisfactorily. That we have not as yet struck out the path through the wilderness of words, opinions, and circumstances in connection with this wide and important subject, we have but to take up the leading journals of the day to find abundant evidence; and certainly, in connection with it, there can be no manner of doubt as to the fact that the interests of employers and employed are in every way identical. For, as we have in another place put it, the briefest consideration will show that, as the employer pays a man to get so much work out of him, it is by no means a common-sense proceeding to force him to live under such circumstances of house

or home as will of necessity deteriorate his working capabilities; and that these are deteriorated by bad house accommodation and its numerous cognate evils, is, after the experience of a long course of years, axiomatic enough. For if we breathe bad air, or live in damp, dark houses, diseases and complaints, more or less marked and dangerous, must reduce bodily strength and that vigorous working power which it is worth something for the employer to have existing amongst his labourers. Enough, then, yet not more than enough, as to what may be called the philosophy of the subject; let us now turn to the practice, which we shall find as we proceed to be surrounded with difficulties of no common order. Nor need this be wondered at, if we consider the vast variety of details and practical considerations mixed up with it, creating what has been truly designated as a many-sided subject. Nor have the difficulties connected with it been lessened by the way in which some, who have claimed for themselves the right to be considered as practical authorities, have gone about its work in anything but a practical way. One circumstance alone, for example, has done much to retard true progress, namely, forgetting or ignoring the fact that the condition, so to call it, of the agricultural working population is materially different from that of the towns; and this extends also to what may be called the economics of landed property. What these are which affect, and are the effects of, this important subject, we shall see as we proceed.

We have said that it is a many-sided one; thus we have to consider what some authorities look upon as the primary, if not the only point,—namely, sanitary details. These, of course, are of vital importance, and must be duly attended to and secured in the highest degree of efficiency; but the paying point is one which cannot be overlooked, for, however much philanthropists may be inclined to do so, certainly the landlords will not be so. Again, the relation of the property created by the erection of cottages on an estate must be considered with reference to the legal position and responsibilities of the landlord in regard to it. Then come up not a few points connected with the social economics of the question, which must be fully discussed and

decided before the whole details can be said to be fairly exhausted. Taking these as what may be called its leading divisions, we proceed to consider in somewhat regular order their important details, and for obvious reasons we shall consider first the second of the above divisions, namely, that which refers to the point of paying. A great deal has been written and said upon this, not always with a wise judgment, inasmuch as considerations connected with the property have, as we have already hinted at, been lost sight of or thought to be of little moment. But these cannot and ought not to be overlooked, as it is not merely present proprietors who are always concerned in the matter, for they act as trustees, so to say, for the rights of those who have to come after them; but apart from this consideration, we maintain that it is perfectly legitimate for every one erecting cottage property to see that he is fairly paid for his outlay, nor in being so does it follow that he is to lose sight of the purely philanthropic considerations. And urgent as these latter are, and essentially necessary to be attended to, we believe that this will be made more likely to be the case when the property is planned and erected so judiciously that it will pay a fair outlay for its cost, than when, by going what we may call wildly into the matter, money is expended so lavishly that no fair and adequate remuneration can be reasonably expected to be obtained from the property. There can be no doubt of this, that the general question of the improvement of labourers' cottages has been greatly influenced by the careless expenditure of many, which has naturally deterred others from following in the same line who have forgot the simple fact that there might be some other plan of proceeding with the work, by which at once the paying and the philanthropic considerations might be equally and fairly met. We shall see as we proceed several considerations which affect this point, but which have been too frequently overlooked. There is, however, the other side of the question, which weighs with a greater force, and operates on a larger number of proprietors than many conceive of, or would be likely to conceive. This class do not trouble themselves as to whether cottages will pay, from the simple fact that they do not care to build them at all;

and this they excuse on several grounds, which need not be entered into here. Suffice it to say, that evidence ample enough can be afforded them, and to some of which we have already alluded, that if philanthropy has no weight with them, their own interests unmistakeably should. This, it must be confessed, is a delicate point for one to enter upon; but if private considerations are to have their due weight, which can scarcely be denied, it must on the other hand be conceded that there are public ones which no man is entitled at least wholly to overlook. Before dismissing the paying point, there is one thing which should not be lost sight of, that the conditions of rural cottage and town cottage property are so essentially different, that the country cannot be expected in any case, however prudently managed, to pay so well as that in the town. Cottage property in the country must almost of necessity come under somewhat the same condition as that of the farm or general land of the estate, which we all know does not yield the high return of that in towns, and much of the outlay of which is a long time before it begins to yield a return at all. On this point a judicious writer has the following remarks, bearing so closely upon the whole subject of the present chapter, and so suggestive of many practical considerations, that we deem it right to give them here: 'Were the outlay on a house and the rent of a house for farm work as indefinite in their proportions and returns as the outlay on the fields of a farm, and its returns as uncertain, and if the human constitution had not such a merciful and such a wonderful power of self-adaptation to hard usage above that of all other created living things, I venture to say cottages would have been infinitely better than they are. How many millions upon millions are sunk in the fields, that have never paid at all, and never will pay! and how many more are laid out every year on the bare probability only of paying in the long run! And this cheerfully, too; for if all this had not been done and were not continued to be done, agriculture could not prosper at all. Persons accustomed to manufacture any other raw material, on which they can exactly, if the market keep steady, calculate a certain return for a certain outlay, are apt to imagine that the same may be done in

farming. A grievous mistake this, truly. Suppose the seasons and the markets never disappointed the farmer, the best chemical analysis and the best and most costly appliances may be all as good as thrown away on certain fields; and yet such risks must still go on, because, as I hear the farmers often say, "If it is not to do with it, it will not do without it." Now I really have the greatest sympathy with all this very costly and constant adventure; but I do plead also that it be extended somewhat more to the moral field, and to stone and lime this field; for I am prone to think that when you set to house-building, you borrow too much of the certain percentage system from the people of the more certain returns on raw materials for outlay and work in towns, than your own land raw material in its working ever can show. Why, then, it may be argued, because of this uncertainty, the greater our return on the stone and lime outlay upon it ought to be. I could answer this in another way, but I take the farmer's way: "You cannot do without it, and I only now plead that you extend your risking to it as heartily as you do to your fields, and most assuredly your so doing will produce a set of hands who will work up this other raw material to you to a better repaying pitch, by much, than it has ever yet been before. Thus will your outlay be repaid, and that with usury." Having thus briefly introduced a subject the importance of which demands, if space would admit of it, a much more comprehensive statement of its various aspects, we now proceed to take up its leading departments.

Arrangement and Construction of Cottages.—The first point in the practical department of cottage arrangement and construction to which we direct attention is that of the site. We have already, in the preceding chapter on the farmhouse, gone into the details connected with soil, and its preparation in reference to site; and what we have there given applies so closely in many details, that we do not require to go much further into the subject now, concerning ourselves chiefly with one or two points only which are frequently overlooked. First is the relation of the cottage to the farm for which it is designed. One would say that obviously the true position for the cottage is the point nearest to the place where the

labourer works. But obvious as this is, it is somewhat absurd to say that in many cases cottages are not even allowed to be built on the land where their occupiers work. We need not enter into any details of the reason why this system was adopted; suffice it to say, that no considerations connected with the operation of the poor law as regards residence should ever have been allowed to interfere with the dictates of what are alike those of common sense and common humanity. It makes one almost ashamed to record the fact, that for the purpose of avoiding to maintain labourers when old age and poverty threw them on the last resource to which unremunerative labour is with us almost invariably driven, they were compelled to walk miles to and from their working place in order to find a house in a parish the bounds of which were beyond that in which the farm was situated. And after all, such a system could not in any sense of the term be said to be an economical one, its very object being frustrated by the loss of labour on the part of the poor workmen who are compelled to submit to it, it being a physical impossibility that any man could give his employer the full benefit of his physical energies, when these had been thrown away, so to say, upon the labour involved in walking to and fro in all weathers, and in all conditions of health, from the farm to his distant home. There is certainly vast improvement in this department; indeed, the system cannot be said now, as a rule, to exist, although for other reasons, or from other causes, cottages are not always supplied to farms, either in the full number required or in the proper state of repair and condition as to accommodation, so that many have to walk considerable distances from the farm to the cottage in which they live. It can in no sense be the interest of the landed proprietor that the labourer should have a difficulty in finding a comfortable home at a point the nearest possible to that at which he works. His interest obviously is all the other way.

But on the supposition that the labourer's cottage is placed on the farm on which he is to work, and that it is placed within a reasonable distance of the farmery or steading, where much of that work necessarily lies, let it be understood as a point of essential importance, that the actual

site of it—for what we have been hitherto considering has had in reality chiefly a reference to its position rather—should be such that the cottage will not merely have healthy land on which to stand, but that it should give to it a cheerful, pleasant aspect. Too often, as in the early part of this chapter we pointed out, cottages are built upon the worst plots which the farm can yield. This is a great mistake; for where all the surroundings are of an adverse character, they exercise a bad influence upon the labourer, so that he is indifferent as to making it what it ought to be, a place pleasant to look at, which is his duty, as well as one healthy to live in, to secure which is that of the landlord. It is scarcely necessary to say that the cottage should have land sufficient for ample yard and garden; and it will add to the attraction of the farm, as well as offer an incentive to the labourer to fill up his spare time with something better than that of filling nightly a corner in the bar parlour of the 'Cat and Fiddle,' if a small plot be placed in front of the cottage to be devoted to flower-gardening, bee-keeping, etc. The yard at the back of the house should be of such ample dimensions as to afford space for a good-sized privy, ash-pit, coal and wood house, and tool-house; and it will be more complete, and will yield another outlet for pleasant labour which will tend to keep the cottager at home, if a small poultry-house or shed be added. The piggery ought to be a part of every cottage, as nothing scarcely tends so much to the economy of the household as the food yielded by a pig, and the food in the form of carefully-saved scraps, which would otherwise likely be thrown away, which 'piggy' himself consumes.

We now come to the *accommodation* of the cottage. This has been, and is, such a fertile subject for discussion, that amidst the vast variety of opinions which have been brought forward in connection with it, it is a matter of no small difficulty to place before the reader even the baldest and briefest statement of the leading points of but a few of these. One set of authorities will be found to insist upon a fixed rule, from which there is to be no deviation, while another set all rules at defiance; both alike, however, agreeing in this, that the peculiar circum-

stances of cottagers are *not* to be taken into account as an element in the consideration of the accommodation which they may require or wish to have. Now we maintain that the very opposite of this ought to be the rule, because it is obvious that these are precisely the points which ought to decide what the accommodation of a cottage should be. Hence cottages should have accommodation of a varied character, not so much as regards the actual size of the apartments themselves,—for there should be a minimum below which no apartment should be,—but as regards the number of those apartments, a small family obviously not requiring the same accommodation which a large one will. It is very remarkable how much of what might be called this common-sense principle has been overlooked; and we venture to say that its having been so has been the main cause of the cottage question having been so much retarded in its practical solution in so many districts of the kingdom. And this simply because many cottages were built of so much more an expensive character than was absolutely necessitated, that the proprietors in many cases being, so to say, alarmed at their cost, were afraid to venture upon erecting others on their property. And we are free to confess that the feeling was very natural, and just what was very likely to be done by other classes similarly placed. Much might be said on this point, which unquestionably is an important one; but its leading features are so obvious, that we need not take up space by further dwelling upon it, the special circumstances of the farm or property giving the key to what will require to be done. One point only we shall deem it essential to insist upon, namely, that one or two or more cottages, according to circumstances, of the smallest class, should be built for old married couples past work, and for which if no occupant of this class on a farm should happen to be forthcoming, the same cottages would obviously do for an able-bodied labourer and his wife, with no family, or, say, with but a single child. As regards this class of cottage for old people past work, we surely do not require to say much or plead strongly for; we can conceive of no addition to a property which would be such a true adornment to it, as a cottage dotted here and there,

inhabited by old people whose youth had been devoted to the service of the proprietor, looking up to him as the source of material comfort in the days when youth had fled. Such cases do exist, and exist, we are proud to say, in larger numbers than many think of; but it would be well if they were still more numerous, as we believe there would be few things which would tend so much to increase and cement the good feeling between the proprietors of land and those who live by the labour which it affords, and which now more than ever, in those changed and ever-changing days, is so urgently required.

A point which has been much discussed in connection with the extent of the accommodation of labourers' cottages, is whether it should be confined to the housing of the family of one man, or whether it should be extensive enough to enable the family to take in lodgers. Some writers have dwelt upon this point, as if the latter system was a greater evil than any one of those about which there has been and can be no dispute; while some, if indeed it might not with almost complete truth be said, nearly all our landlords, having taken this view, have built the cottages on their estates with the accommodation so arranged that it was an almost physical impossibility for lodgers to be accommodated. While freely admitting that there may be evils connected with the system of having lodgers accommodated in the cottages of married labourers, we as freely confess that we fail to see that these are either very great in themselves or likely frequently to come up. After all, it is well to try at least to take a common-sense view of any subject, and deal with facts as they exist amongst us. Now what are the facts? It seems an absurd way to put it, and yet it must be so put, seeing what some writers have said about it; but all the labourers on a farm are not married, and have of necessity to live somewhere. Putting out of the question the bothy system, elsewhere in this chapter described, as, however applicable to the circumstances of certain districts in Scotland, quite antagonistic to the habits, customs, and modes of thinking of the southern parts of the kingdom, it is difficult to see what system can be adopted for the housing of unmarried labourers, if they are to be for-

bidden access to those of the married ones. And after all that has been written about the family circle, and its healthy and happy influence, it does seem an odd thing that the unmarried men on landed property should be driven to such straits as to forbid them to partake of these influences, or, if they should have them, be compelled to walk to some village, perhaps miles away from the scene of their daily labours. Very vivid pictures have certainly been drawn of the contaminating evils of what has been called the lodger system; but it has been difficult to gather whether the family was contaminated by the lodger, or the lodger by the family. One can conceive of a case or cases where both would be bad, and then we are free to admit that the evils arising from such an unhappy conjunction would be considerable; but we incline to think that such cases would be found seldom to occur. Another view of the case is, that if the evils are so great as said by some, but a poor compliment is paid to the family of the married labourer on the one hand, or to the unmarried labourer on the other. And surely there are not a few cases of family circles throughout the country resembling in their happy features the beautiful picture drawn by Burns in his inimitable *Cot-tar's Saturday Night*; and if so, unmarried lodgers, in place of being worse, would be infinitely better of coming under their hallowed influence. On the other hand, we can conceive of a lodger possessed of such a high character as to influence in the best possible way that of the married labourer with whom he might reside, and who was unfortunately dissipated or vicious. Certainly the plan or system cannot be a good one which forces the unmarried labourer, if to nothing worse, to the necessity of trudging long distances to and from his labour in order to obtain living accommodation. A very able paper on 'The Boarding, Lodging, and Maintaining Young Agricultural Servants; the best and cheapest mode of doing so,' was read before the Central Farmers' Club, in which, as may be gathered from its very title, the system of lodging unmarried labourers is advocated, and in which a plan of cottage specially designed to afford accommodation for the married family and for the young men is illustrated in fig. 5, Plate

30. In this, which is the ground plan, *a a* is the living-room, 12 feet square, in which there is a closet or pantry, *b*, at side of fire-place; *c*, a closet for tools; *d*, for clothes. The wash-house, *e*, is entered from the living-room, and has a dresser at *f*, and a sink at *g*; stairs to second floor are at *h*; and entrance is obtained to the yard, *i*, by the back-door, *j*. The wood and coal place is at *k*, and *l m* are open sheds; in that to the left, *n* is the privy, and *o* the urinal. On either side of the living-room are the lodgers' bed-rooms, *p p*, *q q*, each containing three beds, as marked. The bed-room for the married couple is on the second floor, shown in fig. 6, Plate 30, at *a a*. A closet, *b*, enters from the landing, *c*; and another closet is at *b*, in the bed-room, *a*; *e* is a small bed-room for the children (if any), or for another lodger; while another bed is in the apartment, *f*. It will be observed that this plan is that of a regular lodging-house, in which not fewer than six, and as many as eight, may be accommodated if there are no children, by using their bed-room, *e*; or the second bed in bed-room *a* may be used for young children. The objections which have been made to the lodging system will, it is obvious, be more likely met with in this case, where so many young men are accommodated, much of the discipline being dependent upon the ability and firmness of the head of the house; if this be not exercised, difficulties will arise. We should therefore be inclined to recommend the system of having ordinary cottages, with an extra bed-room for the accommodation of one lodger only, or at the most two. By this means the family influence, on which we confess we place great value, will have the best chance of being exercised.

Whatever be the extent of accommodation with which a cottage is provided, there are certain essentials to be attended to in connection with it; thus, however small a cottage may be, certain apartments must be given to it, the smallest that can be built requiring first a living-room, and second a bed-room, with appropriate conveniences; extension of accommodation being as a rule, or, as we may say, always in the direction of the bed-rooms only. This naturally, therefore, divides cottage accommodation under two heads; and to the necessary conveniences of

the two classes of apartments we now briefly direct attention. The living-room first comes under notice, and this, as a rule, is made generally too small. It should be remembered that a certain area of floor space is absolutely necessary in order to enable the work to be carried on, which, with few exceptions, is wholly done in it; and also to enable the members of the family, often pretty numerous, to move about, and also to have space for the necessary articles of furniture. There is scarcely anything which gives one so much absolute discomfort as the feeling of being crushed up and confined in a room, to say nothing of the loss of time and inconvenience to the housewifery operations caused by the want of it. A very common size for a sitting-room is 12 feet square, and even 12 by 10. The last-named dimension is simply ridiculously below the mark, whilst the first is too small for the generality of families. 14 by 12 is a fair size, and will suit the placing of the furniture, etc., with a moderate degree of convenience. But space in apartments need not be grudged, as ground does not possess the same high value in the country as in towns; and while a few inches even add materially to the comfort of the inmates, the extra materials required add wonderfully little to the cost of the building. An essential part of the ground-floor accommodation, supposing the cottage to be two-storeyed, is the *scullery*; this also should be made of pretty ample dimensions, so as to admit of as much of the house work, especially the washing, being done in it with all comfort. The small closets, measuring 4 feet 6 inches or 5 feet wide by 5 feet 6 inches or 6 feet long, do not deserve the name, as they cannot really serve practically the purposes of a scullery. Pantry or cupboard conveniences cannot be too liberally supplied to a cottage, as they not only keep the rooms orderly, but enable clothing, etc. to be kept in the best condition; one closet with a light to the outer wall should in all cases be supplied as a larder. But the best place for storing certain provisions, and a convenient one for many domestic purposes, such as curing bacon, etc., is the underground cellar, which must be dry, well lighted, and airy: the stairs leading to this are placed under those giving access to the bed-room floor, and may be entered

either from the living-room, or from the small passage leading from that to the scullery. As to the fittings of the living-room and scullery, much could be said if space permitted; we can only, however, refer, so far as the living-room is concerned, to the importance of having the fire-place fitted up with a proper grate. The fire fittings of cottages generally are very much below what constitutes the standard of efficiency; by far the best, as it is unquestionably the cheapest, is that used almost universally in Lancashire, and largely in adjacent counties, in which the oven as well as the boiler is heated from the central fire-place, which, by a simple contrivance, can also be made larger or smaller in dimensions according to the size of fire required. The heating of the oven can be regulated in this form of grate to the greatest nicety, by simply drawing out or putting in a damper. An ash-grid in the hearth is a great source of economy, as it enables the cinders to be saved, which are too frequently thrown away, although they assist greatly in making a good, clear fire. The scullery should have a slop-stone in all cases, not a sink, which is well named, considering the abomination it generally is. This is best placed under the window, as all the cleaning operations will be seen. A small boiler with a special furnace and flue should be also part of the scullery fittings. With regard to the bed-room accommodation, space permits us to say but little, and that little will be but a repetition in one sense of what we have said as to dimensions or floor space of the living-room; in fact, the bed-rooms ought by right to be the largest rooms in the house, as they are those in which the largest portion of time is spent, and that under the most unfavourable conditions as regards health. The bed-room floors should be provided with closets in which to place clothing, etc. If the dimensions or floor area of cottage rooms is, as a rule, too small, their height from floor to ceiling is also to be found the like fault with. A height of 8 feet in the ground-floor and of 7 feet and 7 feet 6 inches in the second-floor rooms, which is too generally specified in cottage work, is far too low. A high-ceiled room is always healthier than a low one, and the additional cost incurred by the necessary addition of a course or two of bricks is not

worthy of being at all considered in view of the greater advantages obtained. All rooms, it is scarcely necessary to say, with the knowledge we now have of the healthy influence of light, should have large windows, and these double hung, so that air can be admitted both above and below. A good deal of discussion under the head of accommodation has been carried on, as to whether that accommodation should be given in the form of a single or a two-storeyed cottage. As a rule, the prejudices or opinions in favour of the former prevail more in the north than in the south. In the case of the smallest size of cottage, the accommodation may be placed on the ground floor, forming that class known as single or one-storeyed cottages; and as these are generally or better adapted for old couples, they possess an advantage in having accommodation on one floor, thus saving them the labour of ascending and descending stairs; while the disadvantage, and indeed danger, usually attendant upon having bed-rooms on the ground floor may be obviated by the plan already recommended, of having the flooring raised above the ground level by entering the house by means of two or three steps, and also by having the natural soil dug out from beneath the flooring for some depth, either leaving the space void or filling it up with smithy clinkers, or, better still, a layer of concrete. But in the case of cottages having either the maximum of accommodation or that approaching to it, there can be no doubt that two-storeyed cottages are better than single; cheaper, because the influence which a roof has upon the cost of building must be very considerable. The more closely it approaches to that of a square or rectangle, the cheaper the construction of the roof is. But it is not merely the question of cost as regards this, but also the influence it has on the arrangement of the apartments; a cottage with its outline square, or a rectangular one, affording a larger amount of accommodation than one which is broken up, or has various offsets in its outline. This may be illustrated in figs. 5 and 6, Plate 29; fig. 5 being a square house, fig. 6 being on the rectangular plan. It will be seen from an inspection of fig. 6, that an exceedingly compact arrangement of the apartments is obtained, no space being lost, while it

is obvious that the roof will be of the most easily, and therefore the cheapest, constructed kind, as there will not be a single break in any one part of it. The roof of fig. 5 will also be of the simplest character, the ends being merely gabled, and the eave carried right along from end to end. In fig. 6, *a* is the entrance door, approached by steps, *b*; the lobby, *d*, forming the fourth, thus raising the floor of the house to a very considerable height above the ground level, a point as to the importance of which we have already offered some remarks. The back lobby is at *e*, on the right hand of which there is a pantry or store-closet, *f*, and on the left a small projecting lock-up china closet, *g*. The living-room is at *h*, from which entrance is obtained to the scullery, *i*. The bed-rooms are three in number, as *j*, *k*, and *l*; *j* and *l* having linen or other closets entering from them, as *m* and *n*. From this description it will be seen that a large amount of space is most usefully turned to account, giving many conveniences, as closets, etc., which are exceedingly valuable in a cottage; while separate entrances are obtained to the bed-rooms, without the necessity of passing through one to gain admission to another. In the plan in fig. 6 there is an inner porch, *a*, giving access to the living-room, *b*, the scullery, *c*, and a store-closet, *d*; *c* is the principal bed-room, while *f* is a bed-closet entering from the scullery, *e*. Both of these cottages are single-storeyed. This point is further illustrated in figs. 3 and 4, Plate 30, which are examples of square and rectangular single-storeyed cottages. Fig. 7, Plate 29, and fig. 7, Plate 30, are examples of cottages of irregular form, or with set-offs; the set-off or projection in fig. 7, Plate 29, being at the back, while that in fig. 7, Plate 30, is at the front. The porches, *aa*, and closets, *bb*, in both of these figures will of course add to the expense of the roofage, to save which the plan of inner porch, as at *a* in figs. 5 and 6, Plate 29, is very often adopted. It will thus be seen that the form of a cottage exercises a decided influence upon its cost not merely as regards the roof, but, as we have already shown, it influences also the extent of accommodation which the same amount of walling gives. While on the subject of accommodation, and how that exercises an influence upon the cost of the cottages,

it may be as well again to refer to the size of rooms as influencing the ventilation. And here we point out that although, in the majority of works treating upon cottages, plans more or less elaborate for securing ventilation have been explained and strongly recommended for adoption, we venture, although we shall by many be considered thus to be behind what are considered the 'requirements of the day,' to maintain that all plans of ventilation in common cottages will be simply ineffective, because they will not be attended to. Indeed, if the apertures can be stopped up, and rendered thoroughly inoperative, the almost certain chances are that they will be so, such being the horror—for it is nothing less—which the working classes have, as an almost invariable rule, for fresh air. The expense, then, of adopting such plans may as well be avoided; and the supply of fresh air necessary for health be trusted to by giving a fair if not the largest amount of cubical space to the rooms, and to the action of the fire-place, in conjunction with the openings of doors and windows, which in such structures are generally, and in this case fortunately, by no means too well fitted or airtight. What ought to be the cubical contents of a cottage room is, however, a point by no means definitely decided upon by authorities, their statements varying from as small an amount as 240 cubic feet of air required per day per individual, up to as much as 4320. Where ventilating authorities differ so widely, it is difficult to decide as to the actual amount required. One authority, however, who has had large experience on the subject, and devoted no small amount of time to ascertain what is a fair average space, states that on the ground floor, with a height of eight feet from floor to ceiling, and an area of floor in living-room of 150 feet, the consequent cubical contents of 1200 feet will be sufficient; those of the scullery, with an area of 80 feet, being 640 cubical feet. In the second or bed-room floor, the principal bed-room, with an area of 120 feet, and a height of 7 feet 6 inches from floor to ceiling, will give a cubical content of 900 feet; the smaller rooms, with an average area of 85 feet, will give a cubical content of 637 or thereby. But, as we have already said that these heights from floor to ceiling are too limited, while the same

may be said of the floor area, if these are increased, so also will be the healthier conditions of the rooms. The following statements of area of rooms, with their cubical contents, will be useful under this head:—Living-room, 17 feet by 15, with a height of 8 feet 6 inches, gives an area of 255 feet, and a cubical content of 2170; the bed-room, 15 feet by 10, and a height of 8 feet, gives an area of 150 feet, and a cubical content of 1200; a bed-closet, 11 by 8, gives an area of 88, with a content of 700. Assuming the scullery to be an offset, and of greater height than the living-room, namely, 10 feet, in order to provide for the vapour of washing, etc., when 11 feet by 9, gives an area of 99, and a content of 990; or when 9 feet 6 inches by 9, the floor area in square feet is 85, and the cubical space in feet is 850. Even with small rooms and no special ventilating apparatus provided, if, in addition to the fire-place, and what we might call the mural air-chinks provided by loose-fitting windows and doors, cottagers could be persuaded to open these as required every day for a certain period, nearly all the objects of good ventilation would be secured; and great as their horror is of fresh air, this surely need not extend to the case of the bed-rooms, which they do not occupy during the day, and for a portion of which at least they might have their windows open. A still greater advance would be made if they could be persuaded to have a small part of the upper sash open during the night. Even occasional 'blow-throughs' of fresh air would be of vast service to health and comfort, to which end it is a good plan to have the windows at back and front opposite, or nearly so, to each other, communication being kept open between them by the door in the intermediate wall. Before dismissing the subject of accommodation, we may here remind the reader that we have recommended privies external to the cottage, not water-closets. These, whether internal or external, are found in practice to be as little required by cottagers as plans, more or less elaborate, of ventilation, as they are not as a rule attended to as they ought to be, and hence not only soon get out of repair, but into a condition of the most filthy disorder. If the ashes but not the water slops of the house are thrown into the privy, nearly all the sanitary requirements of the case

will be met; more fully so if the cottager can be persuaded to distribute evenly over the surface now and then supplies of dried soil. 'Sanitation,' to quote the new phrase of the day, can be more easily and efficiently provided for in cottages than the majority of writers on the subject seem to be aware of; the great point to be aimed at being to simplify rather than to complicate their work, to do the latter of which seems, however, to be that at which so many of them strive.

Closely connected with the subject of convenient working of cottages is the supply of water. If it is pitiable to think of the labour which the head of the house sometimes has in walking to and from the farm on which he works to his cottage at a distance, and to which we have elsewhere alluded, it is no less so to think of that thrown upon the wife or children, in many cases, by having to carry water a considerable distance, while that water is often of very nearly the worst quality. Much has been written on the evils of this system, but much need not be here given, as they must be patent to any one on slight consideration. A well, therefore, should form part of the convenience of every cottage; and in many cases, by a little judicious observation, a spring affording a constant supply of excellent water may be found in such a position that, by a little contrivance, the house, without any damage to its site, might be arranged in convenient relation thereto. But even when a good well or spring is provided to the cottage, the supply of rain-water, which is open to every building, should never be neglected. This may be stored up either in an underground tank made in the yard, or in a cistern placed over the scullery, which will be the best position for it.

To estimate the quantity of rain-water which may be obtained from a certain space of roof, measure the roof, and multiply its length by its breadth, so as to get the superficies; make this into inches, divide the number of inches by 231, which will give the number of gallons for each inch of depth of rainfall. The average depth will be ascertained by the table of rainfall for the district; but it may be taken as between $3\frac{1}{2}$ and 4 inches for each month. The quotient, then, above obtained is to be multiplied by $3\frac{1}{2}$

or 4, in order to obtain the number of gallons received from the roof in each month. It has been estimated that in the neighbourhood of London the annual supply of rain-water is 4800, say 5000 gallons, for each 400 square feet of roof surface. A span roof, then, of 10 feet by 20 on the side, will give this quantity; and from this it will be seen what a splendid supply of soft water is within the reach of all possessors of buildings. And as regards cottages and villas, our experience seems to point out this as a rule, that if the whole roof-space be economized, and the water from it be carefully stored up, the supply obtained will be found sufficient for all the purposes of the washing of clothes and person, the extent of cistern space being proportionate to the roof space, at the rate already stated, namely, 5000 gallons annually for each 400 square feet of roof surface. Possibly an average for the whole kingdom may be put at 5000 gallons for each 500 square feet of roof space; so that the proportion, very easily remembered, is arrived at, 1000 gallons per year from each 100 square feet of roof surface. On this point of the supplies obtainable of rain-water in rural districts, a French savant, M. G. de Cause, has been making some curious investigations, of which we here present a brief *resumé*. M. de Cause estimates the roof area of a farm-house of a farm of one or two acres—a mere cottage with us, although the *roof-space* is often greater than in this country, where compactness is more aimed at—at 90 square yards, and the average rainfall 76 cubic centimetres, which gives an annual supply of 60 or 65 cubic yards of water. The consumption of water in farms he puts at 2 gallons per day per individual, for all purposes, cooking and washing, or, say, $3\frac{1}{2}$ cubic yards per year. A horse will consume five times this quantity, or 10 gallons per day, or $17\frac{1}{2}$ cubic yards per year; a cow or ox, 6 gallons per day; a sheep, 2 quarts; and a pig, 3 quarts a day. To ascertain the contents of a tank or cistern circular in form, square the diameter in inches, and multiply the product by .0034, the quotient is the number of gallons for each inch of depth.

In figs. 1 and 2, Plate 29, we give plans of cottages of the second class, and in figs. 3 and 4 those of the first or superior class, built in the

Buchan district of Aberdeenshire, and reported upon by Mr. James Black in a paper in the *Transactions of the Highland Society*. In fig. 1, which is ground plan, built in pairs or as semi-detached, *a* is the living-room, 13 feet by 11, entered from the porch, *b*; *c*, stairs, going over the recess for 'box-bed' (see a succeeding par. on this). In the attic plan, fig. 2, *a* is the boys' bed-room, *b* the girls' bed-room, with bed space or closet, *B*; *c*, stairs. In fig. 3, ground plan of first-class cottages, also built as semi-detached, *a* is the porch, *b* the living-room, *c* the scullery, *d* the pantry, *e* the stairs, *f* the box-bed. In fig. 4, the attic plan, *a* is the girls', *b* the boys' bed-room, the beds being in the spaces *c e*; *d*, the stairs.

In fig. 7, Plate 29, the cottage is single-storeyed, and detached: *a*, the porch; *b*, a closet or a water-closet,—although this arrangement we do not approve of; *c*, the kitchen; *d*, the scullery; *e*, back or children's bed-room; *f*, front or parents' do.; *g*, larder; *h*, wood, coal, or general store-closet; *i*, china, linen, and clothes closet. Here we have bed-rooms with space for free, open beds, and a supply of conveniences, in the form of pantries and closets, beyond the usual standard. In figs. 4, 5, and 6, Plate 31, we give the plans of a pair of cottages,—or semi-detached,—with arrangements and accommodation on the system usually adopted in the North of England, the part in which by far the nearest approach to the 'standard of excellence' in both is attained as a rule, although there are, we regret to say, numerous deviations from this. In fig. 4 is the plan of cellar, an almost invariable adjunct to even the lowest class of cottages in the North, especially 'lordly Lancashire.' In this, *a a* are the stairs, entered from passage, and gained in the direction as indicated by the arrows in fig. 5; *b* (fig. 4) is the cellar room; *c*, a coal or beer place. In fig. 5, ground plan, *a* is the porch or lobby; *b*, stairs; *c*, living-room or parlour; *d*, back passage; *e*, china-closet; *f*, larder, entering from kitchen, *g*; *h*, scullery. In the yard, if a rain-water tank or 'terra-cistern,' as this is called, from being for long lined with terra cement, is provided, its position is at *i*; *j*, privy; *k*, ash-pit; *l*, coal; *m*, lumber-house; *n*, poultry-house or pig-sty. In fig. 6, the chamber plan, *a* is the landing; *b*, the front, *d*, the back bed-room; *e*,

small do.; *c*, linen-closet or bed-closet. Scale, $\frac{1}{8}$ inch = 1 foot. In Plate 32, in figs. 2, 3, and 4, we give half plans to $\frac{1}{2}$ scale; and in fig. 1, half section (to double scale) of another example, with less accommodation than last, of a semi-detached or pair of cottages. In fig. 2, ground plan, *a* is porch; *b*, pantry; *c*, scullery; *d*, living-room. In fig. 3, chamber plan, *a* is landing; *b*, closet; *c*, front or large, *d*, back or small bedroom. In fig. 4, cellar plan, *a a*, space for stairs; *b*, cellar-room; *c*, wash-house; *d*, space for coals or beer.

Although this cottage, as arranged, gives a large amount of accommodation, still it gives it in such a way as to make it objectionable in a constructional point of view. Thus it makes the roof an expensive one; and a cheap form of roof we advocate as a necessity in all classes of structures. All projections, or what are called 'offsets,' such as in figs. 4, 5, and 6, Plate 31, are objectionable, as they necessitate breaks in the roof, which are always expensive. In figs. 1 and 2, Plate 31, we illustrate how the front part may be so altered as to allow of a cheaper form of roof than in figs. 4 and 5. Here, by bringing down the outer walls, as *a*, and extending the front wall right and left, the corner is done away with. This admits of a longer entrance, so that the stairs may be brought forward, and an extra closet obtained at the end, as at *b*, at right hand of plan. Fig. 2 shows the bed-room plan, this giving a small bed-closet at *a*. By taking down the wall, as *c*, shown by the dotted lines, *d*, space for pantries may be obtained, one entering from the lobby, *a*, the other being an extension of the pantry, *c*. This will do away with the corner at *f*, and bring the outline of cottage almost to that of a rectangle, which will be completed by the alteration suggested in figs. 3 and 4. In this, the recess, *i*, in fig. 5, is done away with, a wall stretching across, as in fig. 3 at *a*, giving two apartments which may be made into sculleries; the sculleries, as in fig. 5, being formed into provision stores or linen closets. In the chamber plan, fig. 4*a*, two additional bed-closets are obtained in the cottages, *a a*, those at *b b* being dark closets, or lighted from the roof.

Although we have little space left at our command now, it may be as well to give a few

remarks and an illustration or two in connection with cottages in Scotland. Delicate in some respects as the subject is on which we are about to enter, truth compels us to state that, bad as the state of the cottages of England was at their worst period, that of those in Scotland was decidedly worse. With no desire to take the part of one as against that of the other country, we think that we may refer with safety to such experience as can be derived from the history of the sanitary investigations of rural districts in both countries in proof of the above statement. Nor need we fear even the result of such investigations as might now be made, as illustrative of the fact that, both in arrangement and in construction, cottage-building on the northern side is apparently guided by principles very different from those of the southern side of the Tweed,—those principles affecting closely at once the health and comfort of their inhabitants; and that these are, as far as evidence goes, less thought of by those resident in the north. In support of this, we deem it necessary to cite no further or more conclusive evidence than that given by Christopher North, whose reputation in the world of letters is universally spread, and who at least cannot be charged with lack of patriotic feelings; for if ever there was a true Scotchman, in the widest and best sense of the term, Professor John Wilson was the man. Any one, therefore, desirous to know what *his* opinions were on the subject of cottages, should read his article thereon, as given in his collected works. And if his remarks were pungent at the period at which he wrote his article, when English cottages were at their very worst, when their improvement was not even thought of,—at least certainly not broached as one of the social improvements of the age,—it may be said of many districts of the north that they are not less applicable now, as serving as contrasts to cottages of a similar class in the south. Without going deeply into details, which would certainly be striking and suggestive, we would content ourselves by simply referring to one or two points in construction and arrangement in northern cottages which would at once set them apart as very different from those of a like class in the south. We would not certainly go the length of saying, that in the

arrangement of cottages and the general style of living—which, if not caused, is certainly greatly influenced by them—these are at least a century behind those of English cottages. This, beyond question, is a very exaggerated way of putting the point; but, nevertheless, like all statements of the kind, it conveys a large amount of truth. Nor should it be forgotten that the statement, such as it is, is not one put forward by partisans of southern systems and habits,—those, in fact, as a rule, knowing too little practically of the matter as existing in both countries to be able to give an opinion on it so decided as that stated,—but is chiefly put forward by northern authorities. We have said that there is a large amount of truth in the statement, exaggerated though it be, nor would it be difficult to bring forward many instances in proof of it. Take, for example, the very large number of cottages in nearly, we may say, every district in Scotland, which have no provision made for the exercise of, we shall not say the ordinary decencies of civilised life, but simply the necessities of mere social existence. It is folly in such a case to mince the matter, and to have an affected delicacy about it, when the fact itself exists but too notoriously. Need we say that we refer to the total want of privies or water-closets? We by no means wish to put forward as a fact that this department of house convenience, or rather necessity, is in England in all cases what it ought to be; far, indeed, from it. But this we do venture to say, that whatever be the defects of the privy or water-closet system in England, even the poorest class of cottages have some provision of the kind. Nor would it be easy to find any class of the community, in suburban and rural districts, who would be at all satisfied to rent or take a cottage to which such was not attached. And low indeed as the morals of too many of the lower class of England is, we have found it not seldom to be the fact, that many of them have positively refused to believe us, when we stated that hundreds of cottages in Scotland have no provision whatever of the kind. Whether these statements be absolutely accurate or not, the fact remains for consideration, that it is difficult to conceive how any class of our population should consent to

live under the circumstances we have named. Excuses enough, or at least reason enough, there might be for the very lowest of the population submitting to it, but we need not be surprised when astonishment is expressed that classes higher in reality, ay, in the moral if not in the social scale, have in Scotland for a long course of years submitted, and in large numbers at the very time we write submit to it. It would be wrong, however, to lead those of our readers who are not likely to know the subject practically, to suppose that no improvement in this department has been made in northern cottages. Improvement at once decided in character has been, is being daily made; but notwithstanding which, there is a very wide area in which it can still and ought to be made. We are referring now to exterior arrangements, for the privy in Scotch and in English cottages alike is one exterior to the house.

As an almost universal rule, there are other, and, we fear, numerous departments in which Scotch contrast but poorly with English cottages. Take, for example, the sleeping accommodation. Although there are many cottages in England single-storeyed, in which of necessity the bed-rooms are but a little above the ground level, the rule may be said to be that bed-rooms are on the upper floor. Certainly the opinion is universally prevalent that they should be placed there; and there are sound sanitary reasons for the system, one thing being very obvious, that the room must of necessity be drier and better aired. But while there may be and are differences as to the position of the bed-room in English cottages in the ground floor or upper, it would be a hard task for any one to find an arrangement of the bed similar to that prevalent in many a rural district of Scotland, known as the box-bed. (See *e*, fig. 1, and *f*, fig. 3, Plate 29.) This, for the information of our southern readers, we may state is a recess made against the wall, in which the bed is placed, the front being provided with a folding door, which is usually closed through the day, and too often through the night also, when the bed is occupied. Unhealthy as this arrangement must of necessity be, it is rendered still more so from the fact that the recess forms in too many instances actually part of the living-room, which is occupied constantly, and in which

all the household operations are carried on. Although, as a rule, this is necessitated from the circumstance that many cottages have no extra room or bed-room accommodation, still it is, in many instances, purposely so arranged, inasmuch as the labourer and his wife prefer to have the warmth and snugness of their living-room in which to sleep. Unhealthy as the arrangement is, one of the most enthusiastic, as he is certainly the ablest advocate of cottage improvement in Scotland, states that it is carried out, at least in structures recently erected, not so much because the labourers are aware of its unhealthiness, but because it is their only defence against the dampness. This brings us to note that this same feature of dampness is a remarkable peculiarity of Scotch cottages, and it arises from more than one cause. Perhaps the most powerful is the system—and it is one which builders, with a persistence which has long surprised us, have carried out, although they must be well aware of the evils arising from it—of building the cottages close to the ground level, so that the floor is, as a rule, actually in contact with, or placed at a very little distance above, the natural soil. Now in England, although there are unfortunately exceptions, the rule is that the ground floor is carried above the soil for some height, by having two or more steps by which access is gained to it; while, as pointed out in another part of this chapter, dampness is still further provided against by the system of underground cellar apartments, which are used for storing up provisions, etc. It certainly is a fact that damp cottages are much more frequently the rule in Scotland than in England; and although we believe that it mainly arises from the cause just mentioned, we believe also that it further arises from the stone, which is almost universally used in constructing the walls, as well as from certain peculiarities in the way in which these are put together, and to which we have in another part made special reference. As regards the conveniences of Scotch cottages, by which domestic work is quickly and most economically performed, there can be no question of this, that both in number and efficiency they are far behind those of English ones; indeed, it would be more correct to say that a large number of

them are totally deficient in these. That we take no exaggerated view of the case, those who have a practical knowledge of the conditions of the cottages both north and south will bear us out. And if those who have not this higher advantage will only refer to published works, embracing what may be called the history of cottage accommodation, embraced within the last twenty-five years, and longer than this, for the matter of that, they will find abundant evidence of the truth of what we say. In truth, it speaks in one sense volumes for Scotch cottagers that they are able to conduct their domestic affairs in the efficient way which many of them do, seeing that they are so deficiently supplied with the necessary conveniences, and, as we have said, in some cases not supplied with them at all; for it must be admitted that, under similar circumstances, English cottagers would be quite at a loss how to proceed at all. It is scarcely necessary to enter into a detail of what the deficiencies are in house conveniences to which we now refer, as, on examination of the plans and their accompanying descriptions, which we give in the appropriate chapter and section, these will be noticed by the intelligent reader. But we may here simply refer to the conveniences for cooking, in the shape of fire-places, boilers, and ovens, in sculleries or wash-houses, and in the minor but not less important conveniences of pantries or closets of various kinds, in which the different classes of household materials can be put away, so as to be readily obtained when wanted, and which so materially add not merely to the tidiness—a word, by the way, better known in its full and suggestive signification in England than in Scotland—but to the actual comfort of a house. All these things are, we know, considered north of the Tweed by many there resident as of little, or, to speak perhaps more truly, of no importance, being designated by them by a word which is only expressive to Scotch ears, as ‘fikey.’ That is, as if they were beneath the notice of intelligent people, and not worthy of the trouble bestowed on them. But we venture to maintain, knowing somewhat of the circumstances of the working classes on both sides of the Tweed, extending over what we may almost safely say to be the whole period of the time in which their consideration has formed a leading one of our

social movements, that the above-named conveniences, and such others as we might have alluded to, go very far indeed towards making a house attractive, and acting as a strong counteracting agency to the influences of the beer-shop and the public-house. We may talk till doomsday about this moral influence and about that, but assuredly the truth remains, that a man—and the lower in the social scale he is, the closer it obtains—is mightily influenced by such considerations as meals nicely cooked and neatly and orderly set before him, as well as by a house in which order and tidiness take the place of disorder and ‘confusion dire.’ So mightily, that when to these are added the avoidable nuisances of what to man are almost unbearable, that of washing day and washing up, the chances are that few can resist the temptation of fleeing from them to the ‘Cat and Fiddle,’ or the ‘Jolly Labourer,’ the landlords of which know too well how to make their bar parlours or their drinking-boxes, according as they are in England or Scotland, attractive and comfortable. We write, therefore, on a point of no little importance, when we urge, as we do now, the necessity of providing all cottages with every convenience calculated to make them as attractive as possible. It is well when a man’s house, however humble it may be, is the point to which he looks, when engaged elsewhere in his daily labour, as that which goes far to lighten its toils and hardships, and to which he looks forward during the ‘toil and heat of the day’ as a harbour of refuge therefrom, and a place abounding in those home attractions, which, when once experienced, are always dear, and which are more and more valued the longer it is his happy lot to have them. We do not lose sight of the fact, and we name it with no small degree of satisfaction, that very great improvements have been introduced in the departments now under notice in cottages erected more or less recently in Scotland, and for which that country is greatly indebted to her—by many much maligned and misunderstood—landed proprietors. Still, it would, knowing somewhat practically of the actual state of matters, be a pleasant thing for us to record that this improvement was universal. It has been our lot, even almost at the time we write, to be called upon to examine cottages

very recently and now being actually erected, in which the very worst features of the old system are perpetuated. We believe, however, that where such cases are met with, the cottages come under that unfortunate class—in many cases at least—of building speculations, the proprietors not being amenable to or under the influence of the dictation of proper authorities, or of advanced and correct opinions as to what is required and demanded by a higher standard of efficiency. In addition to the good work done by landed proprietors individually, it is only right to state that an immense impetus has been given to cottage improvement in Scotland by the Association for Promoting Improvement in the Dwellings and Condition of Agricultural Labourers, in the reports of which, published by Messrs. W. Blackwood & Sons, Edinburgh and London, the reader desirous of perusing the subject in its fullest details will find them amply illustrated and described.

The Bothy Cottage.—In connection with the accommodation for the farm labourer in Scotland, there is the feature which may be said to be altogether peculiar to that country, although it is not by any means universal therein, being confined almost wholly to its northern districts,—this is the bothy. This may be described as a detached cottage, exclusively inhabited by unmarried labourers, although we regret to say that in some counties there have been, if there be not now, instances in which workpeople of both sexes have been or are compelled to live under one roof. What the bothy is in its worst features, and, we may say, from what evidence has been afforded us by a very extended inquiry into the subject, what constituted, up to at least a very recent period, its general ones, may be gathered from the description of one whose every statement may be relied on, and which virtually is this: ‘Seldom more than one ill-built house of one apartment, having no in-door, no lath, no plaster, no floor, hardly a window, and a vent (*Anglicè*, chimney or flue) that will hardly draw; no chair, no table, an old broken stool or two, two or three rude and rickety bedsteads, one iron pot, and one large iron spoon or ladle, a water bucket, and a litter of fuel and filth;—and this is all the

accommodation and furniture that some half-dozen constantly and heavily toiled men have to make themselves comfortable with from one year’s end to another.’ If it were not unfortunately too true that cottages in England, in point both of construction and accommodation, have been met with nearly as bad, it would be difficult to make our southern readers believe that such wretched accommodation is given to Scottish farm labourers. The best reform would in the case apparently be ‘to reform it altogether,’ and do away with the system entirely. But it would appear, from what the great majority of practical farmers say in the counties or districts in which the system is prevalent, that it cannot be dispensed with under their style or mode of farming; although to perhaps less prejudiced or worse informed minds it would seem a somewhat reasonable thing to suppose that the ordinary cottage system, workable in other districts, would also be so in those in which the bothy seems to be indispensable. Failing this, the next thing to do is improving the bothy, all too prevalent, of which we have given a description by a most competent authority; and it is perhaps owing to the efforts of this same authority—the Rev. Harry Stuart of Oathlaw—that such improvements have been made. The general character of these, as proposed by Mr. Stuart, is illustrated in figs. 1 and 2, Plate 30. Fig. 2 shows what may be called the ordinary condition of the bothy, in which *a* is the entrance-door, leading at once to the main room, *b*; *c c* being a species of divan of hard boards, called in the vernacular ‘resting-beds;’ *e*, a closet; *d*, space for stairs leading to second storey, being a single room in which there are no partitions, but the beds arranged simply as desired. Fig. 1 shows an improved arrangement of a single-storeyed bothy, an inner porch, *a*, leading to the living-room, *b*, with resting-beds, *c c*; *d*, a closet; *e*, a scullery; *f*, a small bed-closet; *g*, a bed-room, with fireplace in it, and having space for two beds, as at *h* and *i*. By this arrangement a greater degree of privacy is allowed to the men, and conveniences for keeping the place in something like decent order secured.

Timber Cottages, or those of Material other than Stone or Brick.—Having alluded to the pay-

ing point of cottages, we now refer to two points which are closely connected with this, and which are unfortunately frequently overlooked. Indeed, the first of these has been so seldom, if indeed pointedly, alluded to in any work treating on the subject, that it will come to many of our readers now as one altogether novel, the first allusion being made to it, so far as we know, in an article contributed by us to one of the leading agricultural journals. The point refers to the use of a material hitherto almost comparatively unused in the erection of cottages. The materials almost universally used with us for building are brick and stone, about the relative merits of which much has both been written and said. With both, cottages absolutely weather-proof can be obtained, so far as the prevention of wind blowing and rain being forced through chinks is concerned; but in the far higher sense in which weather-proof is seen or understood to mean perfect immunity from damp, it is not so easy to say that either stone or brick are materials by which this immunity may be obtained. That this is true, let the exceedingly large number of buildings testify—first-class as well as second and lowest class—which are to be met with in the country, thoroughly and hopelessly damp. Now we venture to maintain that the first point to aim at in having a house healthy is to have it thoroughly free from damp. A house may be cold, but if it is not damp it will not be unhealthy necessarily; but a damp house, even if kept warm, will be so, must be so, stone varies so much in character; and we know so little practically about it, that the builder cannot be positively sure that if used it will be able to resist damp. Brick, if really well made, will almost always give a dry wall; but there are bricks and bricks,—some so soft and spongy that they take up damp freely, but unfortunately do not give it up so freely, but almost wholly retain it. These facts, as well as this other important fact, that the use of these materials involves considerable cost, have caused inquiries to be made as to the use of other materials, which, while less costly, will give healthy houses, in the sense of being thoroughly free from damp. Amongst these, concrete perhaps takes the first rank. Although much has been said on the score of its

economy, in that of its efficiency nothing has been or could be said *per contra*. We have also seen excellent cottages constructed of galvanized iron, which, although perhaps colder than if built of other materials, were not damp; and we have seen not a few made of wood, which were both warm and thoroughly free from damp. We are a people full of strong prejudices, and are not easy to be moved out of any groove in which we have been long running; and if we were disposed to recommend the adoption of wooden or timber cottages in place of those built of the good old-fashioned materials of brick or stone, we would be met at once with a long list of objections. But if we could take our readers to a certain district in England, in which the contrast is singularly enough presented of wretched, weather-beaten, decaying cottages of brick and stone, and a few constructed of timber, we feel perfectly certain that the conclusion they would come to would be the same as ours: better, a thousand times better, this comfortable wood cottage than those others, although they are built of the orthodox materials. Let the reader remember that we are not advocating the use of wood or timber as against the more lasting materials; but we are advocating this position, that if the cost be too great of building a cottage in the ordinary way, it is better to employ another and a cheaper method, even although that goes strongly against our preconceived notions. And however much we may be prejudiced against wood houses, let *this* be remembered, that whole peoples dwell in such houses: in Sweden they are almost universal; in America they are met with everywhere; and surely no one can say that the winter climates of those countries are better and more genial than our own. Without at all being desirous to become the advocates of wooden cottages, we may say that there is no difficulty in making them thoroughly healthy and comfortable; and in showing this in a brief sentence or two, we may give a few constructive hints, which, if not availed of for cottages, will be useful in connection with other structures of the farm: as, for example, in the construction of shelter-sheds in outlying pasture fields, and in other structures, of which, be it remembered, not a few are used for various buildings of the

farm,—even, indeed, of most important parts of the farmery,—in various districts of the country. The use of wood for the purposes of many buildings is assuredly on the increase, and must have struck those given to observation of what is going on around them; public companies and corporations, even, refusing to consider it a material beneath their notice even for important buildings.

In building a wood cottage, the first essential point to be attended to is the foundation and the floor. If these be well made, the structure will be comfortable. The level of the floor, when finished, should always be higher than that of the surrounding soil. It is the forgetfulness or ignorance of this simple rule that gives us so many cottages damper than they otherwise might be. If the floor is to be boarded, the flooring boards should rest upon joists raised so that at least two steps will be required to enter the cottage. If the floor be made of Portland cement concrete,—or of lime concrete, as in some of our midland counties,—the floor level need not be so high above that of the surrounding soil, as there is little fear of any damp arising through floors of these materials, which, we may here remark, are the best known for making damp-proof floors. The walls of a wooden cottage may be made in a variety of ways. Fig. 1, Plate 33, shows the most complete method. The interior space may be filled up, as it is in Sweden, with shavings or moss, or dried seaweed if obtainable, or, where a little extra expense will not be grudged, with broken stones, the spaces between which are to be filled with grout or mortar or cement, which will go far to make the house fire-proof. The posts, *a a*, fig. 1, are morticed into a horizontal piece of timber, *b b*, fig. 2, which runs along and round the building; or, if a brick or concrete base, as *a a*, fig. 2, be made, the posts may be inserted in this, and the piece *b b* dispensed with. The inner boarding, *b b*, fig. 1, is that which receives the plastering or paper. This inner boarding may be dispensed with in cases where economy is greatly studied, and calico nailed so as to stretch from post to post, and upon this calico the paper is to be placed in the usual way. Those who have not had experience of this method of finishing the inside of a wood cottage would have some diffi-

culty in believing how warm and comfortable it is. Comparatively little is known as to the heat-conserving powers of common paper. Let newspapers be quilted, so to say, between two thin pieces of calico, and a warmer bed-covering will be obtained than even a thick and very much more costly blanket or coverlet would give. This, if the poor would act upon it, is a hint of much value to them. Much of the comfort of the cottage depends upon the way in which the boards which form the outside covering, as *c c*, fig. 1, are put together. If simply put edge to edge, as there shown, and the joints left uncovered, the boards soon give or yield, and open chinks are formed. To prevent the wind, etc. from blowing through these battens, 'rolls' or fillets of wood are nailed, covering the joints. And here we give a hint as to the method of fixing these 'rolls' or fillets. If the 'roll' or fillet is fixed to the two contiguous boards, as *a* and *b* in fig. 3, by two nails, *a* and *b*, as the boards separate,—as they are sure to do more or less,—the inevitable result will be that the force of the separation will split the 'roll', *c*, thus doing away with the very object which it is put up to prevent. But if the fillet, as *d*, is nailed to one board only, as at *e*, however much the boards separate, the 'roll' will not be split, as it will simply go with one board, as *e*, leaving the other, as *f*. The width of the fillets should be about two inches. A much better way to secure a weather-proof joint in the boards is to have them rebated, as at *a* in fig. 4; or the joint which we have ourselves designed, as in fig. 5, may be used. Any rain which may be forced by the wind into the joint will pass no farther than the channel *a*, which will lead it to the foundation, in which a small drain should be made communicating with the outside. It will be observed that, in the latter, it will be a very difficult thing for rain or even wind to be forced through the joint; so much so, that the 'roll' or covering fillet may be almost dispensed with. The outside of the boards may either be coated with coal tar and the surface sprinkled with dry sand, or painted with brown paint, and the sand sprinkled over; the last will look better, but the best preservative is the tar. In fig. 6 we give a section showing the weather-proof boarding we have designed for the roofs of wooden

erections. Fig. 6*a* is an assemblage of two of the roof boards, *a* and *b*, with the 'roll' or fillet, *c*, covering the joint, *d*. It will be observed that any rain forced in at the edges of the 'roll,' *c*, fig. 6*a*, will slide down the inclined part, *a*, fig. 6, and from thence into the channel, *b b*, which will lead the water to the eaves or gutter, as the parts *a b* run the whole length of the boards. In fig. 7 we give a section of a wooden cottage. It is scarcely necessary to add that all fire-places must be built of brick, stone, or concrete. The best covering for the roof is asphalt, well tarred and sanded. In fig. 7 the cottage is shown as having a boarded floor, *a a*; below the joists, *b b*, there is a lime or concrete layer, *c c*, this being separated from the joists by a vacant space, shown in black. This arrangement of floor will give a dry one. *d* is a door leading into another apartment; *e* is the fireplace. The roof is of the simplest construction, with a 'collar beam' or 'tie-beam,' *f*, and the 'rafters' are covered with boarding, and this again with asphalted felt, tarred and sanded three coats over its whole surface. Whatever objection may be raised against the use of timber cottages, certainly this can be said in their favour, that they will be infinitely more healthy and comfortable than are so many of the wretched, tumble-down, half-rotten brick and stone erections which, under the name of cottages, disgrace so many of our rural districts, while at the same time they will assuredly look better, and add to the amenity of the property; unless, indeed, the so-called more substantial structures are to be looked upon as ruins, adding to its picturesque effect. We do not wish to be understood, however, as advocating the erection of timber cottages in preference to those of brick or stone under all circumstances; we simply say, that under those in which the greater expense of brick or stone structures is objected to, it would be infinitely better to build cheap timber houses than to allow the wretched structures of the former materials to remain, as they can in no sense be said to minister either to the health and comfort of those who live in them, or to the reputation of those on whose property they are. Moreover, there are localities and circumstances in and under which temporary structures of timber would be

useful, some of which will at once present themselves to the minds of our readers.

The next point to which we have to direct attention is one in which there are, as a writer has remarked, although in connection with another subject, 'large capabilities of utility;' that is—

The Improvement in Arrangement and Construction of Old Cottages.—There can be no doubt there is a wide field for work in this way, and of that thoroughly practical character which would commend itself at once to many who have not been as yet much influenced by what has been said either as to the philanthropic or the paying features of the subject. There are many old cottages throughout the kingdom which were built at a period in our industrial history when men did honest work, and walls were built which were really designed to last, and have lasted for a range of years, which work if done as now, in these scamping days, would have had no chance of standing out so long. Now, by a very small expenditure, these well-built walls could be repaired, and the whole interior and exterior made ship-shape; the one ministering to cleanliness and comfort, the other to the maintenance of the structure in good repair. And so far as tending to increase the good feeling between landlord and tenant is concerned, a feeling which should be cultivated as widely as possible, we rather think that more would be effected by kindly efforts to improve those cottages which, still inhabited, are yet in such a state of disrepair that they cannot be inhabited with comfort. As a rule, those who inhabit such cottages have a wonderful degree of affection for them; they may have lived long in them, or their forefathers before them; and whether this be so or not, it certainly is the fact that they cling to and think more of an old place than one of those bran-new model cottages, which—it is needless to disguise the fact—are more frequently viewed as things rather 'to be afraid of,' and, at all events, are not much liked. Then, again, by a little management, adding a room to one house and a couple of rooms to another, the varying accommodation which we have often pointed out as necessary can be easily obtained.

The improvement of old cottages naturally divides itself into two branches: first, the repair-

ing of the decayed parts; and, secondly, the re-arrangement of the whole structure, so as to add to the accommodation which the old cottage has to give when in its altered state. Of the first little need be said here, as that will be decided very soon on inspection of the building; and any tradesman can execute what is deemed advisable. One word, however, may be given here by way of warning, and that is, that it is often a mistake to suppose that to patch up decayed parts is the most economical way to do. There are some parts of a building, more especially in the roof, that to make a patch of is little better than throwing away money, the only true economy being to renew them. The judgment of the party inspecting any old cottage property proposed to be repaired will decide this point.

The re-arrangement of an old cottage is the most difficult part of the subject, and one to which we purpose devoting a few remarks, illustrating these by diagrams, which will serve practically enough all the purposes of elaborate and more accurate drawings. There are many cottages throughout the country consisting merely of one room; and although these do, and do well enough, supposing them to be in good repair and otherwise healthy, for single people, or for an old couple without children, still they would be all the better if they had some trifling extra accommodation in the way of scullery or pantry. And another addition is always useful, and that is a porch. This adds materially to the warmth of the house in winter-time, and thus saves coals; the porch may either be added externally or made internally, in which case it affords the opportunity of giving a pantry or little closet off it. This internal porch can only be given where the interior of the cottage is large, and in many cases they are too large, so much so, indeed, that they are difficult to keep warm; and by an old person or old couple, who do not require to be bustling about, a small room is better liked. Take, for example, a cottage of one room, *a, b, c, d*, as in fig. 3, Plate 30, of which there are many in the country. This of itself presents no conveniences whatever, and cannot possibly be a warm house in winter, there being no porch; and the fire-place, indicated by the letters *f p*, being opposite the door, *d*, every wind that blows in that direc-

tion sends a cold current right across the room, and those sitting near the fire to get the heat, get the cold draught in large proportion, doing away with the good of the fire. Strong, stalwart people may do with sitting in draughts, although even with them the practice is questionable; but for poor old folks, with thin blood, and, alas! too often thinner garments, the state of matters is anything but what it should be. And if we who are better off would try to realize the evils that others who are much worse off suffer, certain it is that our philanthropy would take much more practical directions than it often does. Comfort often is required by poor people; it is all they ask, when charity in a more offensive form—and charity with some is always offensive—is the last thing they wish or want. Thus, by simply adding a porch to the cottage, as by an 'offset,' a large amount of comfort may be given to its inmates without in any way expending much money, and yet a true charity may be done all the same. And by adding slightly to the length of the porch, space may be given for a pantry, a convenience which in the cottage under review, fig. 3, Plate 30, is only 'conspicuous by its absence.' Or, in place of putting the porch outside the wall, it may be placed inside. The window might interfere in the extending the length of the porch, so as to give a pantry; but if space can be had in the interior of the cottage, this might be fitted up in a corner of the cottage; or, if the porch is placed outside the house, it may be extended in the direction of the breadth of the house, and space would then be given for a pantry. We might give a wide variety of plans showing how old cottages could be improved, but it will be enough to show the general principle upon which this may be proceeded with. Thus, in fig. 3, Plate 30, we may suppose *a b c d* to be the outline of a single-storeyed, one-roomed cottage, with a door at the point *c*; by adding an offset, *f g h i*, space for a small bed-room, *j*, may be obtained, a porch at *k*, and a small scullery or store-closet at *l*. If a second bed-room be required, the extension *f g* may be carried down to *m n*, the door of the house still remaining as at *e*. But by filling up the corner *c d*, fig. 3, Plate 30, and the old doorway, *e*, a very convenient cottage could then be obtained, the lobby and entrance being at *o*; the old scullery at *l* re-

moved, and formed either into a larder or a small bed-closet for a child; the new scullery being at *g*, and a store-closet at *r*, and a linen one at *s*. But by making the entrance at *t*, and a small inner porch, as shown by the dotted line at *g*, the lobby, *o*, and larder and store-closet, *r*, might be laid together to form a moderately good-sized bed-room, *o r*, space

being had at *u* for a wardrobe. Fig. 4 may serve also to illustrate another example, *a b c d* being the one-room cottage, and by making offsets or additions at the ends, *f g*, considerable accommodation would be secured, and laid out in various ways and for various purposes, of which the illustration is an example.

CHAPTER XIII.

DRAINAGE AND SEWERAGE.

THESE subjects, which, treated of generally, would comprise the enunciation of many principles, and the giving of a great number of illustrations, will be compressed into but small space, inasmuch as they will refer only to the limited class of buildings already noticed, and that in what may be called the simplest of methods. Thus, drainage has only to be considered in connection with the site of the buildings, of which we will take the farm-house as an example, the details being obviously applicable to the other buildings of the property.

Drainage of the Site of the Farm-house.—A great deal has been lately written about the prevention of damp in a house. For long we have advocated the prevention rather than the cure, and as damp in a wall in nine cases out of ten arises from damp in the soil, the only true way to prevent damp in the walls of a house is to drain thoroughly the soil of the site upon which it stands. This may be dispensed with in the case of very light and porous soils, and where the position of the site is such that there is a slope, and therefore a natural drainage from it; but in heavy and medium soils it is absolutely indispensable. In view, indeed, of the insidious nature of damp, and how even in the most porous soils it will be present, we would even with such thoroughly drain the soil of the site. We are confident from what we have seen, and from the results of the experience of others, that houses which are now damp would have been otherwise, even without the constructive applications we have described, had the soil on which they stand been well drained. Of course this drainage can be best, cheapest, and most effectually done, as it ought to be done, before the house is built; but still, in view of the good effects obtainable from the system, we would re-

commend in the case of houses already built, and which have turned out to be damp, the sites to be as well drained as they can be. In such a case, the only kind of drains available are intercepting drains surrounding the house (as the drain shown by the thicker lines in fig. 21), although the cross drains should be carried through as close to the house as its foundation will permit. In houses about to be built, the whole area of the site should be cross-drained, as shown in the diagram.

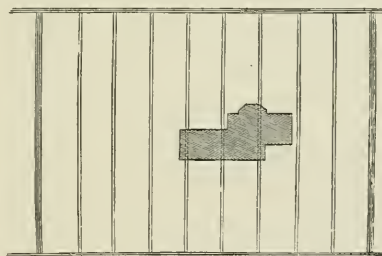


Fig. 21. Plan showing Drainage of Site and Grounds of Farm-house.

The cost of draining a site is not so very expensive; but if even more than it is, the outlay would, in all cases, be well repaid by the advantages obtained. The following brief statement will give one or two practically suggestive details. A site one acre in extent can be thoroughly drained throughout, the whole area surrounded with a deep catch-drain, and the site of the house specially deep drained, at a cost of £20 nearly in two classes of light soils, or at an annual rent-charge of, in round numbers, 30s. 6d. or 34s. 8d.; in medium and heavier soils at nearly £23, or at an annual rent-charge of 43s. One acre of land thoroughly drained throughout, but not surrounded with a catch-drain, as shown by the double line in fig. 21, and the site of the

house specially deep drained, as in the diagram, costs, in light soils, £12, or, commuted into a yearly rental charge, 18s.; in medium soils, nearly £14, rental 21s.; in heavy soils, £17 for the acre, yearly rental 26s. In the first named of the two cases above, suitable for a farm-house with garden ground, etc., the following are the 'qualities' and sizes of drain-tubes required:— 77 yards of 6-foot-deep drains, 277 yards of 5-foot-deep drains, 745 yards of 3½-foot, 1062 yards of 1¾-inch drain tubes, 2235 yards of 1-inch do. For the second case, 147 yards of 5-foot-deep drains, 622 yards of 3½-foot drains, 441 yards of 1¾-inch drain-tubes, and 1866 yards of 1-inch tubes.

Sewerage — Liquid-manure Tanks.—The ordinary sewers, or rather drains,—for sewers, properly speaking, are large,—used in farm buildings are those only required to lead, in the case of the steading, the liquid exuvia from the live-stock apartments; and in the case of the farm-house, etc., the liquid refuse to the tanks prepared to receive it, which is the best place, in the case of the residential buildings, for its final deposit. It may be taken to the nearest stream, or, as it too often is, to the nearest ditch or open drain. But in the first of these cases it is sure to pollute the water, and, in the second, the air in the immediate neighbourhood. No doubt some may take exception to the tank as only the old-fashioned cesspool under another name, about the evils of which so much has been said, and which we, at all events, have no desire to defend. But a liquid-manure tank and the old-fashioned cesspool are two very different things; and yet a well-constructed cesspool is a tank, just as a tank may be called a cesspool. The faults of the old-fashioned cesspools were the bad way in which they were constructed, the bricks or stones being badly set, and the mortar bad; so that the sewage matter drained through to the surrounding soil, and often to the water of neighbouring wells, making both impure,—alike the cause of noxious emanations from the one, and poisonous qualities in the other. The cesspool, moreover, was almost always left uncovered, or, if provided with a cover, it was so defective that the foul gases easily escaped into the air. Now a liquid-manure tank possesses, or should possess, the very opposite of all these character-

istics. The bricks or stones should be carefully set in cement, not in poor mortar, which is easily and soon worked out from between the joints. The backing, moreover, between the bricks or stones and the enclosing soil should be well puddled with clay, the cover should be air-tight, and all openings made into it trapped with deep syphon-traps. If all this be done, and done carefully, and the drains leading to the tank be well ventilated, no evil of a sanitary kind need be apprehended from the presence of a tank in the neighbourhood of the house. It should, however, be placed at some distance from it, say at the extreme end of the garden. This will be the best place for it, as the position will be convenient for emptying the contents for manurial purposes. The value, indeed, of these contents for manure is such, that they will pay at least the annual charge of percentage of the cost of the tank, but in general much more than this.

If a heap of dry, or comparatively dry soil be prepared near to the tank when it is about to be cleared out, and its contents be thrown upon the heap, and the whole mixed up, or the contents of the tank covered at once with the soil, no unpleasant smell need be feared. There is no deodorizing treatment so effective and prompt in its action as ordinary soil.

The Water-closet.—In planning the house, ample space should be given to the water-closet. As a rule, the size of this convenience is so small that it is made one of the most inconvenient parts of a house. This arises from most mistaken notions respecting it; often, too, from a false delicacy, which prompts the putting of it in such places, and arranging it in such a way, as if the best thing to do was to put it out of sight, as the most disagreeable of subjects. And in one sense no doubt it is; but its presence is a known necessity, ministering to the health and convenience of the household; and being so, it ought to be arranged in the way best calculated to meet those most important, nay, essential requirements. The room in which the water-closet should be placed ought, in our opinion, to be a room in the sense of being 'roomy,'—we mean to make no pun,—not stowed away into a closet, literally 'closed' or 'close-set,' as perhaps the word originally was. The place should not only be spacious, but well

lighted; and above all, means should be provided to supply it liberally with fresh air, by which the foul air can be forced out as soon as generated. It should, moreover, be of easy access, yet secluded; and both of these requirements can be met by the exercise of a little care in the planning. Many reasons, and all of them important, concur, we think, in clearly pointing out the plan as being in every way the best, of having the water-closet perfectly isolated from, or projecting from the main wall of the house. This is not easily done, if indeed it can be done at all, in towns; but there is nothing to prevent it being done in the country, and yet at the same time be of convenient access from the house. For the strong, the young, and the healthy, a convenience of this kind should be provided in the garden, at a distance from the house.

Drain Traps.—We have above alluded to the foul gases generated in drains and cesspools. The latter abomination may not have an existence—or it ought not—as the excreta may be sent into a neighbouring river, or, better still, a properly constructed liquid-manure tank, as that belonging to the farm buildings; but drains are an absolute necessity wherever a *water-closet* is used, and in the great majority of instances they act in no other way than as long cesspools,—of small diameter, no doubt, but mischievous enough in their way, from the length to which, even in the most favourable circumstances, they necessarily extend. No doubt, to prevent the foul and most dangerous gases generated in their interior from passing into the house through the medium of the water-closet, or the scullery, or wash-house, sink or slop-stone, ‘traps’ are used. But these, in the great majority of cases, are traps only in name, not in reality. The efficiency of a trap depends upon a certain volume or mass of water, the amount of which is supposed in theory to be always constant; or at least, that water to a greater or less extent should always be present in the apparatus. So long, *but only so long*, as this volume of water is in the trap, the gases from the drain cannot pass through the water, and from thence into the open part of the trap, which is connected with the water-closet or sink. But some traps have such confined water space that it soon dries up in warm weather, and is not of depth enough

to resist the pressure of the drain gas. In water-closets the usual form of trap is a ‘syphon’ or ‘S’-shaped tube, the water which remains in the bent part preventing the gases from flowing into the house through the open end at the closet. But even this form, more efficient in general than the bell trap, as less liable to have the water evaporated, is by no means to be depended upon. If the gases accumulate in the drains to a dangerous extent, or if the outlet of the same is exposed to the action of strong winds, as they often are, the pressure of air upon the water in the trap is greater than the pressure due to the column of water in the bend, and the result is that the gases are forced through the trap and into the house. This happens much more frequently than is generally supposed. Further, traps and pipe connections being almost always made of lead, the gases from the drains soon corrode this, and holes are formed through which they easily escape into the house.

Ventilation of Drains.—All these facts show that some method of dealing with drain gases, so as to prevent either their formation or their accumulation to that extent which becomes dangerous, is necessary.

The best and most trustworthy method of dealing with the difficulty is the adoption of special means for ventilating the drains, so that as quickly as the gases are formed, they are led off from their interior. This method has one great advantage to recommend it, if it had no other, which is, that it is independent of all care—or, what is more likely to be the case, of the carelessness—of attendants; and when once done, involves no expense in keeping it in working order. There are two methods of ventilating the drains, one of which only as yet has been adopted; that is, the carrying of a pipe or tube which communicates with the interior of the drain up the side of the house, and terminating it at the eaves. Rain-water pipes will act as ventilators of drains, but as we recommend the saving of rain-water, which may be collected from the roofs of all houses, in place of its being wasted by being sent into the drains, we of course advise special ventilating tubes to be made, and these to be terminated, not at the eaves, but at a height some feet above them; and also to

be furnished with a special cap, by which the upward action on the draught of the tube will be aided. This method gets rid at once of the objection made to the use of the ordinary rain-water pipes as ventilators, namely, that being terminated at a height very little above the windows of the upper storey, the gases passing out are apt to be blown into the rooms through the windows. The objection is perhaps more fanciful than real, and the evil, if evil it be, thus created, even at its worst, will be innocent compared with the evil of allowing the concentrated gases from the drains to pass directly into the house through defective water-closets, baths, and sinks. For the gases, having always an outlet at the rain-water pipe, would be kept in a much less concentrated state than in the drains, and when once in the open air diffusion is rapid. Gases diluted with fresh air cannot possibly be so dangerous as when concentrated and unmixed with air. But the plan we recommend, if outside tubes are to be used for ventilating drains, will get rid, as we have said, of this objection. An excellent ventilating cap for terminating the pipe is the archimedean screw ventilator, invented by Silver of Farnham, near Bolton in Lancashire. It is stated that some thousands of these are fixed to sewer ventilating shafts in Liverpool alone.

The other method by which drains may be ventilated has only recently been proposed, but we have no hesitation in stating that it is the better of the two; that is, to have a flue leading to the kitchen chimney, the flue communicating by special and minor flues with all the drains or

pipes leading from the water-closet, the bath, lavatory, and sinks. The upward current in the chimney will draw in the gases from the drain as rapidly as they are formed, and the gaseous products of combustion present in the chimney will tend to disinfect them; at all events, by mixing with the heated air and the products of combustion present in the chimney, the united gases will, when they make their exit at the flue mouth, be rapidly diffused in the atmosphere.

It is impossible to exaggerate the evils attendant upon the escape of gases from drains, when they are suffered to pass into the interior of houses. Recent investigations have proved beyond a doubt that much disease, and that of a dangerous kind, arises from this cause alone. Ventilation of drains is the 'newest thing out,' and may, therefore, like most new things, be looked upon with doubt by some; but it is nevertheless of vast importance, and we have shown that it is no difficult or expensive thing to carry out. Neither is it a new thing by any means, for we find a notice of it in the work of an author published no fewer than a hundred and fifty years ago, who insists upon its importance, and shows how, by 'secret vents passing up through the walls like a tunnel,' the 'ignoble conveyances' of the 'suillage' (sewage) may be let in and dispersed in 'the wilde air alofte,' to the manifest advantage of the 'health of the inhabitants.' So the plan, after all, has all the advantages — whatever they may be — which respectable old age brings with it.

CHAPTER XIV.

VENTILATION OF FARM-HOUSES—SUPPLY OF WATER, ETC.

WE have already, in a previous chapter, illustrated the practical details of ventilation as applied to the apartments for the live stock of the steading, and there referred to a succeeding chapter in which the principles would be described; it remains for us, in this place, to fulfil our promise, which we shall do in describing the

Ventilation of the Rooms of the Farm-house.—Of all the questions connected with the arrangement and construction of houses, not one has given rise to such a diversity of opinion as that of ventilation. Architects and builders have been blamed, and in no measured terms, for what they have done, as much as for what they have not done, in endeavouring to settle the question, Can our rooms be ventilated? And yet, on a fair view of all the points connected with the subject, it is open to doubt whether architects and builders have been—or are—entitled to all the blame for allowing, as a rule, houses which they design and build to remain without any attempt at ventilating them. For a little consideration will show that house proprietors and occupiers have done, and in point of fact do still, much to prevent plans for ventilating rooms having fair play when they have been provided. We all know the horror of draughts which possesses the mass of people. The mere notion that air is coming through a hole, if it does not urge them to do what the old proverb advises them under such circumstances,—‘to make their will and mind their soul,’—certainly urges them, in the great majority of cases, to go and stop up the hole, so that no air can get through it. Now, as a rule, if architects do make ventilating apertures in connection with a room, the idea is at once taken, and persistently held, that with these there must, of

necessity, be a draught or draughts, and forthwith the ventilating appliances are condemned, and probably the architect who designed them also at the same time. Now it is obvious that, if fresh air is necessary,—although, it must be confessed, there seems to be a pretty widespread notion that it is not so, from the dislike had to it,—there must be some apertures made by which it is admitted while fresh, and others by which it is to be withdrawn when it is made anything but fresh by its being breathed. And fresh air can be supplied to a room without of necessity creating a draught. The difficulty is to get people to believe it; and believe many of them will not, so long as they have before their eyes the apertures by which it is admitted. ‘Don’t I know that air is coming through these holes, and there *must* be a draught?’ To such a style of argument as this, if argument it be, what reply can be made? It certainly is remarkable how we say this; but we are, after all, not so sure about it, for even people of the most fastidious tastes in almost everything make this of fresh air an exception, and submit, day after day, to breathe foul air, which, to an educated sense of what fresh air is, smells of bad air. The peculiar odour of air which has been again and again breathed is, indeed, very marked, and is well known to ‘practised noses.’ How it exists the next paragraph will endeavour to explain.

Causes of Deterioration of Air in Apartments.—Up to a comparatively recent period, the generally received opinion as to the cause of air becoming foul after being breathed was, that the process of deterioration was entirely chemical. The fresh air being inhaled into the lungs gave up its oxygen to the blood, took up therefrom carbonic acid gas, which, being exhaled, passed out in a deteriorated state. This for a long time was held universally

as the theory accounting for the presence of bad air in our rooms, and is, as above stated, held by a large number of people yet. And it has only been in comparatively recent times that investigation has clearly proved that it is not merely the air which has passed through the lungs, and been expelled therefrom, which constitutes what is known as foul air in rooms. There are causes other than this that tend to increase, not only the amount, but the degree of foulness of bad air. Thus we now know that air, in addition to being chemically deteriorated by passing through the lungs, is organically deteriorated by the presence in it of organic impurities taken up from the body. Then, again, in addition to the organic impurities passed off by the air expelled from the lungs, there are other organic impurities which are passed off from the surface of the body by insensible and also by sensible perspiration. Still further, the air in our rooms is rendered impure by the dust floating about in them, and which dust is often the product of very disgusting substances. Then, again, the air is deteriorated by the product of combustion from candles, lamps, or gas-light, and, what is perhaps worse, by emanations from foul drains in the neighbourhood of the room, or from damp decaying vegetable and animal substances under the floor or within the soil of the site of the house.

Prevention of Draughts in supplying Fresh Air to Rooms.—No doubt there are difficulties in the way of supplying fresh air in such a way that draughts or currents will not be created and felt,—for created they must be, otherwise ventilation could not be secured, for ventilation without currents of air is a mere contradiction of terms. The great point to be arrived at is to arrange the fresh-air appliances in such a way as to diffuse the air as much as possible; this points to having fresh-air apertures as numerous and as small in area as possible, and to have them in such positions that the incoming current may be felt to as small a degree as possible. An arrangement which has been found very effective in practice is, admitting the cold fresh air by apertures in the wall leading to a hollow space behind the ceiling cornice of the room; the cornice being so constructed that its upper part communicates with a species of flat shelf, so to call it, and this shelf is provided with a finely-perforated zinc plate. The

fresh cold air admitted to the room through the apertures, in its descent to the zone of respiration, becomes in a degree warmed before it reaches the zone, and the sensation of draught is reduced to a minimum, if it be not altogether got rid of. For it should be noted here, that the chief source of the objection to incoming currents of fresh air is, that the air being cold it is at once felt, and being once felt it is decided offhand that there must be a draught. We believe, therefore, that if fresh air were sent into a room at or about the temperature of the air in the room, no objection to such currents would be made, and we should hear no more about draughts. Hence the value of the plan above noticed for admitting fresh air, although it possesses certain obvious disadvantages, of which only one may be named here,—the fresh air is warmed by coming in contact with foul air,—although the objection be not a very grave one, seeing that the contact with the foul air is so short in respect of time that the contamination is not much. We ourselves prefer the fresh air to be supplied to a room below, at least not above, the zone of respiration. To secure this we know of no contrivance so efficient as the grate known as the 'ventilating grate;' and of the various forms of those yet introduced, that of Captain Galton we deem the best. In this, the grate is so arranged that in itself it affords the maximum of heat with the minimum expenditure of fuel, while, at the same time, it warms a large supply of cold air admitted from the external atmosphere; which air, after being warmed, is admitted to the interior of the room by openings specially made. As tending much to the comfort of the house in cold weather, we would strongly recommend the hall, lobby, and staircase to be well warmed by means of a stove-ventilating fire-place in the hall, or in the case of a large mansion by hot-water pipes. The various rooms of the house will draw as from a central reservoir supplies of warm air, and the cold draughts so often complained of when doors are opened leading into the hall, lobby, or staircase, will be avoided. With this arrangement might be added another of having the skirting-boards of the rooms at that side nearest the hall or staircase perforated with apertures, other apertures being made in the wall, so that warm air might flow in from the hall, lobby, or staircase

into the rooms; or apertures might be made in the lower panels of the door, and these covered inside the room with a light silk curtain, capable of being raised or lowered like a railway carriage spring blind. Care should be taken to bore the holes in the door panel obliquely up, so as to throw the air upwards.

The supply of fresh air warmed to the required degree being secured by the means we have described, the next point to be attended to is getting rid of the foul air. By far the best means for securing this important point is the addition of a ventilating-flue—or supplementary chimney, as it may be called—built alongside and in close contiguity with the ordinary chimney-flue of the fire-place. The interior of the ventilating-flue gets warmed by being in contact with the chimney-flue, and the current upward is sufficiently strong to withdraw regularly and with certainty the foul air from the room, the foul air passing from the room to the ventilating-flue through an aperture made in the wall near the cornice-ceiling. As the subject of ventilating and warming is such a wide one, it is obviously impossible that we can here go into all its details, even if the scheme of this work admitted of this being done, which it does not. To those, therefore, of our readers who wish to go into the subject more minutely than we have been able to do here, we beg to refer them to a small handbook, entitled 'Practical Ventilation,' published by Messrs. Blackwood & Sons, Edinburgh and London.

The *supply of water* is a point of great importance, and one which should be carefully attended to. The source of supply in the majority of country and farm houses is the well. This should be dug in a position as near the house as possible; of course, near the working parts, as the kitchen, scullery, and wash-house. Where the place of final deposit of sewage matters is the cesspool, or rather tank, as already described, the cesspool should be arranged as far from the well as possible, although if it be lined with Portland cement concrete, as recommended, there need be no fear of leakage from it contaminating the soil, and thence likely to drain towards the well. But the material which prevents leakage from any receptacle to the surrounding soil will prevent leakage to a receptacle from the soil. We would therefore recom-

mend the well to be lined with Portland cement concrete; and the same for tanks in which rain-water is stored up. Rain-water for washing purposes, whether of clothes or of person, is the softest and best which can be procured, and all means, therefore, should be taken by which the rain passing from the roof of the house can be saved. One cistern should be placed at a short distance below the roof, from which the water-closet and the bed-rooms and bath are to be supplied. For kitchen purposes and for washing, the rain-water will be best stored up in an underground tank; this being placed near the scullery and wash-house, a supply being obtained for these when required by means of a pump.

We now come to notice a few constructional points. In treating of the site and its drainage, we pointed out that this drainage was perhaps the best method of securing dry walls. Damp, as a rule, in walls arises from the moisture in the soil being drawn up from it by capillary attraction in the materials of which the wall is composed; the more porous these are, and the more carelessly put together, the damper being the wall. To prevent the damp from rising in the walls, what are called 'damp-proof courses' are provided, these being generally a layer of sheet-lead, slate, or tar, or, in the latest improvement, hollow bricks laid at a level a little above the level of the ground. These are all more or less effective; the lead, although the most expensive, being perhaps the most effective in preventing the moisture rising from the ground up the walls. But the best way assuredly is to prevent, if possible, the existence of the moisture in the soil at all,—we mean, of course, undue or excessive moisture. This is best done by draining the site; the drains should be deep and pretty near each other. Damp, however, often arises in walls from long-continued rain being driven in upon the surface by wind long continued in one direction. From this cause, the side of a house facing the prevalent wind, and if that wind be the rainy one, is frequently damp. A course of slate is often nailed to the wall so exposed, but this, although generally effective, is not an expedient pleasing to the eye. If the exterior of the house is cemented throughout, the exposed side may be cemented with Portland cement, which, if well done and the cement of good

quality, will be effective. The best plan to adopt however, is to build the exposed wall with hollow bricks, or with ordinary bricks with a 'cavity' or internal space. This hollow brick wall or cavity system may, indeed, be carried out throughout the whole building, and with good results, as the house will be warmer and freer from damp than it would be if built with ordinary bricks in the ordinary way.

A capital means to secure a dry house is to have the whole cellared under. Some of the cellar apartments will be found very useful for a variety of domestic purposes.

In the formation of basement or cellar floors, there are several materials at command; those generally employed are stone flags, tiles, and bricks set on edge. In the use of all of these, the great point to be attended to is the formation of a sound foundation. The soil should be dug out for a depth of some inches, and its place taken by well-sifted ashes and cinders, or smithy clinkers; the ashes to be placed uppermost. The whole should be well rammed down, and the surface made as uniform as possible, and of course level throughout, carefully bedding the flags, tiles, or bricks upon the surface. This will make a drier floor than if the natural soil is left, upon which the

flooring material is to be laid. If bricks or tiles are used, the joints should be filled in with cement, pressing this well down and carefully finishing off the surface. A good floor surface can be made with lime and ashes; but by far the best material for the formation of basement floors, and floors of dairies, is the Portland cement concrete, the characteristics of which, and its uses in building walls, etc., we have elsewhere fully described.

Should the expense of cellaring the whole house be objected to, we would nevertheless, in view of the advantages derivable from having a cellar apartment for storing up meat, beer, wine, etc., advise part of the house to be cellared under. The other part, although not cellared, should have an excavation of at least a foot in depth below the level of the under side of the floor joists. This will keep the timber well off the ground, and will admit of its being well ventilated by apertures in the wall—the best preventive of dry-rot. If the ground surface under the timber be Portland cement concreted, the house will be all the drier, and free also from vermin. The foundation course should all be laid in concrete, and this be well brought up to the footings and beyond them, so as to keep the soil away from the walls on the outside as much as possible.

CHAPTER XV.

POINTS CONNECTED WITH THE CONVENIENT ARRANGEMENT OF FARM RESIDENCES.

THIS subject is such a wide one, and embraces so many details, that the title to the chapter would have been more fitting if we had said 'some of the points,' for it is only to a few that we can possibly direct attention. These, however, will be such as exercise a great influence on the convenient working of houses, although they are seldom mentioned and pretty generally overlooked.

Size and Fittings of Bed-rooms.—Much of the comfort, certainly much of the convenience, of a bed-room depends upon the way in which the door is placed, or doors are placed, with relation to the fire-place and the window or windows. Some are so carelessly planned in this respect—if the term planned, indeed, can be here applied—that it is almost impossible to place the furniture in the way it ought to be placed. Not seldom have we been called upon to inspect a house in which the bed-rooms, from this cause, were almost useless. Only the other day we were consulted about a house in which all the bed-rooms were so planned that not a bed could be placed without either stretching across the fire-place or the window. We need scarcely say that this house was not purchased by the party looking at it. With some, all that seems necessary is that the room should have a door; but whether it exercises any influence upon the convenience of the room as a place in which to sleep, does not seem to have been thought of. A very common mistake is to place the door in the centre of the wall next the lobby or landing-place. This position almost invariably cuts up the furniture space so much that it is not easy to place it properly, and in the case of small bed-rooms it is almost an impossibility. Thus take, for example, the case as illustrated in fig. 22, in which *a* is the fire-place, *b* the window,

and *e* the door in the centre of the wall leading from lobby *d d*. Taking the space occupied by

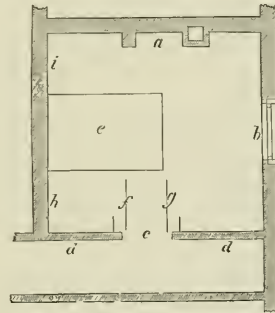


Fig. 22. Bad Position of Door in Bed-room.

the bed as *e*, it will be seen that the position it is made in the diagram to occupy is the only one in which it can be placed; and even this is an unfortunate one, as it throws the foot of the bed too near the fire-place. It cannot be placed in either of the corners *d d*, for the width is such that the sides of the bed, *f g*, come past the door architraves. The difficulty is still greater where the room has to contain a wardrobe, and where the room is comparatively small, for the corners *d d* cannot take it in, and it cannot be placed against the window; and if, to make room for the wardrobe in the corner *h*, the bed is placed nearer the fire-place *a*, the inconvenience in this respect is made worse; or if the corner *i* is taken, the bed comes too near the door. All the difficulties named—and they are not fanciful ones, having been met with by no means seldom in practice—could have been avoided by simply putting the door in either one or other of the

corners *a b*, fig. 23. This at once gives facilities for placing the furniture in the most convenient

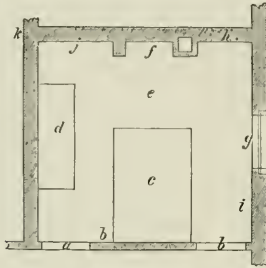


Fig. 23. Bad Position of Door in Bed-room.

position,—the bed at *e*, the wardrobe at *d*; a fair amount of space is thus obtained between the foot of the bed *e* and the fire-place, useful in cases of sickness. But in the case here illustrated there is again a choice between the two positions of the door, one being better than the other; thus it will be better to put the door in the corner *a* than in *b*, as the corner at *b* will then be left free, so that the washhand-stand can be placed at *i*. True, it may be placed at *h*; but as in most rooms there is or should be cupboard or press convenience, and as in brick-built houses the space made by the projecting jambs of the fire-place is always used in this way, the door will be either at *h* or *j*, so that the washhand-stand cannot be placed there. And even should there be no press, and therefore no door, we hold that the best position for the washhand-stand is at *i*—where the door of the room is at *a*, not at *b*—inasmuch as this arrangement gives free space all round the fire-place—a convenience at all times, but more especially in times of sickness, so great, that it should be used in all bed-rooms if possible. But further, there is a choice between a good way and a better even in the mode of placing the door at *a* in fig. 23; for if placed, say, midway between the space formed by the side of the bed and the wall *kk*, the probable result will be that a wall-space is left too short to be made useful in the placing of furniture; but if the door-check of *a* is placed as close to the wall *kk* as will only afford room for the architrave (and this should always be given, as it looks to us always an ugly thing to see a door

furnished on one side only with the architrave mouldings), then a space will be given for the placing of a chair or other article of furniture—as a small table in case of sickness—in the corner *b*, next the door *a*, and at the side and head of the bed. Such points as these may by some be considered as trifling and beneath the notice of an architect or builder, but they are precisely those which make or mar the comfort and convenience of a house. Such houses, as has been well said, are made to live in, not to look at merely, and what adds to the comfort of living cannot be in any sense unimportant, certainly far from trifling.

The case now illustrated is much more difficult for the housewife to deal with, where the bed-rooms are very small, and where the planner has thoughtlessly placed the door in a bad position. And we regret to say that very small bed-rooms are too much the rule in all classes of houses; but as on this point we have already offered a few remarks, we pass on to the subject in hand. Take the case, for example, illustrated in fig. 24,

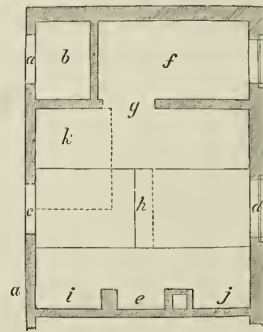


Fig. 24. Bad Arrangement of Bed-room, with Closet and Dressing-room off.

—and such a monstrosity in planning as this has been perpetrated,—in which *a a* is the landing *b* a small closet entering from the same, *c* the door to bed-room, *d* the window, *e* the fire-place *f* a small dressing-closet entered by the door *g*. Now where can the bed be placed? Not in the corners *i, j*, nor in *k*, for the bed would then come within the line of the door *g*; or if this door was even nearer the window *d*, the bed would still come beyond the door *e*; the bed

can in this case be placed only against the window *d*. All such absurd difficulties should never be met with, and would never be if in planning a house special plans on a larger scale of the bed-rooms were taken, and the bed-space put down therein in all positions, so as to ascertain which would be the best for it to occupy. If this were done, in many cases the planner would see that his bed-rooms, however well and conveniently placed they seemed to be in the *general plan*, would not do when coming under the hands of a housewife who has to arrange the furniture of the rooms, and make them, what they should be, convenient and comfortable. How often have we had the complaint made to us, 'Oh! the house is very nice in many ways, but it will not do for us—we cannot get our furniture into the bed-rooms, so as to move about comfortably in it;' which, to our mind, is very much like saying, 'Oh! the house is a very good house, but it cannot be lived in;' as if living in a house were not precisely the object for which it was built, and no other.

The position of the bed is an important point in the estimation of some, that is, the side of the room at which the 'head' should be. Some very curious researches have been recently made by a Continental physicist into the influence of the position of a bed on the sleep of the party occupying it.

Position and Hanging of Doors of Entertaining Rooms.—Nor is this difficulty in getting a house in which the furniture cannot be properly placed on account of, to a large extent, the way in which the *placing of doors* has been done, confined only to bed-rooms; not seldom, indeed, is it met with in the case of the entertaining and working rooms. As a rule, it should be the aim of the planner to give as long and unbroken wall-spaces as possible, against which pieces of furniture can be placed. We have now in recollection not a few rooms we have seen in which it was an absolute impossibility to place a bookcase or a sideboard without blocking up a door, a window, or the fire-place.

The mere *hanging of a door* is a matter of some importance. We have often met with doors to cupboards, pantries, etc., hung in such a way that when opened they actually shut out

the light of a window blocked up, as thus (fig. 25), where *a* is the window, with the door hung so

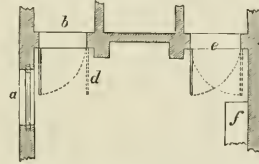


Fig. 25. Bad Position of Scullery and Cupboard Doors.

as to open in the direction of the curve, keeping the light from the closet *b*; while by hanging the door on the side, as shown by the dotted line *d*, when open the full light would be thrown into the closet,—a great convenience, surely, in looking for or arranging things.

The awkwardness of such a method of hanging doors is shown further in the same diagram, at the closet or cupboard on the opposite side, *e*, of the fire-place, farthest from the window, the interior of which will be effectually darkened by the opening of the door; the method of hanging the door shown by the dotted lines will obviate this, and be doubly convenient if a piece of furniture, as a wardrobe or bookcase, *f*, be placed where shown.

The peculiar awkwardness—often leading to accident—of the method of hanging doors as shown in fig. 26 should be avoided, the door *a*

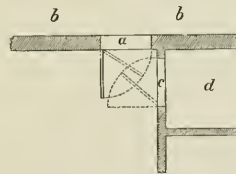


Fig. 26. Hanging of Contiguous Doors in Room Interiors.

of the room entering from passage *b b* being very apt to collide with the door *c* of the pantry *d*, as shown by the dotted lines. Again, in fig. 27, the awkwardness occasioned by hanging the door so as to open inwards, as shown, to a small bed-closet leading from a larger sitting-room, would have been avoided by hanging the door so that it would open to the large room. In fig. 26, the door, opened as at *b*, blocks up the space *c* at side of bed.

Again, doors provided to small rooms, as dressing-closets, entering from a larger room, should as

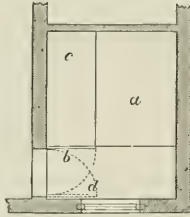


Fig. 27. Hanging of a Door leading from a Small to a Large Room.

a rule be made to open into the larger room. By reversing this method, much of the space of the small room will be done away with. Thus we have known a dressing-room attached to a bed-room rendered most inconvenient by having the door opening into it; as thus, where *a* in fig. 28 is the washhand-stand, *b* an article of

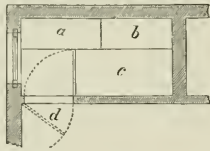


Fig. 28. Hanging of the Door of a Dressing-room.

furniture in the dressing-room, *d* the door opening into it in such a way that any one standing at *c*, and wishing to get into the bed-room *d*, had first to shut the door, then pass to the space in front of it, then open the door and pass out; whereas all this could have been avoided by hanging the door as shown by the dotted lines, so as to open against the wall of the bed-room. So also in the hanging of doors opening into narrow passages; this should if possible be avoided, especially if the doorway is in the centre of the passage, so that one may have occasion to go farther along it; the passage is, in such a case, fairly obstructed by the door opening into it, if the passage be narrow, by being so near the opposite wall that there is no room till the door be closed. In water-closets, from their being made as a rule so small, this inconvenient mode of hanging the

door so as to open into the closet is specially annoying, as many of our readers must have experienced, especially in town houses; and in such cases, as they often enter from a passage, of the two evils the least should be chosen, and the door should be made to open to the passage—although that may be, as named above, inconvenient—in place of opening into the closet. The hanging of doors of water-closets and privies is generally carelessly done; for example, the method illustrated in fig. 29, than which nothing



Fig. 29. Hanging of Water-closet Door.

could be more awkward—the party walking in having first to open the door *a*, then crush himself up into the corner *b*, then shut the door to get to the seat; the process being reversed is just as absurdly tedious in getting out. We could easily multiply instances of badly hung doors, but we have given enough to show that some attention is required in this department of house-fitting, where perfect convenience and comfort are wished for.

Position of Windows.—The arrangement of windows to a room is a matter of considerable importance. Abundance of light should be given to every room, for light exercises a most important influence upon the health of their inhabitants; the windows should therefore be large, and the sills placed not higher from the floor than one foot. This enables the view to be more thoroughly enjoyed, and throws light full upon the floor, thus aiding the cleaning out and dusting of the room. Some attention should be given to the placing of the windows, or at least one of the windows, with relation to the fire-place, so that those sitting at it while at work or while reading should have an ample supply of light. All closets should be well lighted; and all the windows of these should be capable of being opened and shut.

CHAPTER XVI.

FIRE-PROOF CONSTRUCTION ADAPTED TO THE BUILDINGS OF THE FARM.

It would be difficult to name any class of buildings to which a system of fire-proof construction could be so advantageously applied as those erected in rural and outlying districts. The frequency with which accounts are met with in the public prints of this class of buildings being nearly, if not wholly, destroyed by fire, and the number of cases of partial loss which, although known locally, are not publicly announced, shows that they are liable to fire in a degree, if not beyond, certainly quite up to the average of other buildings. Indeed, within the range of our own experience, we are prepared to state that, in cases of fire breaking out in farm buildings, those resulting in total or nearly total loss greatly outnumber those cases in which the fires are extinguished before great loss has been sustained. Nor need this be matter of surprise, if we consider that they are almost always isolated from the chances of immediate help,—and help in case of fire, to be of real value, we all know requires to be immediate. Even in the most favourable cases, where the farms, being suburban, are near a town where fire-engines are obtainable, the time which must necessarily elapse before a message can be sent, and a practical answer to it obtained in the arrival of the fire-engine at the scene of the fire, is in nine cases out of ten just the time which is required to enable the fire to obtain such a mastery that it cannot be put out before large if not total loss is the result, or if put out, only after much damage has been done. In districts completely separated from towns by large intervening distance, the case is worse; so bad, indeed, that, as a rule, the fire has simply full scope to work its will, the chances of getting help in time sufficient to make head against it being altogether against

the probability of getting it while it can be useful. The circumstances, moreover, of farm buildings are such that they present unusual facilities for fire quickly spreading, and this from the presence in large bulk of combustible materials, as straw, and also from the presence, as a rule, of large surfaces of exposed timber work.

Taking all these circumstances into account, it may to some be matter of surprise that farm buildings are not, as a rule, constructed *de novo* fire-proof, or, if not absolutely so, still in such a way that the amount of materials employed in their construction of a combustible character, and exposed to fire, would be the minimum, not the maximum, as the rule unfortunately in practice is. But the real difficulty has been, not the absence of the desire on the part of proprietors to have their buildings fire-proof, but the fact that they could not find any system presented to them, which, while being moderately costly only, offered the advantage of being also efficient. For, strange as it may appear to some of our readers, fire-proof systems, up to a very recent period, have been 'conspicuous only by their absence' in the art of building construction; and although several have of late been introduced, they have not as a rule been characterised by cheapness, however efficient they might promise to be. In no way, we venture to say, is the art of building so defective as in that department by which materials can be so arranged in a building that the chances of their taking fire are reduced to a minimum. Indeed, so distinguished is house construction by the absence of means to prevent ravages of fire, that distinguished authorities do not hesitate to say, that if our houses were built for the purpose of aiding the ravages of fire when once it breaks out in them, they could not be

better built and designed. For not only are materials highly combustible in themselves, used with a lavish hand, as if no other materials were available less combustible or wholly incombustible, but they are placed in such positions and arranged in such combinations, that they positively facilitate, if they do not invite, the ravages of fire. We have wooden floors, wooden partitions, wooden roofs, wooden staircases, wooden doors,—wood everywhere; and wood so put together, as, for example, hollow quartering partitions, and hollow floors and skirting boards, that once fire gets hold of it, the whole goes up little less readily than a firework.

The question is therefore one of no small importance, Is there no way, or are there no ways of using building materials ordinarily met with in rural districts, in such a way that fires will be, if not absolutely impossible, still by no means so dangerous as they usually are? and if so, can the system be so simple that its carrying out will lie within the compass or capacity of ordinary workmen? Such remarks as we are now about to offer, and such suggestions as we propose to make, will enable the reader, we trust, to say whether the question above put can be answered affirmatively or no. In giving a few of the practical suggestions which the consideration of the solution of the problem here offered involves, we deem it necessary to state that they will, with certain modifications which will be obvious to the practical man, be applicable to all classes of structure we have in preceding chapters described and illustrated, domestic as well as those connected with the steading.

Taking timber as the material employed, as that most readily obtained, and with the working of which country mechanics are perfectly familiar, the object in view is to combine it with another material or with other materials not in themselves combustible, and in such a way that the timber will be so protected by these, that practically it may be considered safe from the attacks of fire.

Let us take for our first example the case of a floor, which, in nine cases out of ten in ordinary farm buildings, is left exposed completely from below, no ceiling being provided, and the floor generally ill laid above, so that a fire when once it breaks out has the best possible chance of

consuming the whole of the timber in the shortest possible time. To make this fire-proof, it is necessary that both upper and lower surfaces be so constructed that fire commencing either from below or from above will not be communicated to the opposite surfaces. In the case of ordinary or domestic buildings, this may be said theoretically to be met by the general method of forming plaster ceilings, the timbers on their under side being protected from fire coming from below by the incombustible material with which they are covered. But practically the security afforded by this common arrangement is but a poor one at the best,—the worst one which could be offered, as it misleads people into the belief that at one point their buildings are non-combustible. But in practice, but a very low degree of heat in the room beneath the ceiling causes the plaster to crack, peel, and fall off in large flakes, leaving the laths exposed to the fire, and leading the flame to the hollow spaces beneath the floor, and these again to the hollow partitions or the skirting boards; and thus a series of vents for the fire is rapidly found, aiding quickly and greatly its intensity. The principle of the ordinary lath and plaster ceiling in making a fire-proof ceiling is retained, but the practical working of it out is materially altered. In place of thin laths, which are weak in their liability to split, substitute stiff furring pieces or strips of wood, cut out of half-inch or three-quarter stuff, to have a breadth of one and three-quarters or two inches. In place of being positively rectangular, if they can be cut so as to be narrower on one side than the other, so as to form a sort of dovetail, the work will be all the more secure. These pieces are to be firmly nailed to the under side of the joists or beams, running at right angles to the length of these, and at such distances that spaces of two inches are left between each piece. These pieces form a species of open platform, which is to support and to be embraced in the plaster or quick-setting mortar which forms the ceiling. This mortar is, however, not to be set in place in the ordinary way. The best plan is to have a platform of flat boards supported properly from below, and the surface of the boards to be at such a distance from the lower edge of the joists, that when the mortar is forced into the space thus

left, its thickness will be the exact depth required to form what is in reality the ceiling. A simple method will be by simply holding up a plasterer's board below the joists and strips while the mortar is being placed in position; or the board may be altogether dispensed with, and the mortar put in from above, giving the parts, as they protrude from between the strips and below them, a finish off with a trowel, so as to give or get as well as possible the necessary thickness of mortar below the strips. In this mode of working, a very quickly setting mortar will be required, to prevent its dropping away altogether from the strips before it sets. But this latter mode of working out the system we would not recommend, although pretty fair work may be done by holding the board below, while the quickly setting mortar is put in from above. But in neither of these modifications of the true system of working, first explained, will it be easy to get the proper thickness of material which forms the ceiling below the strips, so that extra material will have to be put on afterwards, plaster fashion. Now one great advantage obtained by working in the proper way is, that the complete ceiling of the right degree of thickness is obtained at one operation, and the solidity of the whole secured, which we have shown to be of such value. But even with the worst done work and with the simplest of appliances under this system, we will venture to promise that a floor and ceiling safer from fire to a degree not obtainable under the old, or rather the present system, will be the result.

The work should be commenced at one corner, so that, at the first, a part of the end and side wall will be got as a resisting surface. Afterwards the next length should be done in the direction of the length, so that one strip stretching along the whole apartment will be done first. The junction between the wall and the mortar of the ceiling should be most carefully made, and the surface of the wall at the line of junction should be chisel-roughed or 'tooled,' to afford a good 'key' to the mortar.

So much for the ceiling or under side of a floor. If all the chances of fire arising were to come from the apartment below, this fire-proof construction might end at the point we have reached, as, if the system described was properly

carried out, fire even of a fierce kind might rage below, yet not reach the timber joists above the ceiling, which, so far as we have gone, are left exposed and not covered in their upper by the mortar, which so firmly embraces and covers their lower sides. But where there is an apartment above in which materials of an inflammable kind are stored, and to which men with their habits so careless of fire have access, then it will be necessary to have a fire-proof floor as well.

If joists were placed near enough to each other so as to admit of the use of the ordinary-sized paving tiles, and if these were bedded with cement on the joists, and their edges brought carefully in contact, a floor to a large extent fire-proof would be obtained, reducing, as it is estimated, the risk of fire at least one-half. This species of floor would be still more efficient if the junction between the outer tile edges and the walls all round was made as tight as possible by the addition of a cement skirting or dado, the base of this reaching well in upon the surface of the floor tiles, and carried up some few inches above it. Flooring tiles would be vastly improved for fire-proof purposes if the edges were rebated all round, that is, with a species of groove at least half an inch broad. This would enable the tiles to lap into each other, and the joints could be made perfect with a thin mastic cement; or, if left in their ordinary condition, the joint would be so far perfect that materials from the surface or flame would not go immediately downwards, but would meet first a solid surface, and then have to travel horizontally the full breadth of the lap or rebate, which would then better be of three-fourths of an inch than half an inch, as named above.

But to make a floor as perfectly fire-proof as can be made without the use of incombustible materials throughout, we must resort to a modification of the system already described as available for ceilings. The same method, indeed, may be followed, only placing the strips of wood nailed to the upper side of the joists, and running at right angles to them, a little closer, so that the mortar when laid on shall not have too easy a tendency to fall through the spaces. The mortar when laid must be of greater consistency than when used for the ceiling, and it should be gently

forced through the spaces, so that but a small portion will be allowed to pass through. As the mortar is laid,—and an inch of thickness above the level of the joists will be sufficient,—the surface should be levelled as uniformly as possible; care being taken, when the work is at any part left off, that the finish be made at or near the centre of a joist, and the outer edge left as rough and jagged as possible, so as to form a good key to the next portion laid down when the work is resumed.

If a boarded floor be desired, narrow battens—if these are dove-tail shaped, placed narrow edge downwards, they will take a firmer hold of the mortar—are bedded in the mortar while soft, these running in a direction at right angles to the intended line of boards forming the floor, and which are nailed down to the battens when the mortar surface is finished. If a boarded floor be not desired, the floor surface is more carefully levelled and smoothed down, or it may be finished off with light tiles. Portland cement concrete or mortar will form an excellent floor. However finished on the surface, the greatest care must be taken to form the junction between the edges of the floor and the walls all round in the way already described. A floor thus made, and finished off as explained, will not only be fire but rat-proof,—the latter a point of great importance in farm buildings, as in the granaries, dairies, hen-houses, etc.

The other method of forming the bearing surface to support the mortar is to bridge the voids between the joists by short pieces of lath or pieces of waste or timber, or even branches of rough trees may be used. The ends of these rest upon narrow strips of wood nailed on the inner side of each joist, and at such a distance from their upper edges, that when the laths are put in place, resting at their ends upon the pieces of wood, the distance from the upper surface of the laths to the upper edge surface of the joists is about an inch. The laths thus laid form a species of floor upon which the mortar is laid, this being put in of such a depth that it will cover the joists to a depth of nearly an inch. The surface is finished in one or other of the ways already described.

By the system now described, the combustible

timber forming the floor, or rather supporting the floor and the ceiling, is completely covered with or embedded in a non-combustible material; and so completely fire-proof would a floor so constructed—if honestly constructed, not scamped in the execution—be found, that if the floor surface was formed of boards, the boards might be burned and yet the joists would remain untouched by the fire. But a building, although infinitely safer with fire-proof floors and ceilings,—for with these, other parts might be burnt, yet the building would remain nearly as good as ever,—still it could not be considered completely fire-proof if the staircases, partitions, and roofs were constructed in the usual way. A few notes, therefore, upon the adaptation of the system described above to those parts of a building will be of some service.

It has been said—and although the saying is exaggerated, there is much truth in it—that fire, as a rule, could be easily put out if breaking out in the lower apartments, were it not for the staircases, which act as ready conductors of fire from a low to a higher level of the building; and the same may be said of partitions, so far as the carrying of fire from one apartment to another on the same level, or on a higher level too, is concerned. Let us take up partitions first.

We are, of course, now considering timber partitions, generally specified as quartering partitions, not of brick, which are practically, *per se*, fire-proof. Timber partitions, being finished with lath and a thin coating of plaster on both sides, are hollow; and as soon, therefore, as fire causes the thin plaster to scale off, which it very rapidly does, the partition may be likened to a chimney or flue, by which the fierceness of the flames is stimulated, and rapidly conveyed to the rooms or roof above, and to the adjacent apartments. Now, by simply filling in the spaces between the sills and posts and braces of the partition with any kind of rough timber, so as to form a number of cells, no matter how unshapely or unlike to one another in form, and filling in these spaces with stone shivers or broken bricks still further to increase the number of cells, and thus form a species of honeycombed work partly of stone or brick, and chiefly of wood, a partition in great measure fire-proof will be obtained,—almost

absolutely fire-proof, if the small cells or honey-comb spaces be again filled up with a quick-setting mortar well pressed in towards the centre from either side, the whole being left rough on the surface to afford a key for the outer and superior plaster, if that be wished for, or smoothed over and made uniform if not. In place of filling in the spaces with broken bricks or stone shivers, pieces of coke may be used as already described; they will be much lighter, and although in one sense combustible, still, placed as they are, they may be considered as incombustible. In Paris, where plaster of Paris rubble is cheap and easily obtained, this is used for filling-in purposes; it is light and quite incombustible.

A modification of the above method is so obvious that it scarcely demands a detailed description as applicable to staircases,—the object being to imbed the timber as much as possible in the mortar, giving this a secure hold by spacing the timber strips nailed on to the under side of the carriages of the stairs in the manner already described. The wood steps of a staircase so constructed might be consumed, and yet the stairs remain intact as means of communication. Timber, to burn quickly, must have air supplied on all sides; it is, in fact, a very difficult thing to set fire to timber planks laid flat and kept so; and it is just in the fact that in the system now described the timber is so placed that little or no air can get to it, that its value as a fire-proof system mainly lies.

And the system is obviously as applicable to roofs as to the other parts of buildings we have already noticed, these being supplied with interior ceilings, so to call them, constructed in precisely the same way as the floor ceilings already described; the strips of wood being fixed to the under side of the rafters, and the mortar put in before the roofing slates or tiles are put on. Where roofs of one-storeyed buildings in farmeries are open, that is, with all the timbers exposed to view, the adoption of this system would be no difficult matter, even in roofs already constructed and finished with their slate and tile covering. Methods of carrying it out will readily suggest themselves to the intelligent reader.

The only parts of a building we have not yet considered are the doors and windows. The latter,

when burned, obviously open up ways of communication for fire spreading from one apartment to another. In farm and other buildings where appearances are not consulted, or in other places where safety is before appearance, the only door at once fire-proof and light, so as to be as easily moved as a wooden door, is one made of corrugated iron plates, or of Mallett's buckled iron plates. Light and absolutely fire-proof doors may be made of corrugated iron, hinged to T iron bars built in or secured to the jambs. By the use of light angle and T iron for the framing, and of ordinary sheet iron for the covering, we have constructed a fire-proof door nearly as light, and moving almost with as much ease, as a timber door. Where doors and sills are very wide, in place of having the sliding doors of timber, corrugated iron may be used with great advantage. Mallett's 'buckled plates,' which are very light and yet very strong, are used for doors. Making the floors of a granary in the way we have described, with the mortar and cement well worked up towards the walls, and finished off with a curve, and with the ceiling and roof also formed carefully, the apartment will be absolutely rat-proof—that is, proof against their attacks from the outside. But if the doors are formed in the usual way, the chances are that the rats will find their way in by gnawing the under part of the door. To prevent this, the lower slide of the door may be covered with sheet iron, which should be turned in under the lower edge, and up for a short distance on the inner side. To prevent rats from gaining access to lower apartments, the only sure preventative is to have a solid floor well worked up to the walls; and no better floor can be made on ground-floor levels than that formed of Portland cement concrete. The windows only remain to be considered, and as the fragile glass is the material we have in them principally to deal with, the only way of preventing them aiding the progress of a fire—which, when the glass is broken by the heat, they do very effectually—is by using the revolving iron shutters now being rapidly introduced into good houses.

The system we have now described, although new in this country, and certainly new to many of our readers, is not in another sense new. It has been for long carried out, and largely, on the

Continent, and is so still, although it is being rapidly superseded by a system in which iron is used in place of timber for the joisting and wooden strips; but as we wished to describe methods or a method applicable only to cases where home materials and easily-got labour were at hand, with a description of this new system we do not now concern ourselves. It remains, therefore, for us to finish our remarks on this important subject by adding a few words on the mortar which should be used for the system we have endeavoured to explain. This should be of the best quality, and to ensure this the materials must be good; the sand must be clean, free from all soil, etc., and sharp, and the lime should be fresh burned; 'stale' lime will not make good mortar. The fresh-burned lime should be slaked with only as much water as will give a dry, loose powder. This powder, however, contains hard particles known as the core of the lime, which, if mixed with mortar to be made from it, will tend greatly to reduce its tenacity. To get rid of these hard lumps, the lime powder obtained as above should be passed through a quarter-inch sieve. The sand should be in proportion two parts to one of the lime powder; these proportions give the hardest and most tenacious mortar. The sand and lime should be thoroughly mixed and well worked, as much of the value of the mortar depends upon this operation being well done. Mortar thus prepared will give most satisfactory results. If mortar is made properly, it will be found sufficient for the system we have described, but the addition of some hydraulic lime or Portland cement will make it set more quickly. On the Continent, where plaster of Paris is cheap and easily obtained, it is used largely for the purposes named in this paper; it has the great advantage of setting very quickly, but which may also be obtained in the case of ordinary mortar by the use of a cement as above named. An authority says a mortar capable of resisting fire may be made by mixing fresh-ground lime of chalk from the lower beds with pozzuolana. But as this may be difficult to be obtained, its place may be supplied by burning any marly clay that is fit for brick-making to a grey clinker, and reducing such clinker to a grain of the size

of coarse sand. The fresh-ground lime to the extent of one-fourth is to be mixed with three-fourths of this artificial pozzuolano, both very dry; and when well mixed, to be made into a paste with soft water.

As we write, we have observed in an American paper a description of a method of fire-proof construction used by the celebrated Hiram Powers. It is a modification of the method used for long in this country for forming flat roofs and terraces of tiles. The tiles are used in conjunction with brick arches, the bricks of which do not exceed $1\frac{1}{2}$ inches in thickness. They are like the ordinary bricks much used on the Continent for building purposes. The following is Mr. Powers' description of his house built on this principle:—'My house has no joists. All the floors are of tiles, resting on arches. One of these arches was made over a room 25 feet square by four men in four days. The bricks are about $1\frac{1}{2}$ inches thick, and laid edgewise with plaster of Paris. There was no framework prepared to lay them on, unless you would so term four bits of wood which a man could carry under his arm. And yet this arch is so strong as to be perfectly safe with a large dancing party on it. It would pay, I think, to send out here for an Italian brick-mason, who knows how to build these thin but strong arches for dwelling-houses. I know there is a prejudice against brick or composition floors. "Too cold in winter," it is said. And so they are if bare; but cover them with several thicknesses of paper, and then carpet them, and no one can discover the slightest difference between their temperature and that of wood floors. (We may observe that the paper saves the carpets considerably.) I do not insure my house, as I know that it is not combustible.' Mr. Powers draws attention to the fact that the great point in getting a house fire-proof is to prevent draughts, a point we have in this chapter insisted upon, and he enforces this by the same illustration we have adopted, the difficulty of setting a flat board on fire: 'A floor will not burn without a supply of air under it. Throw a dry board upon a perfectly flat pavement, and kindle it as it lies, if you can.'

DIVISION SECOND.

ROADS—FENCES—GATES—OUTLYING STRUCTURES AND WORKS OF THE FARM—BRIDGES—DRAINAGE
AND IRRIGATION WORKS—EMBANKMENTS—MARGIN AND RIVER BANK IMPROVEMENTS.

CHAPTER I.


FARM ROADS, THEIR CONSTRUCTION AND REPAIR—BRIDGES.

FARM roads, being those which come under the denomination of 'accommodation,' serving only for the purpose of communicating from one part of the farm to another, and connected only at certain points with public roads, or those under the supervision of the parochial or township authorities, do not require to be of the same high class as regards construction as those just named. Still, it is obvious that the more perfectly they are made at first, the longer they will last without requiring any repairs, and the traffic will be conducted with the least expenditure of horse power. We regret to say that this last consideration is one in a great many instances lost sight of, although it tells very materially on the general expenditure of the farm, few of its items so rapidly amounting to such considerable sums as this. The economical construction of a farm road depends upon several points, as the laying of it out so as to secure the easiest level, the avoidance of sharp curves, and the securing of a soil the best calculated to give a good foundation. These are, however, not always, indeed not generally, easy to obtain, especially in the case of farms the fields of which are already laid out,—these, of course, dictating the position and direction of the roads. In the case, however, of a property which is either to be remodelled in all its departments, or set out *de novo*, more numerous opportunities will be offered to take advantage of the best circumstances. What these are, are involved in what we have already said; and to others less obvious, but not less important, we shall presently direct the reader's attention. In doing this, space will compel us to

be very brief, for the points connected with the subject are so numerous, and these involving so many considerations of practical importance, that a treatise could well be written upon it before it would be exhausted. Fortunately, as we have already hinted at, the subject, so far as the necessities of the present work are concerned, will not suffer by this compression, the work to be done coming under what may be called the simplest class of road construction.

Supposing the roads of the farm to be laid out *de novo*, where changes in their direction are to be made, it is obvious that the best form for the deviation will be that of a curve of as large radius as possible. But as the roads are decided as regards their direction by the fields, and as, from what we have said in the chapter on the laying out of fields and roads, this general rule will have in many cases to be considerably modified, the curves often assume a less decided form, taking often very nearly that of a right angle with a corner, but less or more sparingly rounded off; but the designer will have to be guided by circumstances. Some do not object to fields with rounded corners, although the general rule is to have them rectangular; but where the field is bounded externally by a ditch, this form may still be adhered to, and a comparatively easy curve of road obtained by rounding off the outer line of the ditch. Rules and diagrams, more or less elaborate, might be given to show the best form of curves; but for farm work generally the eye of the designer will be able to mark out those which will be sufficiently convenient, the line chosen being marked out by

stakes driven into the ground to guide the workmen. In the setting out of roads, their breadth is the next point to be considered. Some prefer to have them uniform throughout the estate; but there are circumstances which modify this rule, some parts of the farm obviously having less traffic, or necessity for much carting being done, and there is no use in throwing away land which remains for a large part of the year unused, taking it from fields which are at all times valuable. Roads, for example, leading to upland pasture fields may be made narrower than those leading to fields under arable culture, where much carting to and fro of manure and produce is carried on. Some may be made merely sufficient to admit of the easy passage of a loaded single cart, the points at which fields are entered, or other parts, being without much trouble so set out as to afford room for the passing of vehicles going in opposite directions; while others will require to be wide enough for two carts. It is scarcely necessary to say that the cart width should be calculated from the largest overhanging load which it may have to carry; for example, straw or hay. The width of what may be called the main road of the farm, that is, the one leading to the farm-house and offices from the nearest road or highway, will have to be obviously the greatest, and be provided with at least one footpath. And in some instances a saddle-horse road or 'bridle-path' may be found a convenience. It is a disputed point whether farm roads of any kind leading to the interior parts should have any footpaths at all; but on those connected with the fields on which there is the greatest amount of personal labour done, a footpath, however narrow, will clearly add to the comfort of the workpeople going to and fro. In rearranging fields and their adjacent roads, a good deal of road-space will be saved and field-space gained by rearranging the ditches, which generally border both sides. The drawing, fig. 7, Plate 34, will show one method of doing this. The inclination of the road is a matter of considerable importance. Numerous experiments have been made to show the influence of this upon the draught; possibly Sir John McNeill's are the most complete and conclusive. From these we may state that it has been shown that a saving of no less

than one-fifth is effected by having a road with a gradient of 1 in 40, as compared with one having a gradient of 1 in 20. And Mr. Bailey Denton, putting this into figures or money value, and showing that the difference in these two gradients amounts over a certain given distance to 2d. a ton, it needs scarcely be said that it is of some importance for the designer of farm roads to pay attention to this point. Of course, in farms already laid out, especially in old ones, where considerations of this kind were not much thought of, many instances will be found where it is not easy to have anything like a level road. Still, where the farm is being remodelled, a judicious rearrangement of the fields will allow of that of the roads, so as to do away with heavy gradients. The plan above alluded to is simply having an underground tubular drain, , in place of the open drain, fig. 6. We shall hereafter return to the subject of open drains at roadsides; meanwhile we proceed to point out other features connected with the road surface. The first obvious point is the shape or transverse section of this. Engineers are divided into two classes, one of which advocates the convex, the other the flat form. Theoretically, the flat form is the only one in which the most economical draught can be secured, as all the wheels sustain on such a surface an equal portion of the load; and the road surface is maintained longer in good repair, as there is no unequal pressure. But while the level road is the most theoretically correct, that which gives a convex form to the surface is advocated by perhaps the majority of engineers, on account of the facilities it affords for the getting rid of the surface water. Much, however, of this arises from the defective construction of the road itself, as well as from the careless way in which roads are allowed to get into bad repair, so that ruts and channels are formed, in which water collects and remains. A level road, properly constructed, remains for a long time in repair, and does not admit nearly so readily of the formation of ruts as one ill constructed or of a convex form. And just as we have shown that a steep road involves loss of money, it could be as easily demonstrated that a convex road is also the cause of loss. However, the practical circumstances attendant upon

roads as they are and kept—or, perhaps, to put it more truly, not kept—in repair, make the convex form the best which can be adopted under general circumstances. At the same time, however, it must not be overlooked that much more is made of the advantages of convexity than is properly due to it, because it is assumed that the wet to be shed from its surface by reason of it, is assumed to be pure water, or at least in a state of great fluidity; whereas every one knows that it is almost universally in the form of mud, of more or less viscosity, which requires special means to be taken to be got rid of, excepting in the case of heavy rains, which act as natural scavengers. Where, therefore, the convex cross-section is adopted, it should be kept down to the minimum; and, in fact, an inclined surface, such as the line *i l*, fig. 7, Plate 30, will be better than a decided convex surface, such as is shown in fig. 6. The maximum rise at the crown or centre of the road should not, for a width of 18 feet of road, exceed $3\frac{1}{2}$ inches. It should never be forgotten that the invariable tendency of all high-crowned roads is to cause the horses and vehicles to keep to the highest point, which is done almost intuitively as a mechanical necessity, to keep moving always in the same line, thus forming the deep ruts or channels with which every one is but too familiar, and which act simply as receptacles for the storing up of rain-water, which, independently of other damage, soaks into and injures the road surface. By having the subsoil, so to say, of every road thoroughly drained, nearly all of the evils attendant upon roads generally would be avoided, and the question of convexity of cross-section would require seldom to be discussed. If, also, roads were properly used and kept in repair, to which point reference will be found further on, there would be few of the annoyances and difficulties in wet surfaces so frequently complained of.

The drainage of roads is generally considered sufficiently attended to if side ditches be provided, fig. 1, Plate 34. But these, in place of providing for the dryness, add, as a rule, to the wetness of the subsoil of the road. Formed with little regard to its surface, the water, which chiefly drains from the adjoining fields,—the ditches, in fact, forming the outfall for this,—often stands at a level

actually higher than that of the road. In view of the defects, then, of the open ditch, certain modifications have of late been proposed; one of these is shown in fig. 2, Plate 34, in which the open ditch is done away with altogether, and a deep or narrow trench, as *e*, substituted, this being filled with broken stones and provided at the bottom with a tubular drain, *a*. These stones prevent the silt or mud from passing into the drain, *a*; but where the traffic is considerable, as on the road leading from the main or parish road to the farm offices, a more complete and perfect system may be adopted, as shown in the same drawing. This consists of a small open drain, running along the outer edge of the footpath, *f*, provided at intervals with gully traps, *d* (the trap *d* in fig. 2 is shown in larger scale at fig. 4), which arrest and retain the road mud, the water passing away as it rises by the cross drains, *e*, communicating with the lateral drain, *b*. There is, however, in this form of gully trap such a tendency for the silt or mud to be carried over into the drain, *b*, which silt has a remarkable tendency to set or concrete, and thus to fill the drain, *b*, where the highest form of efficiency is desiderated, a gully trap as in fig. 4*a* may be used. The larger receptacle or cesspool is that which arrests the silt or mud, from which it can be removed from time to time by lifting off the cast-iron grid at the road surface; and should any silt, as in times of flood, be carried over from the larger cesspool, it is passed into and arrested by the smaller cesspool, shown to the left of the drawing, so that there is little chance of any being carried into the drain, *b*, fig. 2. Another method of dealing with side ditches is shown in fig. 5, Plate 30, where, in place of filling up the ditches and treating them in the more expensive forms as just described, they are left open, as in the figure, but a tubular drain is placed along the bottom. This plan is possessed of many advantages. Thus, at certain seasons, these ditches are simply what may be called open cesspools, with small and sluggish streams struggling along their bottom, while their sides are so hardened and baked that their action, as drainage surfaces for adjoining fields, is nearly wholly stopped. But by having the tubular drain as shown some distance below the bed of the ditch, which, at the time of the laying of the drain,

should be levelled and re-formed with clay and gravel, the water in dry seasons is carried by the tube as in the upper diagram, while in time of flood the tube and ditch are as shown in the lower. By giving a proper fall to the drain-tube, and, of course, providing at the proper intervals the junctions not only with the side drains of the road, but with the outfall drains of the adjoining fields, the water is carried in ordinary periods so quickly away, that the ditch, in place of being, as in ordinary circumstances, a receptacle for all kinds of muddy and decaying refuse, is so dry and clean that it may, for the matter of that, be used for a sheltered footpath. The agricultural advantages of this method of arranging the roadside ditches should not be lost sight of; indeed, as an eminent authority points out, the tubular drain-tubes would of themselves act in the way of draining adjoining fields, especially if these were of small area, as in suburban small farms. In a free soil they might drain land inwards to the extent nearly of a chain, although in stiff soils the maximum might not exceed eighteen feet. He gives it, moreover, as his decided opinion, that the ditch, *filled up* after being provided with a tubular drain, will drain a much greater breadth of land than when open; indeed, calculations show that a mile of tubular drains, one on each side of the road, would drain fifteen to twenty acres of adjacent land. The drainage power of the ditch is always more or less injuriously affected by the vegetation which gradually covers its sides, forming very frequently a very thick covering. Nor, when the ditch is filled up, should the value of the extra land obtained be overlooked, it being calculated that the surface of land taken up by ditches on both sides of the road for a mile in length is equivalent to three-quarters of an acre. The gain of cultivable land is therefore considerable, and it is more especially the case in marsh land districts, where the open ditches are not only more numerous, but wider. Thus it has been calculated that, by covering in the ditches in such districts, an acre of land for every twenty-five of water surface could be obtained for grazing purposes. The sanitary advantages are abundantly obvious. These remarks, of course, apply to roads made on the old plan; but in constructing others *de novo*, special drains will

have to be made, in order to have the whole soil of the road as dry as possible, a *sine quâ non* in effective road-making, the best more especially, as may be supposed, in the case of close, retentive soils. Mr. Bailey Denton, the author of a very able paper on 'Farm Roads on Strong Soils,' in the *Journal of the Royal Agricultural Society*, gives a diagram and description of the best method of draining them. We give in fig. 6, Plate 34, a modification of Mr. Denton's plan. In this the road surface is convex, bounded on either side by open ditches, as *e f*, the width, *c d*, of which is thirty inches, and the depth, *e f*, eighteen. These ditches may be bounded towards the field either with an open fence on the flat or a quick-set fence formed in the usual way. As it is a great object to have the surface of the road kept as dry as possible, open fences admitting light and air are better than those which tend to exclude them; and it is one of the advantages of the method of under drains we have described and illustrated at *o* in fig. 7 and in fig. 5, that it gets rid of the huge mounds which bound the side of old ditches, as in fig. 1. In the plan recommended by Mr. Denton, and illustrated in fig. 6, Plate 34, the metalling of the road is limited to a width of nine feet, as from *a* to *b*, which is one-half of the width. This is bounded on either side by the drains, *j*, the depth of which from *g* to *h* is four feet, a 2-inch drain-tube being placed at the bottom of the drain trench. The depth of the layer of metalling is nine inches, and is uniform throughout the whole breadth of the metalled surface; the side parts from *l* to *m* are made up of the soil taken from the side ditches, *e f*. The full width of the road is eighteen feet, or nine feet from centre line, *a*, to side line, *c m*. At every point in the length of road where there is a hollow, or where it is broken by any means, culverts or drains should be placed, the depth of these being such with relation to the side ditches, *e f*, that the crown or upper part of the cross culvert should be no higher than the under side of the lateral or longitudinal drains, *k*. The diameter of the cross culverts, which will be best made of tubular or egg-shaped drain-tubes, is recommended to be eighteen inches. Where roads are remodelled to suit this system, and the existing ditches, as *e f*, are too shallow to suit the level of cross culverts and lateral drains, they must be

deepened. The ends or junctions of the cross culverts should be provided with flaps or iron grating, to prevent the entrance of vermin. The metalling should be of as uniform size as possible; a good dimension for the stone will be that which will pass through a 2-inch ring. Great care should be taken to have the metalling laid uniformly, and greater efficiency will be secured if it be put down in successive layers, say of three inches deep. A great point in the construction of the road on this system is the foundation on which the metalling is placed. This may be a very non-absorbent and very hard material, more or less easily obtained, dimensions not being of such importance as the getting of a thoroughly compact, evenly laying, and well-bounded stratum, with the upper surface as regular as possible to receive the metalling. The best material with which to finish off the upper surface of the metalling is well-sifted gravel of as uniform a size as can be obtained. This should be laid on very uniformly. A disputed point in the construction of roads is whether the road surface should be firm or yielding. Some of our best road engineers maintain that an elastic road lasts longer than an unyielding one; one would certainly be inclined to consider a firm road to be the best of the two, but in some cases the road-maker will have little choice, as the soil will be naturally of a very yielding character. Where this is excessive, as in marshy or boggy land, the difficulties of the undertaking will be greatly increased, and in some instances professional advice will have to be called in, in order to overcome the difficulties in the best and most economical way. In some cases, however, this may be dispensed with, and a very firm and lasting foundation may be formed by means of faggots or fascines, these being placed on the boggy surface and allowed to settle gradually, and successive layers placed, if necessary, one upon another, until a settlement is secured, when the top materials may be placed upon the top layer. In the formation of such foundations the great point is to secure a regularly-formed series of layers, any attempt to make the foundation quickly will be sure to be a failure, it being essential that ample time be allowed for the fascines to settle down on a steady bed. These should not be placed in successive layers parallel

to one another, but each layer should cross the preceding one at right angles. The same care should be taken in the formation of the upper beds of stones, etc., these not being placed *in situ*, but, as in the case of the fascines, they should be placed in thin layers, and with as long intervals between the times of deposition as possible. The great object, in point of fact, in such cases is to overcome the tendency of the swampy, boggy material, of which the roadway consists, to suck in as it were the road material it is designed to bear; and this can only be done effectually by the process already described, always bearing in mind this other important principle, namely, giving as broad a bearing surface to the foundation on which the materials are to rest as possible. These materials should also be bonded together as carefully as possible, and those of a broad surface and comparatively thin will be found better to use than large, heavy, and irregularly formed ones. Perhaps the most difficult soil to deal with on which to form a roadway is that in which quicksands are met with. If these are of limited area, after the soil has been thoroughly drained, the best way to deal with them will be to fill them up with concrete, formed of blue lias lime and gravel, one part of the lime to four of the gravel. Where gravel cannot be obtained, a very good substitute will be found in nodules of burnt clay, which, by the way, may here be named as also forming a good substitute for the ordinary metalling. In all cases of unstable soils, as marshy or boggy, it is scarcely necessary to say that thorough drainage is an essential requisite, and must be carried out as efficiently as possible before any attempt is made to form the road. In the case of boggy soils this drainage is done much in the same way as in their reclamation, as to which the reader is referred to the chapter on the 'Reclaiming of Waste Lands;' the drainage must be done for some considerable time before, in order to allow the central part to get as dry and consolidated as possible. The drains, which are made on each side of the intended site of road, should be cut deeply, and communicate at points with their leading watercourses or main drains; where the soil is very much saturated with water, it will be as well to carry at intervals cross drains at right angles to the intended line of road, these com-

municating with the side drains. These should be of small dimensions, and they will form ultimately useful means of binding the road materials with the natural soil when once it is dried and consolidated. An excellent material for forming the pitching or lower stratum of road foundation is stated to be blocks of dried peat; these must be thoroughly deprived of moisture as far as possible, and be laid with the same care as already recommended with other forms of pitching, so that they may bond well together to form an even surface. The size of the pieces forming the separate layers should be gradually decreased as the line of intended surface is approached. In forming roads above the level of the surrounding land, necessitating the construction of embankments, the work assumes elements of considerable difficulty, in some cases necessitating the employment of professional advice, and in all the exercise of the greatest care, especially at points where watercourses are to be crossed, and where the soil is of an unequal and yielding character. The work in many of its features resembles that required in the construction of embankments at sea margins in the reclamation of land, so that the reader is referred to the chapter on that subject for information as to special details. Where, on the contrary, roads are carried through cuttings, the work may in its general features be one of very simple character, or, as in the case of embankments, may involve such difficulties as may make it the most economical plan to call in professional advice.

The formation of roads in some districts is rendered one of considerable expense, from the difficulty in obtaining the proper materials for the formation of the upper surface. Where, however, stones can be had in abundance, very excellent roads may be formed on the principle adopted by Telford, the celebrated engineer, remarkable for his success in road-making, referred to by Mr. Denton in the paper we have already quoted from, and illustrated in fig. 9, Plate 34.

In this the upper surface rests upon blocks of stones, as *a*, which should be quarried and tooled expressly for the purpose, care being taken to have the stones well bonded, and the upper metalling laid with great care, so that the interstices between the blocks be carefully filled up. For this

purpose, grouting of lime will be found very useful, or a thin concrete of some hydraulic lime and fine gravel. A modification of the new method of paving streets adopted with so much success in Liverpool, under the plans of Mr. Deacon, the surveyor, might be applied in districts where granite or greenstone 'setts' can be had easily. A concrete bed six inches in depth is first laid, on which is placed a little sand; the 'setts,' about three inches wide, are then driven home into the concrete, and grouted with small stones. The whole is then run over with a composition of pitch, tar, and oil. A roadway thus formed possesses all the durability of granite, with the elasticity of wood. It might be used for the roads near the steading leading to the main road. Although comparatively expensive where the ground is of an unstable character, the traffic heavy, or the extent is short, an excellent and, indeed, taking all circumstances into account, by far the best material for road-making is Portland cement concrete. One great advantage it possesses is, that it is so easily used that any common labourer can be employed to put it down; while it sets uniformly and quickly, and the surface is one not only absolutely impervious to water, but for hardness and capability of resisting wear and tear it can only be compared to a large block of solid stone, without crack, crevice, or defect throughout its surface; and, indeed, it may be said to excel even the best quality of stone ordinarily met with. A full description of this material will be found in the chapter on 'Constructive Details,' but an illustration of it will be found in fig. 8, Plate 34. The main feature is a bottoming of stone or road metal, *a a*, some 4, 6, or 8 inches thick, according to circumstances of the soil, resting upon the ordinary ground or soil, *b*, with a layer, *c*, above the metalling of the concrete, for the ingredients and proportions of which see the chapter just referred to. Where bricks are made on the property, they may be used in the formation of excellent roads, as in the manner described in a succeeding paragraph. In concluding our remarks on the construction of roads, which, considering the importance of the subject, have been all too brief, a word or two on the materials used in constructing their upper surfaces may be of some practical service.

The locality will, as a rule, decide which should be used, for it comes to be a very expensive matter when these have to be imported, so to say, from districts more or less distant from the property; but even in cases where the best are not obtainable in the neighbourhood, the exercise of a little care in looking out will often result in the production of one or other kind of material which will be found in the main very serviceable; for in cases where roads are constructed on Telford's principle of an underlaying of pitching, as at *a* in fig. 7, Plate 34, it will be a very singular case where stones of quality good enough cannot be obtained. Even sandstones almost of the softest description may be used for the pitching, if the recommendations which we have given be followed; and although whinstone or greenstone, as it is otherwise called, forms, of course, the best material for the finishing surface or metalling, in cases where it cannot be obtained on the property, others may be found which will prove serviceable and lasting. Granite and flints will form excellent substitutes for this, and even smithy clinkers and hard cinders will, for lack of better materials, form, when judiciously used, by no means contemptible surfaces. Even the broken pieces of bricks, granting, of course, that these are of a good quality, will also be available. Whatever be the material used, the great point to aim at is to get it if possible of such a character that all the lines of fracture of the pieces are as sharp and angular as possible, so that they will cohere and bind or bond together; round-shaped pieces, no matter how hard and non-absorbent they be, are the very worst to use, as they do not bond, but roll upon one another, and always form a surface more or less loose. If in the neighbourhood of ironworks, and where a stone-breaking machine is available, the furnace slag in larger pieces forms an excellent material for pitching, while the smaller are no less valuable for the metalling. Even should no other materials than gravel be obtainable, this, in the form of concrete, made as already described, will be found capable of forming good and efficient roads if judiciously used. It is, in fact, in the way in which peculiar local and other difficulties are met and provided for, that the ability of the manager of landed property is perhaps best displayed, it being easy, or com-

paratively so, to do work when all the materials and appliances required for it are at hand. A very good example of the way in which exceptional circumstances may be taken advantage of is exemplified in the road formed of bricks on one of the estates of Major Stapleton of Myton Hall, under the direction of Mr. D. Livingston, C.E., under the inspection of Mr. Calder, the agent of the estate. The exceptional circumstances were a scarcity of stone to form a road metal, and where stone had to be imported from such a distance that it cost 10s. the ton; but common building bricks were very abundant, so that it was decided to form the road of brick. The plan adopted is shown in part of the diagram in fig. 8, Plate 35, to the right-hand side of the line *a b*. The line of road passing through undrained fields, it was necessary to dry the road base. This was done by putting in side drains of 3 and 4-inch pipes, and of an average depth of 3 feet 9 inches. One of these is shown at *c* in fig. 8. The ground was then excavated and embanked at points where required, the slope of the embankments being $1\frac{1}{2}$ to 1, and the surface of the road was curved, as shown from *d* to *e*. The base was thoroughly consolidated by passing a very heavy roller to and fro several times over it. On the base thus rendered firm, the bricks were placed on edge all over the surface, as shown at *f*, the outer line, or the last or outer row, butting on a single row of bricks on end, as at *g*, these being placed at an angle, as shown, in order to afford a good resisting point. On the top of all, screenings were placed to the depth of one inch, and the whole was then rolled with a heavy roller several times before being opened for traffic. In the same drawing, fig. 8, we show other methods of forming this brick road. Thus, to the right-hand side the road is adapted to a position where a side ditch, *h*, is in existence, with a bank topped with a fence, *i*, the side-walk being at *j*. On the left-hand side of the drawing, an open drain, *k*, receives the surface water of the road, *d k*, this being nearly level, but rather if anything sloping to the point *k* from the centre of road, the side part being bounded by a wood or wire fence, *l*.

There are various methods of forming road surfaces of materials other than those commonly in use; one which is being rapidly introduced

is Portland cement concrete, this resting on a bottoming of ordinary road metal. The French have long been famous for their system of road-making, both in the case of the use of ordinary materials as well as in that of new ones, such as asphalt, in the employment of which material they have succeeded in forming roads of a character vastly superior to any introduced into this country by our own road-makers. Allusion will be made to this further on, but we meanwhile here describe a method of forming ordinary roads which experience has proved to possess so many excellent qualities, that we do our readers a great service by describing it. We may state that it has been subjected to the severest tests, to long-continued practice, and is used throughout France, not only in metropolitan but in rural districts. Before laying down the new material, they loosen the old surface with a pick; then they lay stones much of the same size as those we use in Macadamized roads, and scatter a small quantity of sand over them; next they water them—this part of the process would be seldom required in our climate; then they roll them with a roller of about 4 feet diameter by 4 feet in breadth, and $2\frac{1}{2}$ tons weight, drawn by horses or oxen, according to circumstances. Having passed over the whole surface with this, they re-roll it several times, gradually increasing the load on the roller to 5 tons. The roller is so constructed that it can be drawn backwards and forwards without turning, by changing the team. The effect of this is, that the surface is completely consolidated and brought to its proper form at once, having no hollows to retain water and make puddles, and so hard that a heavy omnibus passes over it smoothly and without disturbing the material. This effects a great economy in the wear and tear of vehicles, and pain and injury to horses, and no loose stones are left about the road. The French occasionally re-roll the consolidated road to keep down inequalities, and they do the same with the foot-paths where made of gravel, so that they can be walked upon comfortably at once. This would be an inexpensive way of improving our suburban footpaths, which are so often complained of by ourselves and strangers. The saving by this system results from the decreased quantity of

material consumed, for the expense of the labour is more than double. It has been stated on good authority, with reference to a particular portion of the road in France, that by the old system the cost per annum for maintaining the road used to be about £1000, while on the new it is reduced to about £600. In the formation of side-walks and of comparatively short lengths, and of surfaces such as are often required in farm buildings, etc., there are sundry materials which may be used economically and effectively, and in such an easy way as to make the work come within the ability of ordinary labourers. We have already alluded to Portland cement concrete; we now show a method of using coal tar, which, if the farm, etc. be near a town, can be got frequently at a very trifling cost. In the formation of side-walks, the first thing to be done is to prepare a suitable quantity of sand, by screening it free from stones; mixing thoroughly with the tar in the same manner as when mixing mortar, using as much sand as can be worked into the tar, which will then be in a proper condition to spread easily. Dig a trench of the desired width 6 to 8 inches deep, and fill evenly with stones to within 2 inches of the level of the ground; then fill all interstices with coarse gravel, forming a moderately smooth foundation, over which pour sufficient tar to fill up any spaces. The object is to cement the gravel. After this, cover with the tarred sand to a depth of about $1\frac{1}{2}$ inches, and smooth to the required shape with the edge of a board. This must be rolled quite firmly, and a clean surface produced by sprinkling over dry sand, and rolling until the tar ceases to come to the surface. It may be occasionally sanded until the surface attains a permanently grey colour. The odour of the tar will gradually disappear, and after the first season will be scarcely perceptible. Private roads may be made in the same manner, by digging some 3 inches deeper, and using first a layer of large stones, and afterwards smaller stones, and then gravel, tarred, topped with tarred gravel, rolled and sanded as described. This plan may also be adopted for stable floors and cellar bottoms, but for such purposes is greatly improved by adding about one part of roofing pitch to two parts of tar, which are heated together until thoroughly blended, and

applied hot. The sand and gravel which are used with it should also be heated, or they will cool down the mixture of pitch and tar so as to render it very hard to work—in fact, impossible to be worked thoroughly. Well made, these are most admirable floors, and almost entirely unsurpassed for walks and private roads.

A very important department of farm roads is that connected with plantations, when these form part of the property. We have already stated in the preceding part of this section, that the general roads of the farm need not be of uniform width, but that those leading to outlying parts, such as plantations, may be made narrower than those on which the traffic is greater. This, however, does not presuppose that the narrow roads should be less carefully constructed; indeed, in those leading to and from plantations, as the weights are more or less heavy, they require to be made with great care. But the traffic to and in plantations being of different kinds, the roads themselves come under different categories, some being used for heavy, others for light traffic. The roads leading to the plantations, although they may be, as we have recommended, narrow, must be made to bear heavy loads, as the roads converge from various parts of the plantations to them. To suit the requirement of meeting vehicles, certain points on the line of road may be widened out, the most convenient for these being at the entrances of pasture or other fields. Although plantation roads are too much neglected, both as regards their laying out in proper directions and in construction, it is not easy to overestimate their importance to the proprietor. Because some are used, indeed it may be said the majority of them, only at intervals of greater or less extent, some proprietors seem to think that they can in a great measure be dispensed with, or if not wholly so, still such as are made are few in number, and of the worst class as regards laying out and construction. But a very little consideration will show that the plantation roads are just as essential as those on any other part of the farm. It should be borne in mind, that one of the most important elements in the valuation of the timber is the expense involved in its transportation from the place of its growth to where it is sold. This element is of far greater importance than

many are disposed to think, and often forms the point on which the question turns as to whether home-grown timber yields the highest possible profit, or merely that which pays little more than current expenses. It is a well-known fact, that timber purchasers look very sharply after the means by which they can get the produce transported from the plantation to the depot where it is prepared and sold; as well they may, seeing that the difference between good and bad roads makes that which will either yield a profit of as much as 20 or 30 per cent., or a loss to the same amount. The offers of timber merchants are not defined merely by their estimate of the value of the timber itself as it stands in the plantations, but is guided greatly by their survey of the way in which that can be transported. And this survey not merely takes cognizance of the number and directions of the roads provided, but, whatever some proprietors may think to the contrary, of the condition in which these roads are; for it makes a mighty difference in the ultimate profit if a road is so bad that the loads on an average take one-fourth or one-fifth more horse-power than they would if they were properly constructed. More need not be said on this point; although, in view of the actual condition of plantation roads on too many properties, what has been said was necessary, and more could have been done so with some practical suggestiveness.

Plantation roads, from what we have said, will be seen to divide themselves naturally into two great classes: first, those which may be said to be mere bridle-paths, which lead up or converge to the second class, on which the heavy traffic is conducted; the first class being used almost wholly for the purpose of dragging single trees to the main road at certain points, where the heavy loads are made up and transported from the farm. In laying out new plantations, the line of road should be carefully considered; but on this point we have already given remarks under the special chapter on plantations, to which we beg to refer the reader. Whatever is done should be done with special reference not only to the general features of the locality, but also to the particular way in which the plantation is laid out, with the classes of

trees of which it is composed. The direction and number of roads should always form part of the plan of the plantation, and not be left till after the trees have obtained a large development. Leaving, then, the reader to refer to the chapter on plantations, which will be found under its special head, we proceed to give a few details as regards construction. The contour or general level of the roads will depend very much on the nature of the ground; but, as a rule, it will be better to choose lines at which there will be a fall both transversely and longitudinally, as the water will shed more easily from off the surface than when they are on a dead level, or approaching thereto; and from what we have said in the preceding paragraphs of this section as to keeping roads dry, it should be understood that this principle applies just as forcibly in the case of plantation roads as those of a general kind. One advantage arising from having the roads off the level will be, that this dryness will be greatly secured with the natural drainage of the land. Of course, it need scarcely be said that this principle of having roads off the level, in both senses of their section, will have to be modified according to circumstances; thus, those having the heaviest traffic should be as level as possible in the direction of their length, the reader remembering what we have said in a preceding sentence as to the great loss of horse power arising from having heavy gradients; and it is just one of the advantages of laying out the roads in the first instance, that the best direction for the road can be obtained. As regards the formation of the surfaces, the class of the road will naturally modify the materials employed, and the way in which these are to be laid down. Thus, the subsidiary ones, or those which are simply used for dragging along the trees which are cut at various points of the plantation to the main roads, will require, as a rule, to be a little more than the mere natural surface, whether that be natural sand, gravel, or other material, more or less consolidated. Of some of these, perhaps the best will be the natural and close-grained grass, so to say, along which the trees may be dragged with great ease; and where these subsidiary roads get larger in consequence of the heavier loads to be transported,

and wheeled carriages have to be used, as the interval between one period of use and another is as a rule very considerable, all ruts which may be formed will be thoroughly filled up and eradicated by the natural growth of the sward. The worst surface to deal with is that which is of a very unequal and yielding character; and in such cases it may be necessary to provide special means for making the surface hard and firm. In many cases, what of itself would form a good road surface is found to be a bad one, chiefly through the excess of water, which may be carried down from the higher grounds, and, stagnating there, ultimately bringing the soil into what may be called the worst condition. Under such circumstances, the first thing to be done is to drain the line of roadway. The drains may be open, and one at each side of the road. Again, this will, however, have to be modified by circumstances; for if the drain on the upper side be placed close under an earth bank, it will be soon filled up by the silt carried down therefrom. A close or a stone-filled drain may therefore there be substituted; or, what may perhaps be better, the drain may be made only at the lower side. But a drain at the foot of the embankment, of such size only as will suffice to carry off surface water, should be made there. The *face* of the embankments should be provided with open diagonal drains, leading into the surface-water drain at foot; this precaution will tend materially to keep the road dry. The width of the best class of plantation roads will vary according to circumstances of locality, but the maximum width may be put down at 14 feet, although 12 may for average circumstances be quite enough. Positions for meeting and turning points, by a little care and observation, will be easily secured. The pitching and metalling of those which have to take the heaviest traffic will be done in the same way as already described in preceding sentences of this chapter.

Keeping up in Good Repair of Farm Roads.— There is scarcely, if indeed there be any of the departments of the work of the farm which occupy a more important position than this. A proprietor or farmer may erect buildings or lay down extensive lengths of road and fencing, without concerning himself much as to the con-

siderable cost which they involve. But when asked to pay for repairs when these are requisite, he will begin, as a rule, to grumble at the cost they involve, and to express doubts as to whether they are really wanted, or, if apparently wanted, to venture an opinion that their execution might be delayed for another season at least, without involving much loss. Such may be taken as the way in which the question of repairs is too often treated, and that it leads to grave and serious losses in the end it is not difficult to understand. Repairs, in place of being looked upon in this way as merely indifferent matters, are in truth in the category of those which, if not in the rank of first, are certainly in those of secondary importance. We do not require to call to memory the wise saws and sayings, or the pithy proverbs of our forefathers, to tell us what ought to be the proper course to be followed in this matter. Common sense, to say nothing of the teaching of business prudence, lets us know, in language most unmistakeable in its purport, that if a repair which at first sight appears to be of the most trifling nature in its character and the work it requires, is neglected, it may be the means of bringing about such an extension of mischief, that to set it right will demand many pounds, where a few would at the first have sufficed. Of all the departments of farm work, there is perhaps none to which the lesson of the proverb, 'A stitch in time saves nine,' is more applicable than that of roads, especially those of the farm. For it should be always borne in mind, that the cause of the surfaces so rapidly wearing down into irregularities of all kinds, does not arise from one influence at work, but from several, and one so acting upon the other, that when once set in operation, they tell with an increased and always increasing force as destructive agencies. Although farm roads have not frequent or much traffic, still that traffic is very heavy. It is not, however, the mere weight of the loads which are hauled over its surface which rapidly deteriorates the surface, but the very smallness of the traffic, or rather the few conveyances which pass over it, brings about an evil which greatly helps the destruction of the road; and this is, that the carters, having a choice as full and complete as can well be of those parts of the road best suited for easiest driving, pre-

fer naturally the centre or highest part. The result of this is, that two lines of ruts become rapidly formed, and they become larger and larger as the traffic goes on, and this in two ways: first, the mere gravity or weight of the load, the pressure of which acts vertically, or nearly so, upon the rut bottom; secondly, the lateral action of the wheels upon the sides of the rut, which being steadily worn down, very speedily adds to its size; the double operations, although different in detail, are precisely similar in principle to those of the locomotive engine on the rail.

Repairs as a rule are very costly in proportion to the material expended on them, so much labour being required, and that, as things go now, is a very high item. The better and most economical way is, therefore, to prevent the necessity for carrying them out. The road being in first-rate order to begin with, every precaution should be taken to keep it so, and these precautionary measures must begin as soon as the traffic begins. To keep the surface as free as possible from mud and extraneous matter of all kinds is a work which may be begun at once; and the more thoroughly this cleaning is done, the greater will be the saving effected. For friction on a road surface is not only caused by the rolling wheels and stamping of the horses' feet; but all stones, mud, etc., left on the surface under the action of the carts, rub and grind themselves down, and while doing so act upon the general body of the road surface, so that a threefold process is constantly going on in wet weather. The extent of the mischief done to the road from this cause will depend upon the hardness or softness of the materials, the depth to which the layer of detritus or muddy silt is allowed to accumulate upon the surface, and the way in which good plans of clearing it away are carried out. A farmer can scarcely be expected to keep a road or 'street' cleaning machine; but in consideration of the aggregate length of roads on the estate considered as a whole, it will assuredly pay the landlord to have one for the general use of all the farms. The capital sunk in the construction of a good many miles of farm road is a consideration of great importance, and it is no uncommon thing to see a length of road which has cost more for its repair than it did in

its original construction, this arising from the defective way in which the repairs have been managed, or rather wholly neglected. If the property be large, and the road mileage be therefore considerable, it will be cheaper in the first instance to purchase a horse-worked road-sweeping or cleaning machine; the cost of this, which is capable of thoroughly cleaning 10,000 yards superficial per hour, is not worthy of consideration when set against the hand-worked machine, costing £3, 10s., and capable of cleaning, at a cost of 4s. to 5s. per annum, a certain surface of road, which done by manual labour costs from 20s. to 30s. The true and most economical way to conduct the management of road repairs, where there is a fair extent of mileage, is to have a trustworthy man 'told off' for the duty of keeping all the roads of the estate in as perfect repair as possible: to this duty may be added the duties of looking after the ditches, fences, and gates along the line of roads. He should be well paid, as farm wages go; and the whole responsibility of the department should be thrown upon him. Consequent upon the length of roads, he ought to send in, at intervals of greater or less extent, a report or statement showing the condition of the roads, ditches, fences, and gates; the amount expended upon their repair during those periods; and, if extensive repair be demanded on any special work, such as the diversion of a road according to plan decided on, his estimate of the probable cost should also be sent in. He will, of course, have a staff of good, well-trained men, and these in course of time will become 'experts' of no small value on the property, even when called upon to do work other than that of road repairing, etc.

The Character of the Materials best adapted for the Repair of Roads.—Judging from what are too frequently seen lying on the surface of roads, by way of making good defects thereon, one would be inclined to say that some entertained the idea that anything not good enough to be used for other purposes was good enough for this. No greater mistake can be made than this; for here, as in every other department of work, the better the quality of the materials used for repairs, the more perfect will these be, the more lasting, and, in the end, the more economical. This may be taken as an axiom of repairing work

of all kinds, and not the converse, which some seem to think the correct way of putting it. The materials employed must possess the following characteristics:—As regards their mechanical properties they must be hard and tough, to resist to the utmost the grinding down processes to which they will be subjected; and as regards shape, the more many-sided and angular or sharp-edged, and the less they have a rounded form, the better 'bind' will be obtained between the different pieces, and the nearer will be the approach to the compacted dovetailed mass, where each piece has a hold or 'grip' upon its neighbour; which, in point of fact, may be called the standard of efficiency as regards the masses of stones used to repair roads.

In the 12th volume of the *Journal of the Royal Agricultural Society of England* (Part ii. No. 24), there is a very excellent paper on 'Roads and Highways,' by Mr. W. H. Wheeler, Civil Engineer, in which there are a good many details of practical and historical value connected with the subject; and although many of these refer to roads of greater importance than the general run of farm roads, there are, however, some which may be specially applied to these, as, for example, in materials used for repairing roads. A brief *resumé* of what Mr. Wheeler says on the subject will be useful to the reader, whom we refer to the volume above alluded to for special and further details. After pointing out the three requisites which are demanded from repairing materials, and which we have already named, and running over the various stones used, he states that there is only one out of the wide range of rocks or stones at command which possesses those requisites, this being fragments of the granitic and trappean rocks, broken so that they will pass through a ring or gauge of two inches diameter. Although expensive in the first instance, unless to be had on the property, still, from its superior lasting qualities, and the smaller bulk of it required as compared with other materials, Mr. Wheeler is of opinion it is the cheapest thing in the end to use, and corroborates this by a series of tables compiled from the working books of certain lengths of road.

As a rule, the stone used for repairs is that kind and quality most plentifully met with and

most easily obtained in the neighbourhood; but some of these, although cheap in the sense of being close at hand where wanted, are so inherently bad that it would be infinitely the cheapest thing to do if granitic stone were brought on to the property, even from a great distance. In limestone districts the limestone is almost universally used, both in the construction and repair of roads; and those who have had much experience in living in a district of this kind, as say Derbyshire, will have had disagreeable experience enough of the rapidity with which it rubs down into a fine detritus, which rain converts at once into surfaces of white mud, and its absence into a white dust. Yet it is a tough stone (one of the requisites we have named), but peculiarly liable to atmospheric influences, as rain or frost. It rapidly disintegrates; it is, in short, so bad a material that it ought never to be used for road work, for, if so used, the consequent expenses involved will be a continual source of outlay. If sandstones are often used, their comparative cheapness, or rather dearness, will depend upon their quality; a vast bulk of worthless sandstones are, however, used yearly, which do not repay the cost of carriage. Gravel is a material in great request for road repairs, temptation to use it arising from its hardness and the apparent ease with which the nodules bind together in the ruts and depressions; but this bond is only apparent if the gravel nodules be round; in this case their working up to the surface, on which they lie loosely, is merely a matter of time. No road is more dangerous to the horses than that on which rounded materials have been used, and worked up by the pressure of the traffic to the surface; it keeps the poor horses working on it in a state of perpetual nervous excitement lest they should fall, or causes not seldom serious accidents to them when they do fall. Flint gravel, if the nodules are not round, makes a good material if used judiciously, giving a clean and firm surface. If the sea be near the property, one may be tempted to use shingle or the stones met with so plentifully at various parts of the shore; but here, again, the caution as to shape or form of each piece must be remembered, for to use those rounded is simply throwing away money. There are many departments of work which will illustrate

the old adage, that even gold may be bought too dear; to few does it apply more forcibly than to roads, for materials may be used which will never repay the cost of even carting them a short distance on the property itself. Hence it is that Mr. Wheeler, to whose paper we have referred, insists that it is cheaper to import granitic stones, even from a great distance, than to use those which are close at hand. On many properties large supplies of granitic rocks may be met with easily; and as in such cases it will be useful to know the best way to prepare it for use, and how to use it to the greatest economical advantage, Mr. Wheeler gives some very useful instructions. The stones are to be carted to and laid alongside the road to be repaired, in heaps at regular intervals, the usual average bulk or weight of each heap being $1\frac{1}{2}$ tons; but this, we may remark, will be a point regulated by the repairs necessary to be done at particular points; some repairs, being slight, will require less bulky heaps, and *vice versa*. As soon as the autumnal wet season commences, that of the repairing of roads begins too; and no loss of time can be tolerated through slow, easy-going processes, but the work—especially if the mileage be extensive—must be pushed on with vigour, when we say that all repairing work must be finished before the middle of January. The stones put in after this time are found in practice to work themselves up to the surface, in place of remaining *in situ*. In point of fact, the repairing stones put in seem, as may be reasonably supposed to be the case, to require a certain period of comparative repose in which to get compacted. The broken stones, previously prepared of the requisite dimensions, are taken from the heaps by barrowfuls, and they are taken from this by means of a shovel, and spread openly over the loose surfaces of the ruts caused by the pressure and grinding away of the sides of these by the wheels, as well as by the treading on and grinding down action of the feet of the horses. Some care ought to be taken to have the ruts and depressions supplied with the stones, not shovelled carelessly in, irrespective of the relationship which exists between the depth of the ruts, or their breadth, and the number and weight of the stones. Again, where the ruts

or depressions are very deep and broad, some attempt ought to be made to fill in the stones with that regularity as to the depth of each layer which will best give a fine and compacted mass. A good deal of the after success of the repairs depends upon the way in which those are done. By proceeding thus, Mr. Wheeler says that a bad gravel road may be converted into a granite road possessed of an even surface, and that hard and firm, and capable of resisting even heavy traffic. The expense, moreover, of the transformation is by no means great, considering the nature of the results obtained; thus the weight of granite stones during the first two years may be set down at about 50 tons per mile, the weight during the third year falling to 30 tons.

The principles of repairing of roads which we have propounded may be shortly stated as that of keeping up a continuous well-drained system, filling up the ruts and depressions as they arise or are formed; thus fighting the enemy, so to say, in detail, and never allowing such a length of time to elapse as is the general system, so that a large extent of mileage has to be put under repair at once, and the whole breadth of road covered in with the usually too well known and too well dreaded layers of stones, through which and over which the poor horses have to drag their heavy loads as best they may, until, by a long, tedious, and expensive process, the stones are crushed and crumbled down into the road, and a comparatively hard and smooth surface is at last obtained. But upon the system we have explained, and still more efficiently by the employment of granitic stone covering advocated by Mr. Wheeler, the better surface is obtained; the work though in one sense continuous is not so, as we have explained, but being taken in detail as the defects arise, each hole thus takes only the minimum of material. But excellent as the plan of repairing roads described is, where thorough efficiency and the highest standard are aimed at, the construction of the road being in the first instance supposed to be sound both in principle and in detail, the road afterwards should be so managed as not to allow of ruts being formed at all. Where the traffic is heavy, this will be difficult to accomplish; but in farming districts, where, though heavy, it is not continuous, this

higher efficiency could be secured by no great outlay of time given to suspension of the traffic. Mr. Wheeler says, what under the old system took 200 tons per mile to keep it in good repair, under the new system required only some 80 tons, a difference representing a large amount in only one department of the property improvement. Of course, Mr. Wheeler's notes, of some of which we have given a brief *resumé*, refer chiefly to highway or turnpike roads, but they can be modified to any required degree when applied to farm roads, and the principle is applicable to all classes of roads.

Repairs would be reduced to a minimum if roads were properly used, as they are not. If carters would be persuaded to vary their line of progression even by but an inch or two, so as to avoid the continual driving along in the same rut day after day, not only would they find their labour easier, and this because that of their horses would be easier also, but they would soon come to see that ruts would almost disappear. Roads which are, especially in winter-time, almost a terror to the carters themselves,—who, though rough, are not wholly devoid of feeling for their horses,—would become by the above system so well and evenly surfaced, that the carting would be a pleasure. Nor is the principle of managing the road traffic shown only in its good effects in the prevention of ruts and hollow parts here and there over the surface, but also in the getting rid of those loose stones, which, lying on roads, are a great cause of loss in cartage and suffering to the horses. These loose stones are the results of the system of carting always in the same line; for the pressure which causes the formation of ruts and hollows in one place, is that which keeps the stones in a state of perpetual movement upwards till they reach the surface. No doubt it may be said, that to manage the road traffic in this way would involve so much labour in supervision, etc., that few farmers would be willing to carry it out. But as they have not the work to do, but only to see that it be done, to one acquainted with human nature and the management of men there would be no difficulty in hitting on a plan which would secure the ready co-operation of the carters in carrying out the system here advocated. And so quickly

manifest would be its advantages even to themselves, we believe, that they would have some inducement to carry it on. And as for the proprietor and farmer, so great would be the saving to the one in money, and to the other in time in getting his carting done, that they have every inducement to see the system carried out. Few have any idea of the loss of money and rapid deterioration of horses caused by bad roads, and it is a loss which is continuous, as it goes on all the year round. And for this, if for no higher reason, on the score of humanity, have we given such prominence to the subject of repairs. For there is an enormous mileage of farm roads throughout the country, constructed so badly as regards their cross section or form, and made with materials greatly, in many instances wholly, unfitted to form a good body and surface of road, that the only way to bring them into proper condition is by carrying out a judicious system of repairs, such, for example, as that we have advocated. And that it would pay to reform the farm roads on properties is beyond a doubt. To pay in the highest sense, there will, of course, be demanded good administration, careful choice of the workmen, of the materials, and in the way in which these are conveyed to and laid along the road under repair.

There can be no doubt that the keeping of farm roads in good condition is a matter of the highest importance, and that a large percentage of loss occurs yearly from their being neglected is beyond a doubt; and this loss arises in many instances not so much from the fact that the roads have been badly designed and constructed in the first instance, as from their being allowed to get into bad condition, either through neglect or absolute indifference. At the same time, it should never be overlooked that a road badly constructed in the first instance will be much more difficult and expensive to keep in good repair than one which has been made rightly at the beginning. This is a point too frequently overlooked, for if faultily constructed, the faults are always there, and no amount of repair, however conscientiously undertaken, can overcome them. We have endeavoured to point out the best and most economical methods of laying out and constructing roads for the farm; but it will

not be amiss if, in conclusion, we give a brief *résumé* of these, and offer a few further remarks. And the first point we would draw attention again to is, that however carefully the bottom or foundation, as well as the surface, be made, defects will inevitably and too speedily begin to show themselves, unless drainage be thoroughly attended to; and we should here impress upon the reader the importance of the principle that both upper and surface drainage be alike specially attended to. Some road-makers conceive that if one be done the other may be neglected,—a damaging belief, which gives rise to endless necessities for repairs. Others, again, who carry out both under and upper, attach greater importance to one than to the other. Now both should be thoroughly done; indeed, it is a question with some able road-makers, whether, if saving has to be carried out, it should not be done in the case of under rather than surface draining. The best roads which have been made are probably those in which surface drainage is carried to what may be called perfection; and apart from other circumstances, a convex surface certainly gives greater facilities for this being secured than a perfectly flat one (see previous remarks on this point). The convex form of the road is too often changed and injured by the system of placing all sorts of rubbish along the side boundaries, continuing the practice by allowing it to remain for unlimited periods, until the sides actually in some instances become higher than the centre. It is only in very badly neglected places that this is carried out to any great extent along the whole length of the road; but it is obvious that, where adopted, the convexity of the road will in like proportion be injured or destroyed. The roadsides should be kept scrupulously free from all encumbrances, those only being tolerated, at certain distances pretty far apart, at which materials for repair are laid down, as we have already recommended. Indeed, so scrupulously would we keep a roadside free from all extraneous matter, that we should even go the length of having offsets made at certain points for the deposit of repairing materials. The surface drainage is greatly aided by having the side fences as light and open as possible, so that the wind can sweep over the surface of the road with the

least obstruction, and the sun's heat gain access. These points are greatly overlooked in many instances, to the detriment of the road. Hence the absurdity of having roads bounded by high fences. Another point in under-drainage greatly overlooked is the importance of having the road bounded by two drains, it being essential to have a drain on either side, the effect of which in consolidating the road, as well as thoroughly draining it, can scarcely be over-estimated.

The great point, to sum up this part of the subject, is to keep the road dry throughout from top-surface to foundation. As regards materials for repairs, the farmer who is on the look-out will be surprised to find that he has a wider range than he is apt to suspect, many a good material for the purpose being overlooked or considered unfitted. The truth is, that in this, as in other departments, much is lost simply from want of care and attention. In the paper by Mr. Bailey Denton, to which we have already alluded, and which should be studied by every one interested in the subject, a very suggestive hint as to repairs is given, in his saying that it is an axiom with engineers that roads should be so well constructed, that their maintenance should be reduced to that point at which the current loss of materials will be represented by the wear and tear; but with regard to internal farm roads this rule may be safely modified, the same reason for keeping them in the high class of repair demanded by public roads not existing. Less material, therefore, may be used by the farmer; but if so, it is obvious that it will be all the more incumbent on him to use it with judgment, and on this point we need scarcely say that it involves repeated examination of their condition. Of course, much will depend on the repairing materials used, some lasting longer than others. We have said enough, in concluding the subject, to show that the condition in which farm roads are kept depends upon the farmer himself. In a large majority of cases he will find, when disposed to blame the contractor, the fault lies more upon his own

shoulders. He cannot, at all events, bring forward the excuse that he is ignorant of defects, as he has abundant opportunities of finding these out when he is going from the one part of his farm to the other. It is surprising, however, how repeatedly one will pass over places in bad repair without ever being aware of the fact. No one requires more to study the habit of observation, or to whom it is more practically valuable, than the farmer.

In close connection with the subject of roads comes that of bridges. It is such a wide one, and embraces so many important points, that we can hardly refer to the simplest constructions of the farm, except only in the briefest fashion; to do justice to it, would take up the limits of a treatise. In fig. 5, Plate 46, we give the sketch of a wooden bridge for foot-passengers, with a width of roadway of between 5 and 6 feet, and a span varying from 24 to 30. The main beams, which are separated at intervals by braces, are 12 by 8; the uprights of the handrail are about 4 feet 6 inches high, and 4 by 6 in scantling. The bridge is supposed to be reached on one side by steps, *a*, at which there should be a broad landing, *b*, the other side, *c*, continued on the level. Fig. 6 shows a form of abutment of stone work used in cases where the bridge beams have not a solid base of soil to rest upon, or where the span is broken up into more than one length in crossing the stream, ravine, or valley. Fig. 9 shows a design for a light iron bridge on the lattice principle. In fig. 8 we illustrate a plan for forming a gangway reaching from the low level, *a*, as that of a stack-yard, up to the first floor, *b*, as say of the granary. Broad landings in such cases should be given as frequently as possible, as at *c*; they are very convenient, as affording resting-places for those carrying heavy lifts. In all cases, in entering an apartment on a higher level, as *b*, a broad landing, as at *d*, should be given, as useful for shutting and opening doors and as resting-places.

CHAPTER II.

FENCES AND GATES.

Fences.—This department, although it is often classed as one of the minor subjects connected with the improvement of landed property, is nevertheless one of great practical importance. Fences may be divided into two classes,—first, those used simply as a means of enclosing fields, dividing them and the crops which they bear from one another, and preventing the stock feeding on pasture land from passing either from one field to another of the same character, or to fields bearing arable crops. The second class comprises fences which not only serve the above-named purposes, but also that of shelter in districts more or less exposed to high winds, etc., or which are situated in severe climates. As our succeeding remarks, and the illustrations which when necessary will accompany them, will show, the kinds of fences in use are very numerous. Some are marked for the extreme simplicity of their construction, others for their complication; some for the small extent of land which they occupy, others for the very reverse of this. There is, perhaps, none of the minor departments of improvement of landed property which has met with so much warm discussion, and on the points of which such very decided opinions have been expressed, as that of the fences of the latter class just named,—fences which, at one period, were almost universally used, and as universally esteemed as necessary agents to good farming. Those huge erections—for the term is specially and strictly applicable, as may be well supposed—were sure to call down the reproaches of farmers in modern times, when the value of land was much thought of, however little it was deemed by our forefathers, to whom they owed their existence; nor were the reproaches less forcible of those who knew what farming really

was, when the damage done to the crops was taken into consideration. The warfare between the upholders of the old and the advocates of the new system of fencing was long and bitter; and the former had warm advocates in the lovers of the picturesque, as beyond a doubt these old-fashioned fences added a charming feature to the landscape, which in many districts is now wholly lost, and will soon be entirely so all over the country. It is unnecessary to enter into the details of this controversy now, inasmuch as it is a settled question that great loss accrues to the farmer, if from no other cause than that arising from the extent of land, irrespective altogether of the expense in erecting them, and the labour involved in keeping them in repair, cleaning them, and keeping them free from weeds. As an example of the first-named loss, a writer mentions the fact that the fences on his farm take up no less an extent than five acres, which, if devoted to a proper system of culture, would actually keep ten cows. But apart from the question of the losses above stated, there is another point of the highest consideration in connection with fences, and this even in the case where these are constructed on the most approved and most modern principles; and this from their influence on the steam cultivation question. Years ago, in the leading journals of agriculture, while having occasion to describe the different systems as they were introduced, and to record at a later period the eminent success of those which are now the established systems in daily work over a large area of land, we pointed out that none of them would be able to develop their powers to their fullest extent until the fields of our farms were specially prepared in order to meet their essential requirements; and this not merely in the way

of preparing their surfaces,—a branch of farm engineering which is hardly as yet in its infancy,—so that they could be made as level as possible, but in that of decreasing the number of fences, so as to give the largest area of minterrupted sweep, so to say, in which the apparatus could work at the greatest advantage. This consideration alone is one which will affect the future of our system of fencing, which in many of our farms is being already carried out. But there is another consideration which will have a like result, and that is the mere cost of the fences necessitated by a system of farming which apparently demands numerous fields of small dimensions. Some advanced farmers, indeed, go the length of saying that the burthen now entailed upon them is so great, that a modification of the system is essential, even if there were no other considerations affecting the question. The mere interest is a matter of some moment, and if expended in carrying out an improved system of farming, would yield considerable results. This is not the place further to enter on the subject; but, as an example bearing upon it, we may just allude to the system of soiling or stall-feeding of cattle and dairy cows, which, if carried out, would do away almost entirely with the necessity of having fences. Where, however, the system of pasturing is adopted, we shall see in a succeeding paragraph that fences will, on an improved system, be rather increased than diminished in extent; and even in the case of the old-fashioned fences, there are special cases in which it may be advisable to retain them. In certain classes, moreover, of landed property improvement, fences of various kinds are necessary, so that, apart from the circumstance of the great and radical improvements we have just alluded to, which will not, like others, be carried out with great rapidity unless they form an exception to a general rule, fencing of all kinds will remain, we may safely conjecture, an important department of modern farm work. We therefore proceed to describe the various classes of fences.

Mud or Turf Fences.—These are much more frequently used than one would anticipate, after what we have said as to huge erections occupying much space of land; but they are very useful, nevertheless,—as, for example, in reclaiming land,

in the formation of sunk fences, and in the fencing off of plantations, etc. In conjunction with stone, they form a very good and, if properly attended to, durable fence. The term ‘mud’ is not in all cases strictly applicable, indeed rarely; for it is soil in different conditions of humidity, generally more or less dry, so that it can be cut and placed *in situ* like turf. A fence of this material, to fence off a plantation of reclaimed land, is shown in fig. 2, Plate 36. The pasture or arable part of the farm is at *a*; the sunk fence or ditch at *c*; *e*, the mud fence; *b*, the plantation. The mud wall is surmounted with flat stones, or with gorse or whin as shown. If of mud, the wall may be backed up with the soil from making the ditch, *c*, fig. 3, Plate 36. This will allow of the face being nearly perpendicular, thus increasing the difficulty of the wall being leapt by the cattle at the side *a*. For protecting two contiguous fields, say of rough or reclaimed land, a mud fence may be built, or one with any of the rough stones which may be found in abundance on such land. The fence is simply a duplicate of fig. 2, a second ditch being on the other side of the fence, as shown by the dotted lines *d*, fig. 2, Plate 36. Fences for moorland pastures, reclaimed commons, etc., may be made, in fact, of almost any materials readiest to hand. Turf may be had in abundance in some fields reclaimed, which are pared and burned, as much being recovered from the burning as will form the fence. This may either be required to fence from one side only, as in the case of a plantation being on the other, in which case the fence will be formed as in the last figure, either with or without a sunk fence or ditch; although this latter not only adds to the difficulty of stock leaping the wall, but is not all lost ground, as some seem to think, for good bites may be had from the inner side, if water is in the ditch, or from both sides and bottom if there be none. The mud or turf fence, to fence both sides when there is a field on either side of the fence, may be made as in fig. 4, Plate 36, with a broad base to give stability to the fence, and protect it as much as possible against the attacks of cattle. It is usual to crown the top with green turf, but as the grass on this sometimes grows luxuriantly, and tempts the cattle to put their feet on the sides

in order to reach the grass, it will be the safer plan to crown the top, *b*, with stone, or if that be not easily obtained, with whin, gorse, or thorn stops and branches, according as either one or other of these can be had with the least labour. These tops must all be dead wood, thus giving no chance of them taking root, which would defeat the object in view, by producing a crop of leafage more tempting to the cattle than grass from turf coping would be. Or stakes of timber may be used as coping, as in fig. 5, tied palings-wise by a horizontal bar, *a a*. The worst of all these latter tops, dead wood, branches of thorns, etc., and wood, is that they present orifices at their junction with the top of fence which admit rain, which, descending to the interior, rapidly destroys the solidity of a mud wall; and in the case of stone, it is difficult to fix the wood stops, etc. The better way is to build the wall high enough, and finish it off with small stones, if larger ones cannot be had. The best plan, however, is to make the mud fence in the centre between two sunk fences, as in fig. 6, a scarpment or set-off at the base, as at *a a*, being made sloping, to increase the difficulty of the animals gaining a footing on the wall; the slope will also carry off the water quickly. If the fence be made, as in fig. 7, in the centre of a broad ditch, *a a*, the base, *b*, must be of stone, to carry the mud above the water line,—that is, unless the ditch, *a a*, be a dry one; still even in this case there will be lodgments of water, so that a low stone foundation should be made in which to place the turf, as in fig. 8.

Fencing on Hilly Moorland.—The importance of this department of work need not here be commented on, as it is evident that it must play an important part in its reclamation. Their disposition and situation will, of course, be regulated by a 'variety of circumstances, such as the extent of the farm, the character of the land, whether arable, pasture, or meadow, or the inequalities of the surface, the supply of water, etc. On farms of tolerable size, having a moderate quantity of arable land, the number of enclosures should be twice as many as the number of years in the rotation of cropping. Thus, in a moist grass land district, where the fields remain in pasture for several years, and are under the

six-field course of culture, there should be twelve enclosures, two of which are always under the same crop; and the situation of each field should be so arranged as to group together a good and an inferior field, one being at a higher elevation than the other, and consequently at a greater distance from the homestead; the homeward field (being nearest the manure heap) thereby affording roots for the yards, if wished, while the distant elevated poorer field has its produce consumed upon the land. In the adjustment of the lines of fences, much convenience and some saving of expense in drainage will be secured if they are made to correspond with the outlets of the main drains; and these, again, with the carriers for irrigation.' In our introductory remarks on fences (for which see chapter on 'Roads and Fences') we have gone fully into the pros and cons of this much-debated subject, and have drawn special attention to the injury done by the large old-fashioned fence of mud, sods, or earth, surmounted with trees and shrubs of all kinds, and covered over for their entire surface with weeds and grass, affording refuge for a host of vermin. But while these are objectionable in districts enjoying fine soil and mild climate, it should be remembered, as pointed out by Mr. Smith, what is too frequently forgotten, that large fences, affording shelter, are necessary in less favoured districts; for 'in corn countries it is no matter how few and how low fences are; but in a moist, windy, and elevated district, suitable for the production of stock alone, which naturally require shelter against such elements, good stoned and ditched banks, with healthy beech plants upon them, are no small adjunct to the capabilities of a West of England hill farm.' And what is true of farms there of this class, is no less so of the farms of other districts. The modern fence used on the West of England hill farms is illustrated and described by Mr. Smith in his paper 'On Moorland Cultivation,' and of which we give a diagram, fig. 9, Plate 36. It is faced with stones, *a a*, on each side to the height of four feet, and then topped with two feet of grass sods, *b*. Upon this top or crown, beech plants, *c c*, in two rows are set, protected on each side by low hedges, *d d*, the stakes of which are made from fresh-cut or live willows. The plan of live stakes is a good one,

for these materially aid the growth of the beech plant, and support the bank by the quick growth of their roots. In the enclosures of moderately elevated moorlands in the same district, the fences are of the class known as hedges on the flat. These have a ditch sunk upon each side, as *a b*, fig. 11, Plate 36, and the soil taken from these is thrown into the centre, by which a platform or bank, *c d*, is formed, in which the quick plants, as *e e*, are laid in as the work proceeds, or as soon as possible after its completion. These are protected by a double post and rail, *f g*, a double sod bank, such as was used in Lincolnshire at the enclosure of heaths, illustrated in fig. 10, in which *a b* are the side ditches, 18 inches in width; *c d* the base, on which the sod walls, *e f*, are raised; *g g* are the two rows of quicksets. When these were sufficiently grown, it was customary to take down the decayed sod banks or walls, and to use their materials in the formation of compost heaps along with quicklime.

Stone Fences.—These range from the simplest up to the most elaborately designed and constructed structures, according to circumstances, and the desire of the proprietor to have work more or less complete and finished in character. The simplest of all is that formed of boulders or rough stones, such as are met with in abundance on some classes of hilly moorland; and in such cases form rough and rude-looking fences, but quite in keeping with the locality, and yet thoroughly effective. Rough boulder stones, but of a more rounded character, and smaller generally than those of moorlands, are also met with in river beds of lower districts, and in such abundance as to suffice for the erection of fences of this class. Some care is, of course, necessary to select and place the stones so that they will bind or interlock, so to say, with each other, as on this being efficiently done depends the stability of the wall. To save the trouble of doing this, some workmen trust to the giving of a very broad foundation, making the fence rather a heap of stones, conically shaped, than a structure having some, and those the most valuable, features of a dry-stone wall. But it should be remembered that this style of 'throwing together' a heap of stones is costly, inasmuch as the cartage is a costly item; and a fence thus built, if the term

can be used of it, takes a much larger number of stones than one in every way lighter, but which, properly constructed, gives by far the strongest fence; and it may be taken as a rule, that a good workman will *build* a 'boulder wall' as fast as a bad one will throw together a heap of the stones of the other kind of fence. The mere weight of extra stones which the workman has to lift is no small matter in the item of time alone; and time is money. Fig. 9, Plate 37, illustrates a form of boulder fence, to aid in the erection of which a rough 'template'—hereafter illustrated when describing stone walls of a higher class—will be useful in giving the form or section, and enabling this to be maintained throughout. This may be made in a few minutes with some rough sticks, nailed or even tied together at the points of junction. Forms of large boulder fences are shown in figs. 10, 11, and 12, and will be found described in the chapter on reclaiming land under the section, 'Reclaiming Land encumbered with Boulders.' Where large, broad, flat stones are numerous, a good firm fence may be made, as at *a a*, fig. 13. Where the soil is light, the stones may be jammed up by wedges, as at *b b*, and greater strength may be obtained by overlapping them, as at *c*. A combination of low mud fence, as *d*, and flat overlapping stones, as *e*, may be made very strong to resist cattle, by having at intervals wood braces, as at *f g*, in place of having continuous lines, as *g*, on the ground level; offsets, as *h h*, of soil may be made. Fig. 1, Plate 36, shows a stone wall in place of the mud, as shown in fig. 2. Fig. 14, Plate 37, shows two forms of templates with plumb lines, which are used in building dry-stone walls in order to keep the outlines correct and the wall perpendicular. Forms of dry-stone fences are shown in figs. 1 and 2, Plate 38, fig. 1 being a sunk fence, and fig. 2 a retaining wall. Figs. 3 and 4, Plate 38, show stone walls on the slope, *a a*, in fig. 3, being the mode of setting out the foundations, and *b* of terminating the wall at foot; *c* shows the coping. Fig. 4 may illustrate a wall sloping from a road, *a a*; *b* being the line of outside retaining wall; *c c* shows the form of footings; *d d* the drain from road. Figs. 5 to 29 illustrate various modes of building stone and brick walls adapted for superior parts of

the property, as those near the residence, or where work of a better class is required. Fig. 5 is a stone wall of the kind called 'rough or random rubble,' in which the stones are put together without any dressing, as they come from the quarry; the stones being of all sizes, the only point attended to being the choice of stones as uniform as possible, especially at the base and outer sides. The strength of the wall depends chiefly on the goodness of the mortar, although this is aided by causing the stones to interlock with each other as much as possible, and by using at intervals 'through' or large stones going across the wall. In random rubble work of the best quality, in addition to mortar being used in the ordinary way, the stones are further cemented together by what is called grouting—that is, filling in between the interstices mortar in a thin condition. Fig. 6 illustrates what is called coarse rubble, the stone being partially dressed with some regard to uniformity of size. Bond is obtained by the use of headers and stretchers. A header or through, as *c*, fig. 8, goes right across the wall, while a stretcher, as *b*, goes along the length of it. They are generally placed alternately, as shown, and as in fig. 10. In place of large stones being used throughout the thickness of the wall, the central part may be filled up with small stones, as figs. 9, 10; or these may be employed as backing, as in fig. 9. Figs. 7, 11, and 12 show part walls built of ashlar, which is the highest class of work. Of this the most superior is what is called rubbed ashlar, as in figs. 12 and 13, in which the outer surfaces of the stones are rubbed smooth. Figs. 13 to 18 show different modes of finishing off superior walls, as those bounding the gates of the entrance lodge, fig. 16 being known as a rusticated work. Designs for the low retaining-walls at entrance gates to parks, etc., are shown at *a a* in figs 1 to 8, Plate 45, with bounding or gate posts at *b*. Where part of the retaining wall is finished with timber, as in fig. 6, in place of being stop-chamfered, as in fig. 9, they may be finished as in fig 10, in elevation and section. Figs. 24 to 29, Plate 38, show park enclosing walls of a superior kind, designed chiefly to be built of brick. For high walls materials may be saved by using offsets, as in fig. 26, in section at A, and elevation at B; or a

thin wall may be built, as in fig. 27, having at intervals counterposts or buttresses, as *a a*, in elevation A, section B, and plan C. Figs. 25 and 28 show cornices for brick walls, and fig. 29 a hollow wall with coping, *a*, of stone weathered or sloping on both sides, and throated or grooved, as at *a*, all along its under sides, to prevent the water going down the front of wall. In fig. 20 the coping is finished with half-round bricks, *a*, or with tile coping, as at *b*. Fig. 21 shows the method of setting out brick walls on the plan known as 'Old English' or 'English' bond, in which the courses are alternately of stretchers, *b b*, and headers, *a a*. Fig. 23 shows the 'Flemish bond,' in which the courses are made up of headers, *a*, and stretchers, *b*, alternately. In both of these, *c c* show the half or quarter brick known as 'closers,' used to finish the end of the wall off with proper bond, without which, at certain points, the joints would reach from top to bottom of the wall, as at *a b c d*, fig. 22.

Sunk Fences.—As it is the general wish to make the grounds immediately surrounding and in the vicinity of the mansion have the appearance of unlimited, or at least apparently unknown extent or expanse, some other than the ordinary enclosing blank wall of stone or brick, as the case may be, is demanded. Generally what is called a 'sunk fence' is employed. Sunk fences are made pretty wide at top, to prevent any favourite breed of sheep or fancy cattle, which may be allowed to graze on the lawn, from leaping across, as the wall on the other side is of necessity kept as low as possible. The width of sunk fences will vary according to circumstances, but care should be taken not to make it too narrow; the very least width from face of retaining wall, *e*, to point where the land or field, *f*, fig. 1, Plate 37, begins, should be six feet, but eight to nine feet will be the best. In place of having the face of wall, *e*, fig. 1, perpendicular, it will be stronger, and resist the back pressure of soil at *b* better, if made with a slope or batter as in fig. 3, with openings to allow of the drainage water to pass through from back to front. The top of wall is covered with a thick grassy sod, to give the green finish necessary to keep up the grassy appearance of the whole extent of park, etc. The fence is shown in fig. 1, Plate 37, where *a a* is the ditch, the soil

of which may be wholly or partly used to form a backing, *b* (this may be short, as at *b*, or thrown out towards *c*), dying away into the ground; and if this is sown with grass seeds, the whole will have a green and level look when viewed even from a short distance. A very pretty kind of sunk fence may be formed without incurring the labour and expense of building a stone wall, by the arrangement as shown in fig. 3, Plate 37; where *a* is the ditch, both sides of which, *b* and *c*, are grass-covered; at the side *b* a scarcement or set-off, *d*, is made, and the soil taken from *a* thrown up and back as at *c*, the part *e* forming a bottom for the quickset fence *g*. The part *f* need not be high, and if the ground at the back slope upward it may die away into the general incline; if level at the back, it may be formed as shown in the preceding illustration in this section. The illustrations in fig. 6, Plate 36, and figs. 7 and 8, Plate 37, will serve to show how the fence as arranged will protect from both sides; but if positions occur where a sunk fence may be made on either side, as in the diagram in fig. 7, Plate 37, the arrangement has this advantage, that the hedge, *a*, may be kept very low so as to be little observed, the necessary height of the fence *per se* being obtained by the depth of the ditches or sunk fences, *b* and *c*, on either side. This will give little obstruction to the view, and both fields will be protected from cattle, etc., passing from one to the other. In similar localities, a small brook or watercourse, as in fig. 8, may be made to form part of the fence, fencing off, as in the last case, two contiguous fields, and giving at the same time the advantages of a sunk fence; the brook, *a*, fencing from the field, *b*, and the ditch, *c*, and quickset or hornbeam fence, *d*, protecting from the field, *c*. Where the nature of the ground behind the fence and the character of the soil will admit of it, the stone retaining wall, as in fig. 1, Plate 37, which gives, of course, the best work, may be dispensed with, and a sod or turf wall may be substituted; the outer surface of this becoming covered with herbage—especially where it has a good batter or slope, as in fig. 2, Plate 37—this will accord more with the general green surface than the surface of a stone wall. Yet in process of time this latter even will become covered with green moss, etc. But even in the case of a stone wall, its colour may be

said to be lost when viewed from a distance of, say, fifty or sixty yards, and to become merged in the general appearance of the ground. This fact admits of a sunk fence being so made that the full depth of the ditch, as *a*, fig. 1, need not be taken into account, the height being made up by increasing that of the wall some 24 or 30 inches, as at *a* in fig. 4, Plate 37. This will save expense in cutting, and relieve the difficulty in getting rid of the excavated soil. To aid the drainage of the mass of soil behind the wall, in addition to the apertures through this, it will be a good plan to have a backing of stones behind it, as at *b*. A sunk fence of this kind is useful where there is rising ground behind the wall covered with plantation, and where there is a considerable distance between the level where the ground begins to rise and that of the policy or park ground below. Should the face of the rising ground behind the wall be rough, or if it be desirable to conceal it, it may be faced with a hedge of quickset or beech, as in fig. 5, Plate 37, at *a*. The wall should be so well set forward as to admit of a good backing of soil behind and at top, to admit of the roots of the plants having a good start at first; and if the wall is of stone, it will be as well if it be capped with a stone coping, *c*, 'weathered' towards the ditch side to throw the water into this; and this coping may be 'throated' to keep the drops from running down the face of the wall. All this, while it adds to the expense, will also add to the efficiency and the lasting nature of the wall, if this be made of stone. Where the ground behind the wall is only of moderate height, or where it is not deemed essential wholly to conceal or rather mask its surface, a very good effect can be obtained by having a gorse, whin, or furze fence trained to fall over the point of the wall of sod, or turf, or of stone, as at *a* in fig. 6; and if plants of the white broom be here and there put in at intervals, a remarkably pleasing and striking effect will be obtained. As there will, if well trained, be a perfect flush of yellow blossoms from the overhanging gorse or whins, this fence may be used in situations pretty near the house, as it will add to the beauty of the 'outlook.' A further pretty effect may be obtained in the winter season by having holly plants here and there in line of fence, the red

berries of which will contrast beautifully with the green of the gorse; nor will the decayed yet ever varying tints of the leaves of a few horn-beam or beech plants, put in here and there, lessen the effect of the fence as a whole. All this, of course, involves trouble and some small amount of thought, but all will be well repaid by the results, and what is now here stated may serve as hints for other circumstances and other work.

Wood Fencing and Paling.—Where home timber is grown in abundance on the property, the thinnings out of certain parts, and the prunings of other more advanced trees, will afford in many cases a fair supply of wood applicable to the erection of fences and palings. The stock of timber would be larger if greater care were taken of the supply yielded from various sources; but the reverse of this is often the case. Again and again have we witnessed in wood operations, that in collecting and burning the brushwood and small undergrowth, most serviceable pieces were collected with the rubbish and ruthlessly destroyed. Again, large scantlings of excellent timber will be found lying uselessly by road and ditch side and in corners of fields, broken by the wind from adjacent trees, etc., or littering the farm-yard, all of which, if collected and taken to the wood-house, and cut up, if necessary, by the saw, would form excellent material for topping of fences, filling up of gaps, or for the formation of palings, but which is otherwise allowed too often to lie neglected till it rots and decays. 'A place for everything, and everything in its place,' is a wise saw, which should be ever exemplified in all departments of the property, and will alone—independently of other obvious advantages—secure neatness, trimness, and the sense that there is a clever directing head in the administration of affairs. The opposite of all this is suggestive of many unpleasant considerations, of empty exchequers, an absent or careless and indifferent agent or landlord. These remarks will not have been given in vain if they serve to urge but one here and there to 'have his house in order.' Nor will he lose by the influence which order will have on the men under him, who most readily take their tone from the master; if he be indifferent, they will be so, and *vice versa*. Not always is this

the case, but it operates more extensively than some are inclined at times to admit.

The simplest and by no means the least effective wooden fence for ordinary work, and certainly not so ungainly in appearance as some say it is, is that made of upright posts, *a*, fig. 1, Plate 39, with stay-posts, *b*, at intervals to strengthen the whole, in addition to which a horizontal brace or bar, *c*, is carried along near the top of the posts. This may be altered, if not improved in appearance, by making the upright posts double the distance from each other, and filling in the lower space by shorter pieces, *d d*, which will thus make the fence rabbit-proof, if desired, while the fence will be good to fence off cattle, etc. from either side. In place of having a horizontal brace or bar, as *c*, fig. 1, Plate 39, at the top, some use lengths of hoop iron, tarred to prevent rust, to secure the posts together, thus,—*a a*, fig. 2, being the posts, *b b* the hoop iron twined in and out, showing at front and back face of each post alternately. To prevent the iron from slipping, nails may be driven in here and there, although they will not often be required, if the stay-posts be strong and well braced with braces projecting at right angles to the line of fence. With braced stay-posts, this will be a strong and elastic fence; the hoop iron, as it gives and takes laterally, yet comes back to its original position when the pressure is removed, allows the fence to yield to any sudden pressure, as of cattle or sheep, without giving way. In place of hoop iron, galvanized iron or steel wire may be used. The diagram, fig. 3, Plate 39, shows a fence of galvanized wire with timber posts between. This fence is easily erected, and may be made rabbit-proof by having the wires close together at the bottom, and gradually widening towards the top. A top rail of timber, *b*, is usually added in order to make the fence more plainly visible to cattle and sheep, who are apt to hurt themselves by coming violently against wires which they do not see, the upright posts only partially aiding this. If the annealing of wire could be depended upon, more might be made of its elasticity in the cheapening of fences in which wire is used. Wood fences, with horizontal bars passing through mortices in the uprights, are efficient, and look very well. In diagram, fig. 4,

Plate 39, *a* is a sectional end view of a post with the mortice holes, *b*, in it. The bars, *c*, are passed through these end to end, either butting against each other in the centre of the face of the post, which is the simplest form of joint, or having the ends of the bars cut into 'half-lap' joints, as at *e*, or sloped off as at *d*; *c* is the most secure form of joining the bars. The contour of the ground over which fencing passes is rarely uniform, and so also the direction in which the fences pass from point to point, it often being the case as regards the latter, that, in place of the posts being in a straight line as in fig. 7, Plate 39, the direction is as in fig. 8. In such a case, in place of having sharp angles, as shown in the dotted lines *a*, *b*, and *c*, the fence will look much better if the posts are placed in curved ones, as shown; the larger the radius of the curve the better. To a workman with accurate eye, these curves will be set out with sufficient accuracy at once; but to one not so gifted, the better way will be to continue straight parts of the fence, as *b a*, *a c*, to some distance beyond the point, *a*, where the fence post would be placed on the angular system, and then joining those lines by a curved line, *d*, at the centre of which the post would be placed. As regards the vertical deviation from the level, as indicated in fig. 9, the way to have the posts in unison with the irregularities of the land is to mark off what is to be their standard height from the ground, as from *a* to *b*, on all the posts, as from *c* to *d*. Then, by driving slightly in nails at those points, cords, as shown by the dotted lines, *e f d g*, can be hung on these, and they will be parallel to the contour of the land, as shown by the lower line, *h c*. Then, by allowing so much above and below this line, according as the ground rises and falls, the upper part of the fence will be uniform with the contour of the land, although, as in the other case previously named, one with an accurate eye may save all this trouble. A wood paling of a superior kind is illustrated in fig. 14, this being finished with a cap, forms of which are shown in fig. 13. In this form of fence, the bars are dressed off to uniform scantlings before being fitted up. In fig. 14 these bars are shown as being placed on the posts at uniform distances; but a neater fence is secured by having them

placed at varying heights along the length of posts. Where the bars are five in number, including the cap bar at the top, good distances between them are 3, 3½, 4, 4½, and 5 inches, the greatest width being of course at the top. To facilitate the placing of the bars at the proper distance along the length of fence, two bars should be provided, as *a a*, fig. 10, in which nails may be driven, and these bars hung by the upper nail to a cord, which should be stretched along the line of posts at the proper height from the ground; the other bars are dropped quickly on to the nails, which will give at once the height at which they should be secured. In this case the bars are nailed to the outside of the posts. As the bars are apt to slip off the nails, iron catches may be fixed to the hanging bars, a hook being made to hang on the upper cord. A combination of iron wires and wooden posts, with upper bar, to show the fence to sheep, is shown in fig. 3, the wires being closer together near the ground, to prevent rabbits passing through. There are a great variety of forms of wooden fences, which it is needless here to illustrate and describe. In fencing off turnip brakes, when eaten off by sheep, or in temporarily dividing a pasture or other field, what are called hurdle fences are employed. These are made very light, but strength is obtained by angle bracing, as in the diagrams, fig. 16, Plate 39. These hurdles are driven into the soil, kept in line by diagonal braces, *a*, at intervals connected with and secured to the upright, *b*, by a wood pin, and at foot by another pin taking into a stob or stud driven into the soil. The whole, although apparently complicated, can be put up and taken down with great quickness. This arrangement is illustrated in figs. 1, 2, and 3, Plate 42. Iron hurdles are now made, and are in many districts fast superseding wooden ones; the vertical uprights are terminated at the ground line by forked ends, the prongs or tongues of which, when forced into, take a firm hold of the soil, and keep the hurdles in line without involving the use of diagonal stays, as in the case of wooden hurdles. If the forked ends be made on the twist, that is, with one prong in advance of the other, so that the two form a line oblique to that of the hurdle fence, they will take a much

firmer 'grip' of the soil than if made straight. The worst of wood, when employed for fencing purposes, is that the feet of the upright posts decay rapidly, in consequence of the wetness of the soil into which they are driven. It is not constant wet which destroys timber rapidly, but the alternation between wet and dry. Charring the lower ends is only efficient, and that even but to a moderate extent, when done so that the carbonizing of the wood extends pretty deeply; to char a mere skin is of little or no service. Dipping the feet of the posts in one or other of the wood preservative liquids now so extensively used may be found to act beneficially; but perhaps the readiest way is to bed the foot in a layer of clay puddle, and ram this well round the foot up to and a little above the ground level; this will keep the wet from striking upon the timber for a long time, especially if the puddling be carefully done. A good deal of controversy has arisen on the point as to which is the best way of driving in uprights made of young trees, etc.—that is, with the thick or thin ends downwards. It saves labour to drive the thin ends in, as little or no pointing is required; but there are those who maintain that the true way is to have the posts in the same position as the tree grows, thick end down, especially in the case of larch. Other forms of fences, in which iron wire and timber are combined, are shown in figs. 2 and 3, Plate 44, fig. 4 showing a combination of iron with stone. In figs. 5 and 6 iron fences are illustrated, with straining posts, as in fig. 6; and in figs. 7 and 8, iron hurdles. Rustic fences of timber are shown in figs. 5 to 10, Plate 42.

A form of fence in which wood and wire are used as the materials, and on a plan somewhat different from those in use generally with us, has been introduced in America, and with decided success, as we understand. It is possessed of great strength, and may be modified in construction to meet the necessities of different kinds of stock. The wire is used of as many strands as may be required to give the necessary strength, both as regards the strength of each wire or the purpose for which the fence is to be employed, the stretching posts and intermediate posts being made of timber. The stretching posts are placed at distances apart of from 150 to 350 yards;

and the intermediate ones at distances of 6 yards apart, according to the strength of the wire and the kind of stock required to be kept fenced in. Slabs of varying thickness, according to circumstances, are placed between the intermediate posts, being first bored through with holes edge-ways, that is, in the direction of the breadth of the slab, the number of holes corresponding to the number of wires in the fence. The intermediate posts are fixed in the ground, and the slabs strung, as it were, between them on the wires, these passing through the holes in the slabs; which being about 4 inches in breadth, are, being presented flat side to the fields, easily seen by the stock, who therefore are not liable to be hurt by dashing up against them in their runs, which often is the case where what are called 'invisible' or thin wire fences with small-sized stretching or straining posts are used. The 'stretching posts,' placed as already stated at the longest intervals, are moveable, working or giving laterally in slots or grooves cut in the ground; the wires are tightened up in these posts by means of cross bars which pass through the posts, the ends of these cross bars being made with a mortice to receive wood wedges or wedge-shaped pins; these, as they are driven home, tighten the cross bars, and through them the wires which are fixed to them. The great advantage of this system is that the wires do not require to be strained till they are very tight, the degree of tension required being that only which is sufficient to keep the wires in line, as the slabs strung on to the wires between the intermediate fixed posts, acting independently of each other, produce, so to say, a number of cross strains, the resultant of the whole of which gives the necessary degree of tightness to the whole system. By making the slabs double, and merely nailing them together, any one half can be removed, so as to release the wire and enable the slabs or parts of them to be renewed as they decay.

Palings are generally employed in the neighbourhood of the house, and are of flat boards secured in a variety of ways to vertical uprights, these being on the side farthest from the house, so that a flat surface of timber is presented to view. This is when close-boarded paling is used. As a rule, palings of this kind

are profoundly ugly as put up with us, and one has to go to the Continent to see what really beautiful effects can be produced by the way in which the boards are cut into ornamental forms at their termination, or provided with perforations on their surfaces of a very neat and often striking character. In figs. 1 to 4, Plate 40, we give illustrations of various forms of paling, chiefly of an ornamental character. Figs. 6 to 11, Plate 40, and figs. 4, 5, 6, 7, and 12, Plate 41, are designs for the upper termination of gates.

Gates are of various designs, so far as the way is concerned in which the bars, etc. are arranged together; but there is one point in every well-formed gate which is an essential feature. This is illustrated in fig. 1, Plate 41, and is the placing of a diagonal, as $a b$ or $c d$, stretching from one corner to the other, dividing the rectangular frame $a b c d$, into two triangles, as $a d b, b c a$. This arrangement of triangles, which is the element of a truss, is the way in which the greatest strength can be given to a rectangular frame, as $a b c d$, of a gate. Any arrangement, therefore, such as in fig. 1, Plate 42, in which this diagonal arrangement is absent, is sure to give a defective and weak form of gate. The diagonal acts either as a strut or a brace, or as a tie (for definitions of these terms, and for other matters of great practical constructive importance, the reader may consult with advantage our large work, *The Practical Guide to Carpentry and Framing*, published by the Messrs. Fullarton & Co., of Edinburgh and London), according to the position in which the gate is hung. If e be the hanging post, or that by which it is hung to the fixed post, the diagonal $c d$ will act as a tie and be under tension, the parts of the gate having a tendency to fall in the direction of the arrow; it may therefore be an iron rod. The other diagonal acts as a brace or strut, and may be of wood; but in a wood gate it would look awkward to have two materials, wood is therefore used for both diagonals. However a gate may be designed, and its general surface or body within the frame filled up, so as to show a front more or less ornamental, as figs. 8, 9, 13, 14, and 15, Plate 41, the diagonal should always be provided; for when absent, some part will go wrong, and will inevitably be weak, and give way sooner or later

at some of its parts. This is the principal cause of gates drooping and pulling down the posts, although we shall see afterwards that this arises from defective ways of fixing the latter. Various designs for gate-posts and balustrades, and posts as terminations for balustrades, are given in Plate 45.

Hanging Gates.—Some prefer to have a gate hung so that it will be ‘self-closing.’ This has its disadvantages as well as its advantages, and we incline to think the former greater than the latter, as they are sources of danger as well as of inconvenience. Thus, in passing through a self-closing gate, especially if it be so hung as to close quickly, the gate may catch an animal before it gets fairly through, and do it injury; or it may come in contact violently with the hind part of a vehicle. A self-closing gate may, in fact, be said to be a contrivance to overcome the difficulties which arise from pure neglect of a duty, which is to close the gate after it has been passed through,—a duty which is clearly one which ought to be done. In hanging a gate which is designed to hang freely at any point of its opening, all that is necessary is to make the upper stud, a , fig. 12, Plate 43, exactly perpendicular over the lower stud, b , so that a bar passing through the centre of both will be exactly vertical, that is, if the post itself be so. To make it self-closing if not opened more than three-fourths of its sweep, which sweep is a semicircle, described from the centre of the gate-post hinge stud, the gate opening both ways, the stud of the upper hinge, as a , must be made at a point from the plumb line, $a b$, nearer the gate, as d , equal to two inches, than the lower stud, b ; the gate in this instance being on the side, d , of the plumb line, $a b$, or gate-post. If the upper stud, a , be placed to the left of the plumb line, $a b$, or nearer the gate side of the post to the extent of an inch, and the lower stud, b , be placed an inch to the right of the plumb line, or farther from the gate side of the post, as at the point e , then the gate will fall wider open if it be opened to a greater extent than the fourth of a circle, which it will in the great majority of cases be sure to be. This disadvantage is obviated by the arrangement of the studs first named. As to people passing through on horse-

back or in a vehicle, as it is a trouble to them to descend to close the gate, it will be as well to hang it so that after passing through it will have a tendency to fall towards the post without requiring a great push to enable it to catch the latch. It is scarcely necessary to say that in place of adjusting—when the gate is designed to be self-closing—the studs from the plumb centre line, *a b*, fig. 12, Plate 43, the same result will be attained if the ‘hanging post’ be set in the ground one inch or two inches off the perpendicular or ‘plumb’ according as desired, and as above stated. A self-closing latch is a necessary appendage to a self-closing gate; one which may be made by any labourer is shown in fig. 13, Plate 43, by bending a rod of iron and jointing it at *a* to the bar of the gate below the latch, *b*, and upwards towards *c*, where it may be finished with a handle, *c*. Simple forms of the joint, *a*, and handle, *c*, are shown at *d* and *e*, which can be made in the ‘smithy’ by any labourer. The greater the angle made by the line *a b* with that of *a c*, or the distance of the handle, *c*, from the joint, *a*, the easier the latch falls down.

There are different modes of fixing the hanging or hinging post, to which the gate is hinged, in order that it may be as firm in the ground as possible. Fig. 9, Plate 43, illustrates one method to which generally various minor modifications are added. In this, *a* is the hanging or hinging post, inserted pretty deeply into the soil, say some thirty inches or three feet, and thereafter fixed in the centre of a flat stone, *b*; and there is sometimes the further precaution taken of having another stone, as *c*, placed vertically as an additional bearing surface, with smaller stones between it and the soil. A stay or tie, *d*, is sometimes also secured to the post and to a stone, *e*, placed at an angle as shown. The same arrangement is made at the lock or latch post, at the opposite side of the gate. Another method of securing the two posts—the hanging and the latch—is shown in fig. 10, in which the two posts are

connected at feet by two iron bars, let into matrices made in the posts, *c d*. Fig. 11 shows a method of fixing the feet of the posts by small stones at sides and bottom. The forms of hinges are very numerous; some are made very ornamental. Fig. 3, Plate 41, shows a form of hinge in which the upper part of head post of gate, as *e*, fig. 9, in place of being made plain, as in field gates, is finished off as at *a*, fig. 3. Figs. 4, 5, and 7, Plate 41, show other ornamental forms of finishing off head post, top, and upper rails of gate. Entrance gates to parks are made highly ornamental, generally in keeping with the style of the house. Various forms and parts are shown in Plate 41, fig. 10 being a rusticated gate, formed, like the fences in Plate 42, of natural branches of trees selected with care and a natural taste for one’s work. Some have a peculiar aptitude for work of this kind. We know a gamekeeper who constructed work of this kind which would have done no discredit to a first-rate artist, yet he had no designs to work from. It was all done by the aid of the eye alone, and the design seemed to work itself out, so to say, as he proceeded. A small hatchet, a hammer, a saw, and a forester’s knife were all the tools he had. The forms of latches are also numerous. In Plate 43 we give various designs for iron gates, fig. 3 being part of one adapted to iron fencing, in which the gate is at some part where an entrance is desired. Fig. 5 shows part of a farm field gate. Fig. 4, a wicket gate, made by Messrs. Morton & Co. of Liverpool, which is designed to admit of the full opening being given, so as to admit of sheep, wheelbarrows, etc., being passed through. This is effected by simply jointing the part *aa* at *bb*. The arrangement is shown in plan in fig. 7, where the turning part *a*, centring at *b*, is kept locked, which it may be by one or other of the arrangements shown in fig. 8, Plate 43; the gate cannot pass the points, but by unlocking *a b* the full opening is obtained, as at *d*.

CHAPTER III.

OUTLYING STRUCTURES OF THE FARM—SHELTER SHEDS IN PASTURE FIELDS, ETC.—
SHEDS OF TIMBER GENERALLY.

IN a preceding chapter in the First Division we have devoted a brief section to the explanation of the principles on which the necessity for shelter sheds in outlying fields is based and advocated by advanced farmers. These sheds are essential, not only in serving as protection against the cold and damp of winter, but from the excessive heats of summer, with their attendant plagues of tormenting and even dangerous insects. We now give a few remarks and illustrations showing how such sheds can be economically and readily constructed. The cheapest kind of structure which can be obtained, and in the quickest way, will be that made up of rough (home) timber posts, or the bolls of young trees driven into the soil at intervals, more or less wide as the posts are strong or the reverse, with their branches interlaced between them horizontally, and the spaces thus formed filled up with gorse or whin or broom; or failing these, the smaller loppings of beech or hornbeam, with their attached leaves, may be used. Fern leaves or bracken may also be and have been used; and if so with some degree of skill and care, so that they interlace and bind in one with another, a shelter of no small efficiency in keeping out blasts of biting cold winds will be obtained, and at a very trifling cost. The final interlacing or finishing cover should, of course, be so arranged that the rain will be shed towards the ground; and it will serve to keep the shed, as a whole, freer from damp, if an open drain or cutting be made all round the shed. This will be most readily formed with the spade, making a triangular section with two cuts taken at an angle. The cut should be made shallow at the beginning of the drain, and gradually deepen as it ap-

proaches the point at which it is carried on to the ditch. Should there be a high bank or stout fence at the part of the field most exposed to the prevailing wind, this will form a good site for the shelter shed, which, being to the windward of the bank or fence, will be thus sheltered from the full force of the wind; otherwise it might be injured, if not blown down, in heavy gales. To strengthen the somewhat frail structure,—for at the best it will be but a makeshift,—diagonal stays may be added, these being driven into the soil and secured there somewhat as hurdles are secured in folding sheep, and nailed or spiked finally to the vertical posts.

Makeshifts as such shelter sheds just described are, and rough-looking and ugly as they will be in appearance, they will be infinitely better than none,¹ and their erection will yield to the farmer such mental satisfaction as will amply repay him for the trouble he may be at in providing his fields with them. Apart altogether from the pecuniary benefit he will obtain from their use, he cannot, if his mind be rightly balanced, but feel more comfortable from knowing that the animals entrusted to his care are by them made more so,—saved, in fact, from what in many cases

¹ In some—we may say with all safety, in many—districts of England such rough-and-ready structures form the only buildings, if such they can be called, of the steading or homestead; and they are so placed, moreover, in relation to one another, that any of the regularity in working, which we have already shown to be essential to secure economy of time and labour, is utterly out of the question. Such steadings are a disgrace to the farming of any district in which they are met with, and may well give rise to heart-burning complaints and charges. Nor is Scotland—the land *par excellence* generally of substantial steadings—altogether free from such excrescences of structures as forming part of the regular steading, but fortunately they are few and far between.

and seasons is absolute pain. Such higher considerations ought not to be left out of account in considering the subject now being discussed.

Should the farmer have in his employment one of those men who are known as 'Jack of all trades,'—a title which savours more of ridicule than such men deserve, inasmuch as they are really valuable servants about a farm, where, as on ship-board, such varied work is required to be done,—he would find no great difficulty in constructing sheds of timber, but the 'filling-in' of which is of straw, in place of gorse, furze, whins, or brackens, as just described. These timber and 'straw-walled' sheds, if this term can be used here, will be much neater in appearance, if executed with anything like a fair degree of care, than the rough gorse-filled ones, and they can be made very durable by coating the surfaces with one or other of the preservative materials we have elsewhere described. The following brief hints may serve as a guide to the 'Jack of all trades' in erecting and finishing such straw-walled sheds.

At the four corners of the intended shed, posts should be secured, these being well wedged up with wood wedges or stones, so as to keep them as 'plumb' as possible. Between these, other posts of smaller scantling or dimensions should be secured, and diagonal stays or braces placed between and nailed to the upright posts. The height of all should be equal, and over all horizontal pieces should be secured. The back posts should be higher than the front ones, so that when a series of poles are laid from one side to the other, these poles, forming the roof, will have a slope from one side to the other. These poles may be nailed to the horizontal timbers, or tied to them by tarred ropes. Between the posts at the sides and ends and the poles forming the roof, smaller poles may be wattled or intertwined, and straw at the same time filled up in such a way that it will go in and out between the whole. A 'natty' labourer will do this sort of work in a quicker way than we take to describe it; and if the covering is not thought thick enough to keep out the cold, straw may be put on and secured by pins and tarred rope in such a way as to make, if not a neat, at least a thoroughly snug shelter. The door should be made at the end or

side opposite to that at which the 'cruellest' wind blows generally. This is but a hint, but there are many other ways in which shelter sheds, 'rough but kindly,' may be extemporized, and which will serve not only for wintry but for summer weather, in which the poor animals, rendered half crazy by the attacks of the 'fly,' may shelter, for at such times shelter sheds are scarcely less useful than in cold wintry weather. The 'Jack of all trades' should have also no difficulty in designing a system of portable shelter sheds, the parts of which could be set up and taken down with great facility. The posts should be made 'multiples' of each other, so that any part could fit any required position which it had to assume, and so that there would be no looking out for this part and that part to 'fit in.' The vertical posts in very superior work might be fitted with the adaptation of Mitchell's 'screw-pile,' now so largely used in a variety of ways. The roof timbers and braces should also be made adjustable, and of the same dimensions throughout, so that any one could be used for any part. There is more to be made of this convertible system of construction than has yet been made in the farm, and its uses will suggest themselves to many in construction.

The capability of taking such shelter sheds to pieces, and again erecting them in some other and not very distant part of the farm, with anything like moderate ease, and so as not to require the employment of skilled labour, offers advantages which will at once be obvious to our readers. The only part which we would be inclined in some cases to form of anything like a permanent character would be a foundation-course of brick, on which to lay the 'site' to carry the uprights; but even this may be dispensed with by tarring the 'sill' and coating it thereafter with sand; this, if well done, will preserve the wood for a long time against the effects of damp. The foundation 'sill' may still further be protected from wet by making an open drain all round the shed, sloping away from the side; or if flat stones can be easily had in the neighbourhood of the site of the shed, a handy labourer will not be long in building up, dry-stone-wall fashion, a foundation course a few inches high, which will keep the timber sill well out of the wet. This, however, will apply more

strictly to sheds placed permanently than to those which are portable, the lower parts of which will be sufficiently protected from the effects of damp and wet by using one or other of the preservatives we have elsewhere described. The reader will find in some of the earlier plates of the work, designs for timber erections which will give the 'Jack of all trades' some ideas useful in carrying out this suggestion. These will, of course, be equally applicable to the designing and erection of such shelter sheds as, being in fields near the house and steading, or forming, indeed, some parts of the latter for the housing of one or other of the various classes of live stock, will require or ought to be of a more substantial character as regards construction, and more pretentious in point of architectural design, if such an ambitious term can be applied to them. The drawing in fig. 5, Plate 15, will give a suggestion or two as to the way in which a timber shed can be made to look fairly attractive, at least kept from being positively ugly in the bald and bare deformity generally met with in timber structures, even in cases where some neatness in elevation is clearly required and expected. In concluding this subject, we may say that, much as timber structures may be despised by some, they will afford an infinitely more comfortable and healthy means of sheltering live stock, or storing up produce, than the wretched tumbledown stone or brick structures, or those composite ones of wood and gorse or whins, too often met with, while in point of appearance they will be as superior. Timber properly looked after will last a long time; and we may here—in addition to what we have in a preceding paragraph said as to preservative materials to be applied to them—call attention to the paints for damp preventing and ordinary work introduced by the Silicate Paint Company of Liverpool. Those paints, etc. are highly esteemed by competent authorities.

One system of constructing timber sheds, etc., we would propose,—for there are several we could suggest if space permitted,—is illustrated in the following figs. in Plates 64 and 65, and is a modification of that largely used in America, where timber is used in ways and for purposes which our carpenters little think of. We may here note that as the system is applicable to the construction of

timber houses of a more ambitious character than 'sheds,' and may be applied to structures in which there are two storeys, and in which the flooring is of timber, we have deemed it advisable to prepare the illustrations in such a way that they will serve for both classes of structures, indicating those parts which are not required for the more simple constructions at present under consideration.

The first part of the structure is the sill, which is shown at *aa* in fig. 3, Plate 64, end view, as rectangular in section, and of 8 inches by 3 inches in dimensions. The method of junction at the corners is shown in figs. 1 and 2, the joints being of the kind known as the 'half lap.' In fig. 1, *aa* is the 'sill,' running, say, from west to east; *bb* the half end of the joist, which runs at right angles to this, or north to south, showing in the other view in fig. 2 at *bb*, *aa* in this corresponding to *aa* in fig. 1. The sill is laid all round the site, and of such length and breadth as may have been determined upon,—see a preceding section for best width of buildings for various classes of stock,—each corner being made as in figs. 1 and 2, and when the battens forming the sill require to be lengthened, the same kind of half-lap joint is used, as indicated by the dotted lines at *d* in fig. 3; the two being further secured, if deemed advisable, by a trenail or pin inserted in an auger hole made at *d*.

At each corner, and also at door or entrance, the upright posts, as *cc* in figs. 1 and 2, are square in section, the size being 4 inches by 4 inches; but the other posts between the corner ones, as the posts *bb* in figs. 3 and 4, are rectangular in section, being 4 inches by 2 inches. (In the case of a structure in which a wood floor is required, the joists for supporting the timber flooring boards are laid as shown in figs. 1 to 4, the 'corner' joists, as in figs. 1 and 2 at *dd*, being of larger scantling, 8 inches by 3½, than the central joists, *cc*, figs. 3 and 4, Plate 64, the scantling of which is 7 inches by 2 inches.) The posts may be joined to the sill by the common mortice and tenon joint shown in fig. 2, *e* being the 'tenon' made at the end of the post *f*, *g* the 'mortice' in the face of the sill *hh*; the post tenon may be simply let into the mortice, or be secured there by a trenail or wood pin as at *d*

in fig. 3, or a wrought-iron screw bolt and nut may be used in place of the wood pin. The distance between the corner and smaller posts, as $b b$, figs. 3 and 4, from each other, may vary from 2 feet 6 inches up to 3 feet, these widths serving as the openings for windows, if these be required.

The sills and posts being put in place, the next operation is putting in the 'wall-plate' which is to carry the rafters of the roof. This is illustrated in fig. 5, Plate 64, in which $a a$ is part of the vertical post, corresponding to $b b$, figs. 3 and 4; $b b$ the wall-plate, simply laid on to the squared off end of posts, and secured by nails. The wall-plates join end to end by a plain 'butt' joint, as at d , or they may be made with a half-lap joint, as at d in fig. 3. The rafter is at $c e$, and is laid on at 14 or 16 inch intervals, or even up to 18 inches, according to the lightness of the roof covering, being notched to the wall-plates as shown. In place of nailing the wall-plates to the upper ends of posts, the under side of the wall-plates, $a a$, fig. 6, Plate 64, may have notches, as $b b$, cut in their lower side to half their depth, and of breadth equal to the width or thickness of the vertical posts, the intervals between the notches being equal to the distances between the posts. These notches receive the ends of the posts, the rafters being secured as shown in fig. 5. In large structures on this system, such as used for the reception of heavy material, as a granary, the corner posts, in place of being in one length of a large scantling, as say 4 by 4, are made up of two pieces 4 inches by 2, which is the scantling of all the other pieces, arranged as shown in fig. 7, Plate 64, in which $a a$ is the sill, $b b$ the flooring joist, $c d$ the corner posts, each 4 by 2, but one, e , being placed at right angles to the other, d . In the case of two-storeyed structures, the vertical posts may be required to be lengthened. Fig. 1, Plate 65, shows one method of doing this, in which the lower piece, a , and upper, b , are joined by a simple butt joint as at c , outside flitches or covering pieces being nailed outside on each side as shown. Fig. 2 has the joint with a mortice and tenon as at a ; the outside flitches, as $b b$, may be dispensed with when this joint is used. Fig. 3, Plate 65, shows the simplest method of securing and supporting

the flooring joists, $a a$, of the second floor, these resting on cross pieces, $b b$, nailed to the vertical posts, $c e$. Fig. 4, Plate 65, shows another method, in which the cross pieces, $a a$ (corresponding to $b b$, fig. 3), are notched into the vertical posts, $b b$; $c e$ the flooring joists. An inspection of the various diagrams illustrative of this system will show that one of its principal characteristics is that the timbers are so disposed that the strains or pressure to which they are subjected act in the direction in which they are best calculated to resist pressure, namely, in that of the length of the fibres of the wood, not across them, as is too often the case in other methods of disposition of timber framing; in other words, the strains are nearly all tensile, that is, having a tendency to pull the fibres apart, in which direction timber exercises its greatest strength; indeed, it is a difficult matter to tear asunder timber along its length, while it is comparatively easy to break it across. This feature of the system enables timbers of much less scantling or dimensions to be used than under the ordinary system. It will also be observed, that although the ordinary joints of carpentry, as tenons (as in fig. 2, Plate 65), scarfing (the half lap, as in figs. 1 and 3, Plate 64), and notching (as in fig. 6, Plate 64, and fig. 4, Plate 65), may be used, they can all be dispensed with and simple nailing used in place of them, thus making the work so easy as to be within the compass of the most ordinary labourer's capacity for work of this kind. It is to be observed, however, that the nails must *never* be driven at right angles to the pieces, as at e , fig. 2, Plate 64, but always diagonally, as at f in same figure; this diagonal method of driving nails is the true secret of obtaining the strongest possible construction. We have every confidence in recommending this system to the notice of the practical reader; it has been most extensively adopted in the United States, where structures sustaining heavy weights are formed with scantlings of timber so small as to have called forth expressions of astonishment how such slender, spidery-looking erections could do the work they did so well. The carpenters of this country have much to learn from those of America. Rough, home-grown timber may be used with this system as well as the squared timber of foreign growth, a

little *nous*, of course, being required to select and adjust the pieces. The structures in which it is used will not, of course, look so well as when squared timbers are employed, but for sheds for cattle this will not matter so much. Fig. 5, Plate 65, will illustrate how rough pieces may be used so as to give somewhat of an ornamental effect; and fig. 6, same plate, illustrates the method of forming straw walls and roofs. The support for the straw of the walls is obtained by the vertical uprights or poles fixed firmly into the ground, as *a a a*, and placed near enough to each other to give ample support to the straw. This should be of as long lengths and as unbroken as possible, flail-thrashed being the best, so that it can be interwoven, so to say, between the posts, as *b b b*, shown on larger scale in separate drawing in fig. 6. The straw should run in the direction of top to bottom of the wall, and the interweaving should be done so that the one length will mix with or 'bond,' as a brick-layer would say, with the next contiguous. Still further to give a support to the straw, horizontal pieces of timber, as *c e*, such as small branches, may be placed between the upright vertical posts, *b b*, fig. 6. The straw forming the roof will be put on much in the same way, the best arrangement being shown in *d e*, where the upper layer or row, *d*, overlaps the lower, *e*. The straw should be secured at intervals to the roof-poles or branches by nails, as shown at *f*, the nails being broad headed, and provided with what may be called washers of strong listing or leather, so as to give the nail heads a secure hold and bearing surface on the straw. The roof-poles or rafters, as *h h*, are to be laid pretty close to one another, and secured to what may be called the 'wall-plates,' *g g*. The rough sketch diagram here given is only designed to be suggestive of methods of forming rough shelter sheds with such ordinary materials as may be easily obtained on any farm. A clever labourer will be able to 'knock up,' as the phrase goes, a very effective structure, which, although it may not look very 'tidy' or shipshape according to the ideas of regular workmen, will be found eminently useful, and will serve to save many a valuable head of stock from the tortures of a severe winter, no less than from those of the insects of the summer.

Cheap roofs, which can be made chiefly if not wholly of 'home' materials, is an important department of farm building economy. The following remarks on the subject we communicated to the pages of *The Field*, and give a place to here, although with one or two additions which we consider necessary to make them fitted for our present purpose:—

'Where rough boards can be had, a very good, and indeed a lasting, though cheap roof covering may be obtained by using them. Slabs will answer if of uniform breadth throughout their whole length, although the boards may vary in breadth where uniformity of look is not essential. This uniformity of breadth in each slab is necessary, as the junction lines or edges must run in straight lines from ridge to eave of roof. The joints will thus be so that they can be covered from end to end with the wood "rolls" or "slats." To save labour, if neatness is not important, these covering slats may be made flat on both sides, although the rounding of the upper side adds much to the appearance of the roof. To prevent the covering slats or rolls from being split by the "giving and taking" of the boards of the roof, the joints of which the slats or rolls cover, these must be nailed to the boards on one side only,—that is, either to the right or left of the joint between two contiguous boards,—never to both right and left. In other words, each slat should be nailed to one board only. Thus, if the line of nails of one "roll" be on its left-hand side, the line of nails of the "roll" next in order should be on the right side. Each separate roll thus covers its own board, and is quite independent of the next, and all thus have freedom to "give and take" as they shrink or expand, as the case may be. The neglect of this precaution, or, in other words, the nailing of the slats or rolls to both of the contiguous boards, gives rise to great disappointment and loss, for the joints are never tight. The expansion and contraction—and one or other is continually going on—of the boards either split the rolls or the edges of the boards. By nailing the rolls or slats to one board only, the other board is allowed free to move to and from that to which the roll is nailed, and the joint is always kept covered. Of course, the roll or slat should be made broad enough to cover

the joint even at its greatest amount of expansion. This caution we here give applies also where rolls or slats are applied to cover the vertical joints of the sides of a boarded shed.

'A roof boarded and rolled may be made to last well for years, without slates, tiles, zinc, or asphalted felt, by simply covering its surface with a composition of ordinary coal tar, in two or three coats, as follows. The first coat is the coal tar simple, applied hot, and in fine weather, when the surface of the boards of the roof is dry. The tar should in the first instance be applied with a soft brush, and as evenly or uniformly over the surface as possible, beginning nearest the ridge, and working gradually down to the eaves. It is better, also, to cover the whole surface by narrow strips, each strip reaching from the ridge to the eaves; beginning the strips, say, at the west, and working on gradually to the east end. By this means the whole will be more uniformly done, and in such a way that when once a strip is done there will be no necessity for walking over the surface till the whole is thoroughly dry. As above stated, the coal tar should first be laid uniformly on the surface being worked at with a soft brush, and then this part well rubbed in with a hard brush. There is a brush made on purpose for this, which is at right angles, or nearly so, to the handle. The tar should be rubbed well into the wood by means of this brush, working it backwards and forwards, and in angular directions as well. The object being to get the wood well saturated with the first coat, a little labour and pains should not be spared at this, the first part of the work to be done. The next coat is made up of coal tar as before, mixed with clean, dry, sharp, river sand, in the proportion of one part sand to three parts coal tar, the whole being well and thoroughly mixed before it is applied to the roof surface. The application is made as above described for the first coat, care being taken that the first coat be dry. If two coats satisfy the owner, the last coat when finished, and while the stuff is wet, should be sprinkled well over with the dry sand only, which may be pressed down with a flat board to secure its adherence to the tarred surface below. A very pretty effect is obtainable by using, in place of sand, crushed or pounded

shells; and if these can be obtained of different colours, by a little judgment displayed in the laying of these on the surface, either in horizontal or vertical strips, or in diamond or other shaped surfaces, a still more pleasing effect may be obtained. The more numerous the coats of coal tar and sand are, the more lasting will the roof be.

'The same application as above described may be given to roofs the boards of which are covered with asphalted or roofing felt. As to the laying of this on, little need here be said, the maker from whom it is obtained generally sending out explicit directions for putting the sheets of felt on the boarding with which the roof is covered as a foundation. One word of advice only would we give here: do not make the overlap—where one sheet overlays the other—too narrow, with the object of saving the felt; this is false economy. Let the overlap be at least three inches in width, and use zinc, tinned or galvanized, not iron nails, or better still, copper nails.

The objection to coal tar in its crude state is that, from the pyroligneous acid present in it, it has a tendency to destroy the material of which felt is composed; but this objection does not obtain with such force in its use for covering wood boarding. When objected to, an excellent preservative for felted roofs is a mixture of asphaltum with the light oil or naphtha obtained in the distillation of crude coal tar. In place of the pure asphaltum, which is rather dear, the pitch obtained also from the distillation of crude coal tar may be used with almost equally good effect. The pitch is first melted, and the naphtha added while the pitch is warm, not too hot, as the naphtha will be apt to take fire; when well mixed and allowed to grow cold, the substance may be applied to any surface like paint. It is also valuable for preserving zinc or galvanized iron roofs, rain-water pipes, or other metal surfaces exposed to the atmosphere. A composition, with this mixture as a base, has been recently introduced as a substitute for felt, broken or crushed asbestos being mixed with the pitch and naphtha; this is spread on the material with which the roof boarding is covered as a foundation, canvas or paper being used for this purpose.

'The cement known as "Portland" is now being used, as we have repeatedly exemplified in these

pages, in a variety of ways in construction, and with marked and most economical advantages; perhaps its most recent application is to the formation of cheap and durable roofing in conjunction with coal tar, and the strong brown paper, such as is used for laying under carpets. The paper is laid upon the boarding of the roof, the sheets overlapping not less than three, but better if four inches; the sheets are then tacked down, and the surface covered with the composition, which is made as follows:—Take 180 lbs. of Portland cement (this should weigh, to be good, 100 lbs. to 110 lbs. to the bushel), and mix it well in a caldron heated by a furnace. Care must be taken to heat the tar gently at first, so as to prevent it boiling over; and the cement must be mixed gradually in small quantities, so as to ensure its thorough mixture with the tar. The mixture, when completed, is to be spread over the surface of the paper with a brush, and in as hot a condition as possible. The surface is then to be rolled over with a light roller, to make it as even as possible, and when partially dried is then to be covered with another layer of brown paper, care being taken to make the second layer to “break joint” with the first-laid layer; that is, the centre of the sheets of the second layer should be placed over the joinings of the first layer. A little practice will enable this to be done with ease. In some cases a layer of sand is laid all over the surface of the boards before the first layer of paper is laid down. The second layer, which will not require tacking down, as it will adhere to the cemented surface of the first layer, is next to be coated with the hot cement, as before, and a third—and if a first-class roof covering is desired, a fourth—layer of brown paper laid down, each layer breaking joint with the one preceding. The last layer is covered like the others with the hot cement, and strewed thickly and uniformly over the whole surface with clean sharp sand and ashes. The gutter is attached to a gutter board, which should project six inches at least beyond the eaves, this being fixed or nailed down after the first layer of paper has been laid down. The second layer will, of course, be made to extend over the whole surface of the gutter board. The flashings at chimney and copings, if any, should be placed so as to pro-

ject at least six inches above the roof covering; and they should be turned at their upper edges into the joints of the brickwork, if this be the material, or secured to the timber if that be used, and well cemented in the same. To prevent the feet of the workmen injuring the surface of the paper, they should work on thin boarding placed over the roof; and to prevent all returns upon the surface laid down, the layers should be begun and continued at the ridge, and worked down to the eaves.

‘As a substitute for the asphaltic *felt* roof covering so largely used, a new species of roof covering has been recently introduced, in which pasteboard is the base in combination with asphalt. We have used this, and found it to form an excellent and very durable roofing. It becomes in a very short time as hard as slate, and is said to be fire-proof, as indeed most crucial tests which have been applied to it showed it almost, if not quite, to be. We are glad to say that none of the buildings to which we have applied it have afforded us the opportunity to put it to this test. In all other respects our experience enables us to speak highly of it.’

Few have advocated the use of timber for the erection of the main buildings of the homestead or steading, and in view of the readiness with which this material takes fire, and the quickness with which, when it does so, it is totally consumed, prudence would scarcely justify its adoption. Still in some districts, where home timber is plentiful, and sawing machinery driven either by water or horse power is available, there may be cases in which additions, at least, might be made to the steading with it. These might be considered as but temporary until erections of a more durable and safer kind could be constructed, or maintained only till some special purpose or urgency which called them into existence was met. In a paper read before the Farmers’ Club, London, by Mr. Bullock Webster, ‘On the best and most economical plan of Farm Buildings that can be recommended to Landed Proprietors’ (November 1854), he advocates the use, indeed, of such materials as the district best and cheapest affords,—bricks in one place, stone in another, clay clumps in a third, timber in a fourth, and so on. As regards the general principle of

arrangement, Mr. Webster advocates the use of a series of sheds, arranged in the way best suited to the peculiarities of the district and the kind of stock to be kept, but prefers the square or oblong (rectangular) as being the 'most advantageous,' and admitting the convenient arrangement of the sheds for working. He is a strong advocate for wide buildings, such as we have insisted on, the width of his sheds being, in fact, the same as that we recommend, namely, 18 feet; the height from floor to the level of wall-plate for roof being 8 feet. Where timber trees are abundant on the property,

Mr. Webster suggests that in cutting them down, and afterwards in cutting and sawing them up into timber, directions should be given that anything which could cut up into rafters, wall-plates, etc., adapted for the sheds, if 18 feet wide in the clear, should be laid aside and stored up, so as to be ready for the use of any of the farmers on the property who were building or extending their farm steadings. The reader will find in another part of this work remarks and illustrations on the use of timber as a material for the construction of cottages.

CHAPTER IV.

LAND DRAINAGE—ITS IMPORTANCE TO LANDED PROPERTY.

Land Drains and Drainage—what they are, and what it is.—It is not our intention, as it is not indeed within the province of our work, to give anything like an exhaustive statement of drainage in its practical details; our object will be fully served if we name a few of its leading principles, and this chiefly with a view to show the importance of carrying it out thoroughly, wherever it is desired to have lands capable of yielding their fullest produce. In addition to this statement, we shall also give brief paragraphs descriptive of drainage as applicable to certain lands and districts. The importance, to all interested in landed property, of a correct, even if it be but a limited amount of knowledge of land drains and drainage, can scarcely be overestimated, for to the system of modern drainage of farm land may be attributed much of the increased produce which it now bears, as compared with that formerly obtained from it. But although drainage has done so much for farmers, it is certainly surprising how many even of them have very inaccurate views as to what its principles are; nay, more, even as to the way in which drains act, and the several ways in which they operate beneficially on the land. We say the several ways, for it is not known to all that drains do not act in one way only, as so many suppose. What these ways are we shall see as we go along. The primary, and what may be called the essential work which drains have to perform, is to get rid of the water which lodges in the soil. This, in our moist climate, with such heavy rainfalls, is generally in excess of the requirements of the plants; and when so, and especially when lodging in or about the part in which their roots find a space, in a stagnant condition, materially injures them by arresting their growth

and preventing their full development. This injurious action of water in excess in a soil operates in several ways; amongst others, it tends to lower the temperature of the soil, and by increasing the sources of evaporation, lowers that also of the atmosphere immediately in contact with the surface or floating over it. This is known and understood even popularly, as a damp soil is always set down as being in or forming a cold region. Our ancestors had a dim perception of the evils arising from an excess of moisture in the soil designed to bear the few crops they cultivated, and in order to get rid of what they believed to be the only source of this excess, namely, the rain water which percolated from the surface to the soil below, they formed channels, known as furrows, at varying intervals of width, and communicating with ditches made alongside the hedges. These channels or furrows led the surface water into the ditches; and when to a certain extent the land was kept or made to be surface dry, they fancied that all that could be done was done. In districts in which the rainfall was less than that in others, as less surface water had to be carried off, the furrows or channels were made less frequently, or at wider intervals along or across the surface of the fields. Hence the difference in the width of land between the furrows in different districts, a circumstance which has puzzled not a few to account for, and is popularly set down as one of the many examples of the careless way in which farmers did their work,—a puzzle which, in another way, has descended to our day, and which has increased rather than lessened the intricacy of its solution; for it so happens that, as a rule, the modern drains have followed the lines of the ancient furrows, so that this diversity in drainage practice is also set

down to the stupidity or carelessness of farmers, whereas, as we may see, there are good reasons for the practice. In process of time, as men began to see that the mere getting rid of the excess of rainfall did not get rid of the dampness, etc. of the soil, it occurred to some that the evil was connected with something more than with the surface only of the soil. It is far beyond the limits of our brief chapter to enter into the history of draining, interesting though it be; we must pass its details wholly over, stating only this much, that one plan followed another, each more or less successful, so far as one point only was concerned; but all were wide of the true mark, till at last the blot, so to say, was hit, and the true system of drainage discovered, and at once placed on the list of things accomplished, by and through the scientific knowledge, practical skill, and indomitable energy of Smith of Deanston, to whom agriculture owes many other inventions and discoveries, and who gave to his system the name of 'thorough drainage.' At once grasping the difficulty, he saw that the key to its solution lay in the fact that the evil was under the surface, and that under the surface it must be met. In place, therefore, of placing his trust upon the furrows of his predecessors,—although he did not discard them, as they served more than one useful purpose,—he made his channels under ground. These were laid or dug at some depth from the surface of the soil, and taking the arrangement of main drains and subsidiary ones, the underground was intersected by a series of channels, all converging and leading their contained water to the main outlet or outfall drain or ditch. The position of the drains or channels was regulated according to the peculiarities of the land to be drained, and their slope or inclination as well. When first introduced, the system laboured under great disadvantages, chiefly arising from the defective nature of the materials used to form or fill in the drains with, and which at that time were alone those which the agricultural engineer had at his command; and it was not till the earthenware or burned clay drain-tube was invented that it could be said to be carried out with all the efficiency which was essential to its thorough success. The reader not initiated into

the mysteries of the farming art is, of course, to understand that the drain-tubes are placed at the bottom of channels or trenches cut into or out of the land to receive them; that, made in short lengths, they are placed end to end, so as to form a continuous line for the whole length of the trench; and that when properly laid, the soil taken out to form the trench is filled in so as to cover them completely up. The interstices throughout their length, at each point where two contiguous tubes are placed end to end together, allow of the water percolating through the soil from the surface downwards, laterally from the sides, or upwards from below, to enter the interior of the drain-tubes, and these being placed or laid upon an incline or slope, carry the water on towards and deliver it to cross intersecting and larger diametered drain-tubes, and these again to the main outfall, which may be a ditch, or rivulet, or stream, or river. Such, then, is a very brief and simple statement, free from all technical details, but which, nevertheless, will convey, we hope, a fair idea of what drains are, and how they are placed or laid in the fields which they are designed to drain. How they do drain it, or in other words what drainage is, the statement also shows, but not so fully and explicitly as we wish it to be, and to which fuller description we would beg the reader's close attention. Popularly, and indeed, we may say, technically, on the part of those closely connected with farming, it is supposed that what drains do is chiefly, if not by some thought wholly, to catch the water as it descends through the soil from the surface, or such portions as may pass through the sides of the trench or the soil at the sides of the drain-tubes. Now although this is the case to a large extent, it is not always that the drain-tubes catch or arrest descending water; in many soils the probability is—for we can only conjecture in such hidden operations, although the conjecture is pretty well founded upon facts—that by far the largest proportion passes the drain-tubes wholly by as the particles (of water) drain through the soil, and this because they find an easier passage vertically, than by deflecting and going onwards towards the drain-tube, this being more decidedly the case farthest from these. How, then, can drain-tubes in such cir-

circumstances drain the land? A little farther back we italicised a few words, which were these: '*or upwards from below*;' and this is what was meant by them. In all lands there is a level, the depth of which varies according to circumstances, at which level or point the water is arrested, the nature of the soil below or at this being such as to prevent any water passing through it to a lower level. Now suppose that so much of the surface water, not arrested or caught up by the drain-tubes, keeps passing down the soil till it reaches this level, and that it cannot, from the nature of the surface, pass away to any side; the consequence is, that the water must continue to accumulate below in what we may call the lowest receptacle, and as it accumulates, its level will continue to rise upward in the soil, until at last it gets to the level or a little above that of the drain-tubes; and the next result is, that it will pass through the interstices of the tubes, and into their interior, and as these are on the slope, it will be at once led off. In this way, therefore, drains act as conveyances of water coming up from the soil below. This process, not known to a few connected with farming, may be popularly illustrated by supposing a sponge to be placed at the top of a glass vessel, descending into it say an inch in depth. Water poured into this vessel on the top of the sponge will pass through this, and, filtering slowly, will drop from its under side to the bottom of the vessel; continuing to pour water upon the sponge, the space below it will ultimately get full, and coming up to the level of the sponge, will again be re-absorbed by it and be again filled, but this time from below. Here the sponge is the soil in which the drains are placed, the space under it the lower stratum of soil, the bottom of the vessel the impermeable soil through which the water cannot pass to a lower level.

The distances between the drains, and the depths from the surface at which the drains should be laid, are points about which a vast deal has been written with reference to the fixing of certain rules applicable, or said to be so, to all circumstances. This uniformity of practice, however, it is needless to say, can never be hoped for, in view of the wide variety of soils, their position, locality, and mechanical or natural character-

istics, such as light, heavy, or intermediate. The points of practice can only be decided after a close investigation of the locality, and a mature consideration of all the points connected with the land proposed to be drained. As regards the depth, one point has been made very clear by the experience of the last generation or so, namely, that this has been far too shallow. That the full advantages of draining cannot be obtained by the shallow system, will be obvious by studying the considerations and principles we have pointed out in our preceding remarks. By drains placed at but a few inches' depth,—for some are but little better than this,—the zone or stratum of soil brought within their influence is very limited; and that many advantages are thus lost, which would be gained by a deeper zone, will be seen from the following consideration, which must be added to the others we have already given as making up the important list of advantages which drainage affords. For it is not only the withdrawal of the water from the soil, preventing the formation of stagnant deposits therein, and raising its general temperature, which exhausts the list of drainage benefits; there is another and an important one which it serves, namely, the opening up of passages or ducts, as they may be called, down and along which air is led and passes through and amongst the particles of soil; for as water contains air, as the water percolates downwards through the soil it delivers so much air to it, as well acting thus as in another and a mechanical way, so to call it, that is, by frictional dragging or carrying down what may be called columns of air. Again, as the drain-tubes, which intersect each other in the form of main drains, cross drains, and subsidiary drains, cut up the ground into a series of parallelogramic or rhomboidal spaces, and as these have a great number of open joints, and as all ultimately terminate at points, namely at the out-fall, open to the air, there is thus formed in the interior spaces of the soil, at a depth proportionate to the depth at which the drains are laid, a series of air tubes, along which air is continually passing, and through the joints of which it is supposed to pass into the soil. Nor are the aerial operations thus continually going on, and which are ever working to ameliorate the condition of the soil, and to afford nourishment and a stimulus

to the roots of the plants which grow in it, confined only to the media we have explained; the influence of evaporation of the water and moisture must not be overlooked, as being powerful more or less in this way. A continual circulation is thus going on within the soil of those very influences which we have seen to be beneficial; and these are rendered all the more efficient if they are carried out in conjunction with deep cultivation, on which in another part of this work we have offered a few remarks. It will now be evident that deep drainage is much better adapted to secure all the benefits we have thus described than the shallow system so often carried out. But while many are ready to admit that deep drains will act efficiently in light soils, as these are open and porous in texture, in heavy soils of precisely the opposite character they will not admit that they can operate at all. We cannot afford the space necessary to explain fully those principles upon which depend the action of all drains, and which influence that of deep as well as of shallow ones. But a few words will perhaps suffice to make the chief points so clear, that the reader not quite up to the subject will be able to think it out further and fully for himself, and be satisfied with this, that deep drains will and must act so long as the natural laws exist. It is, perhaps, too familiar a way to put the matter to quote the saying, that what can get in can get out, still it really conveys the gist of the point. For heavy lands in many instances are known to be wet, and the source of wet to arise chiefly from surface or rain water going downwards, no under water existing save that which accumulates below at the level of impermeability, as we have already explained. In all cases where objects are hidden from inspection, or are occult, it is dangerous to dogmatize in either way,—as much so, to say that deep drains will take away or drain the water from land, as to say that they will not. In such cases, what is left us to do is to examine what would seem to be the result of the action of certain laws which we know do operate in other cases. Thus we know—and this is not disputed by any one, even by those who are the most determined opponents to deep drainage—that drains placed or laid at depths even of thirty inches, but to give the

utmost limit of allowance, say twenty-four inches, do drain, and drain land effectually. Now, in the absence of facts on either side, it appears somewhat hazardous to say dictatorially that up to those above-named depths drains act, beyond they do not. Who can draw the line which separates the efficient from the non-efficient drains? If thirty-inch drains 'draw,' to use the technical or popular term to indicate that water passes down to them, why should a thirty-one-inch one refuse to do so, why a thirty-three, or even a four-foot drain? We *know* of no law which says that drains will only draw up to thirty inches, but will not draw at forty-eight. But fortunately for the interests of practical science, we have a pretty wide array of facts to prove that drains even at fifty-four inches deep 'draw,' and 'draw' efficiently. Let any one who does not believe in deep drainage cut in the most adhesive and densest of clays a drain trench to the above depth, and he will be soon convinced of the truth of what we have stated. Of course, if it is essential that drains at shallow depth should be well laid, it is still more essential that where laid deep every care ought to be taken to have the best of work done in connection with them. From what we have said, the reader will have perceived that deep and thorough drainage does not yield to the soil one advantage only, but several, and all of the highest value from a cultural point of view. Further, it will have struck the observant student that these advantages would be rendered still more valuable by combining with deep drainage deep culture of the soil; just as deep drainage would increase the value of deep culture, the two acting and reacting on each other, both combining to keep up the continuity of a circle of operations and processes of the highest value to the soil and its products.

Indeed, one may be said to be the complement of the other, and the system of cultivation is not complete unless both be carried out; the two complete the circle of operations which should be carried on in the soil. The depth to which drains should be made, and the distances between the drains, depend upon circumstances; it is in vain to look for rules or a system applicable to all soils, localities, and circumstances. These

require all to be carefully considered; and the fuller and more accurate the knowledge which the farmer possesses on all points connected with the formation and character of the strata, the more likely will he be to be successful in draining. It is not a hap-hazard operation, but one which demands the exercise of a wide, varied, and accurate knowledge of science, and true is it that a thoroughbred farmer is a thoroughbred man of science. But any kind of drainage, so that it be 'thorough,' is better than none; but now that so many good engineers and surveyors thoroughly well acquainted with drainage under all circumstances can be had, there is little excuse for any landowner or farmer not having his lands properly drained.

Importance of Drainage Works being properly executed.—When circumstances of soil and locality are so favourable as to make drainage an easy matter, or where the farmer knows its principles and practice so well that he designs and executes his own drainage, we need scarcely remind such a one, what so many, however, forget or overlook, that an important element of success in drainage work is the personal overlooking of all its details, more especially the levels and the laying down of the drains. We may talk as we like of the 'solid worth, honesty, and integrity of the British workman,' with whom, somehow or other, now-a-days, all the virtues alone seem to remain. But we know a trifle of their habits, and so also, we take it, do not a few of our readers. And one unfortunate habit (to put the matter mildly) is, that whenever any work is to be done which can be or is from its nature covered up or hidden when completed, or said to be completed, some portion at least of that work (again to put it mildly) will be sure to be 'scamped,'—that is, not done properly, or perhaps not done at all! Drainage is of this class of work, obviously, and it will be but prudent on the part of the farmer to see that the work is really done, which means done well. If not done at the beginning, it will not be done at all; and 'Oh, never mind, it will never be seen,' if not a phrase often heard from workmen's lips, is a thought sometimes present in workmen's minds.

The Forms of Drains, or the way in which they

are filled up, varies according to circumstances. In Plate 35, figs. 1 to 6, we illustrate those now generally employed; figs. 1 to 3 being those in which stones are used to fill up the drains, figs. 4 to 6 those in which drain-tubes are used. The horse-shoe drain and flat tile, at one time so much employed, are now almost entirely discarded. In reclaiming land where stones are numerous, by far the cheapest mode of filling drains is to employ them, as in figs. 1 to 3. The method will, of course, vary according to the size and shape. In low lands where clay fields (see succeeding chapter on 'Tile-kilns') are present, and extensive tracts of land are to be drained, by far the best form of drain is that in which the circular drain-tubes are employed. These are sometimes used along with 'collars,' in which are short lengths of circular tubes, as *aa*, fig. 11, Plate 35; these embrace the drain-tube, *bb*, so as to cover the joint, *c*, and prevent any roots from entering the tube by means of the joints, or soil, etc., apt to silt and stop them up. The collars are, of course, loose, and wide enough to easily admit the water. They add considerably to the expense, and some do not deem their presumed advantages to be repaid by their use, holding that the better way is to have the tubes properly laid, so that the tubes will not separate and get out of place or true level. On this point we have already offered a remark. Attention must be paid to the condition of the 'outfalls,' and the 'valves' or 'traps' fitted up there. Generally the 'outfall' drain is led to the nearest open ditch; but this is often through neglect allowed to get so silted or filled up with mud, that this gets up to or beyond the level at which the outlet flat, valve, or trap is placed. In this case it is obvious that the latter becomes quite inoperative. The ditch should be kept quite free from mud (see Chap. I. Division I, on 'Roads'), so that the trap will be free to act. The simplest and perhaps the best form of outfall flap is the earthenware one shown in section in fig. 8, Plate 51, and in front elevation, fig. 9. This may be made more effective in preventing rats from entering the drain by having a small frame with grating attached in front.

In laying drains, it is essential that the level of the bottom, or the 'floors,' shall not only be

perfectly uniform throughout, that is, not leaving any indentations here, protuberances there, but that the line of descent or inclination to the out-fall shall be perfectly straight. To ensure this, what are called 'levelling rods' are used. These are illustrated in fig. 10, Plate 51, and consist of central staffs, three of which are used. Two of those staffs are made two feet long, and the third as much more than two feet as the drain is deep; that is, if the drain is 3 feet 6 inches deep, it must be 5 feet 6 inches long. The staffs are strips of wood, with cross-pieces 9 inches long at the end that is to stand uppermost. The two shorter staffs are planted upright, one on the ground on a level with the field at the head of the drain, and the other at the lower end; and a man stands at one of them looking over its top, with his eye in a line with the other. A second man then takes the longest staff and holds it upright in the drain, just touching the bottom, and walks along from one end of the drain to the other, keeping it in the upright position. If, while it is moved along, its top always appears in a line with the tops of the other two, as seen by the person looking along the three, the fall of the drain is uniform; but if it rises above this line at any one place, the bottom is too high there, and requires to be reduced; if it falls below the line, the bottom is too low, and must be raised. In this way the fall may be rendered perfectly uniform.

The Cost of Drainage.—A great deal could be written under this head, as it is clear that circumstances of locality and soil, supplies of materials, rate of labour, etc., exercise an impor-

tant influence upon the point; at best, one can but give what may be looked upon as an average illustration, and perhaps a practical one is met with in that given by the well-known authority, Mr. Spooner, in a Parliamentary paper issued on the subject of drainage. Under the old system of construction, with drains stone-filled or provided with horse-shoe tiles and soles, the general rule held was that the cost was equally divided between the labour and the materials; but under the improved system of tubular drains, there is found to be a considerable balance of the materials as against the labour. It is right, however, to note, what will be evident enough, that the cost of drains is materially increased as their depth increases,—a general rule being, that their cost is doubled for every foot of increased depth, and the same proportion for every part of each increase. The cost of labour, however, can be determined with sufficient accuracy by comparing it with the standard of the value of moving a solid yard of earth of any one description of hardness. On this basis Mr. Spooner has drawn up the following table, applicable to the two classes of drains, stone-filled and tubular,—the depths in each being assumed as 3 feet in figs. 3 and 5, Plate 35; 3½ feet, figs. 1 and 4; and 4 feet, figs. 2 and 6, Plate 35; the width at top being 18 inches in fig. 2, 16 inches in fig. 1, and 12 inches in fig. 3, the width at bottom in all three being uniform, namely 8 inches. The widths of figs. 4, 5, and 6 are the same as in figs. 1, 2, and 3, but the width at bottom, *b*, is 3 inches. The following is the table referred to:—

STONE DRAINS.

Average Width of Back Drain.	Running Yards of Drain to the Cubic Yard.	Sandy Soils, Light Loams, and Light Clays, easy diggings, at 4d. per Cubic Yard.		Stiffer Clays and Gravel, requiring some Pickwork, at 6d. per Cubic Yard.		Hard Clay and Close Soils, requiring Pickwork before they can be done, at 8d. per Cubic Yard.	
		Per Yard.	Per Rod.	Per Yard.	Per Rod.	Per Yard.	Per Rod.
14	2 +	2	11	3	1 4½	4	1 10
12	2½ -	1½	9	2½	1 1¼	3½	1 5½
10	3½ +	1½	6½	1½	0 8½	2½	1 0½
PIPE TILE DRAINS.							
		<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>s.</i> <i>d.</i>	<i>d.</i>	<i>s.</i> <i>d.</i>
10½	2½ +	1½	9	2½	1 1¼	3½	1 5½
9½	3½	1 ½	7	1 ½	0 10½	2 ½	1 2
7½	5 ½	0 ¾	4½	1 ½	0 6½	1 ½	0 8½

The + and - attached to the figures in the second column imply a small fraction greater or less than the number stated. In the price per rod, the fractional parts are reduced to the farthings nearest to them.

From the table it may be seen by inspection that the cost of cutting a stone drain of $3\frac{1}{2}$ feet deep may be 9d., 1s. $1\frac{1}{4}$ d., or 1s. $5\frac{1}{2}$ d. per rod, according to the hardness or otherwise of the soil. For pipes the cost would, under the same circumstances, be either 7d., $10\frac{1}{2}$ d., or 1s. 2d. per rod. So also a pipe drain in one description of soil may cost in labour but $4\frac{1}{2}$ d. per rod, in another description $8\frac{1}{4}$ d. per rod, and the same if for stone 1s. $0\frac{1}{2}$ d. per rod. Having ascertained the number of rods and tiles required per acre, the drains at any given distance, the cost may be easily ascertained as follows:—Suppose the soil to be of Class No. 2, the working of which is worth 6d. per cubic yard, the drains 24 feet apart, 3 feet deep, pipes $1\frac{3}{4}$ inch in the bore,—

110 rods of drains, at $6\frac{1}{2}$ d. per rod,	£2 9 7
1815 pipes 12 inches long, $1\frac{3}{4}$ inch bore, at 21s. per 1000,	1 18 $2\frac{1}{2}$
Cost per acre,	£4 7 $9\frac{1}{2}$

Example 2d.—Soil, Class No. 3, worth 8d. per cubic yard, laid with horse-shoe tiles in flat soles,—

110 rods of drains, at $8\frac{1}{4}$ d. per rod,	£3 15 $7\frac{1}{2}$
1815 2 by $2\frac{1}{2}$ inch tiles, 12 inches long, at 25s.	
per 1000,	£2 5 4
1815 flat soles, at 16s. 6d.	
per 1000,	1 9 $11\frac{1}{2}$
Cost per acre,	£7 10 11

In both these cases Mr. Spooner has not included extra estimates for leaders, and for the larger-sized tiles required for them, inasmuch as, when the tract of land to be drained is of large extent, he finds that the estimated quantity of the other pipes exceeds the actual quantity used, and that the extra expenditure for leaders is thus generally covered.

Hill-side Drainage.—In connection with the

subject of drainage, there is a wide field of improvement in that of the hill-side pasture land of many districts. A vast proportion of this, if it cannot be said to be lying in a state largely unproductive, may certainly be said to be capable of such improvement as to be productive of a larger yield of sheep food, and consequently greater rent to the landlord. The popular notion connected with sheep pasture land in hilly districts is generally an erroneous one, this being confined to that which supposes them to be composed of vast tracts of rough and innutritious grasses, which owe this condition to the want rather than the superabundance of moisture. But the truth is, that in mountainous districts all kinds and classes of soils and subsoils are met with; so also, as a natural result, their condition as regards moisture. And just as varieties of soils are encountered, so also are all varieties of surfaces, from the steep declivity, to wide tracts of flat table-land. Drainage, if properly carried out, can effect great improvements in soils of such districts, in the same manner, although not, of course, in the same degree, as those which lie in more favoured ones; still it is beyond a doubt that, when properly carried out, this will be the case. In districts where it has been so, there has been an almost immediate increase in the value of the herbage, and an increase, but that in a much higher ratio, of the rental of the land which produces it. Nor should it be overlooked that the water, which is the result of the drainage of such districts, may be utilized for the irrigation of the lands which lie at the foot of the mountain ranges. These are frequently flat in surface and boggy or mossy in character, abounding of necessity in water, which renders the soil wholly unproductive; and strange as it may appear, these can be best changed from this character by means of irrigation, the supply of water for which is derived by the drainage of the adjacent hill pastures. It will thus be seen that, even under circumstances which seem to be the most antagonistic to all improvement, there is a wonderful connection between the two classes of soil or land, so apparently unlike and antagonistic to each other; that the excess of a substance which prevents by its presence the improvement of the one, is the very thing which is required to

aid in that of the other. We have here, therefore, another of the many instances which might be adduced of the fine adaptation of natural circumstances, which look at first sight so opposed, but which are in reality remarkably well adapted to each other,—an instance of how the evil of one may be found to be the benefit of another district. From what we have said as to the character and variety of the soils and surfaces of hilly districts, it will be seen that their drainage is one which involves no small amount of consideration as to the best, the quickest, and the most economical way in which it can be effected. Nor is this influenced by the above circumstances alone, but those of climate and locality, and even of the kind of stock to be kept, come into play, and modify of necessity to a large extent the systems which will have to be adopted, that which is suited for one being obviously unsuited for another. No small amount of ability in taking note of the circumstances which we have named is required in order to carry out a system which will give the best results; modifying this just as these indicate or do not indicate what ought to be the course of procedure to be adopted. Thus it might appear to be necessary to get rid, in the most effectual manner possible, of the water which is apparently the cause of the low nutritive condition of the grasses, while in reality it might be necessary to retain on the land a certain degree of moisture; indeed, over large surfaces of hill pasture, even in cases where there is an apparent and decided excess of moisture, this precaution above alluded to is essential, as tending to maintain a certain temperature during the colder months of the year, as well as to keep up the supply which is necessary for the nourishment of the herbage. It is just, indeed, in that fine and close adaptation of the peculiarities of the system adopted to those of the soil, locality, and climate, which characterises the work done in this class of the improvement of landed property, from those plans which are carried out with a preconceived notion that one system is applicable to all circumstances. Hill drainage, as a rule, differs from that of arable lands in more favoured localities, in that it is of a much simpler character. The drains being generally open ones, their dimensions would

seem to be dictated, as indeed, strictly speaking, they should be, by the circumstances of the particular locality to be drained. But here, as in other cases, the plan adopted must be varied in details to meet certain conditions; thus, if on certain soils the drains are made too shallow, the grasses which they bear are apt to grow in such a way as rapidly to fill them up with a close undergrowth which renders them inoperative; while, on the other hand, if made of too great a depth, they are apt to act as traps, so to say, being in a measure but minor ditches, into which, being unprotected, the young lambs are apt to fall and be lost or injured. It is difficult, therefore, to give precisely any definite rule by which to decide the size of hill-side drains. But in view of the danger above alluded to, they should be made with sides of considerable inclination, as a lamb has obviously a better chance of getting out of a drain so formed than of one with sides more perpendicular. A depth, therefore, of 12, and certainly in no cases exceeding 18, but better, say, 16 inches, will, in the generality of circumstances, be found to be a fair average. The width at bottom should be comparatively narrow, for the reason above stated, if for no other (that of between 5 to 7 inches being also a fair average, a width at top being from 20 to 24). The direction of the drains, or that in which they run in relation to the surface of the land, varies or should vary according to circumstances. A very general plan is to make them run oblique to the surface, running into main drains which ultimately deliver the water to the outfall; this in many districts being afforded by the streams or small rivulets which always abound more or less in hilly lands. The distance between the drains will depend upon the quality of the land and the herbage; the higher the land is, the better it will afford to have the drains cut at more frequent intervals. Poor lands, or those of the lowest quality, although in one sense requiring to have the best drainage put upon them, obviously do not permit of the expense of putting drains at too close intervals. A great deal of the skill of the hill district drainer will be shown not merely in what may be called a knowledge of ordinary work in details, but in deciding whether or not few or many drains will be required; one drain, well placed, frequently

doing more good than several not so judiciously disposed. The skill of the drainer will further be tested by the presence of parts of land of unequal character, and of mossy or boggy parts. One point is very necessary to be attended to, and that is not to overdrain hill pastures; for it should be recollected, although the fact is often overlooked, that their very formation is such as demands and requires a certain degree of moisture, and this moisture varying in degree, according to the soil, the herbage, and also the kind of stock which is designed to be maintained on them. As we began what has been of necessity but a brief outline of the leading points of the subject, so we conclude, by directing attention to the fact that a considerable increase in the rental of such parts of landed property may be looked for from drainage judiciously carried out, and this also frequently in conjunction with irrigation improvements, which will largely increase the breadth of land producing richer herbage, and therefore capable of carrying increased numbers of sheep, and, not least, maintaining these in a higher state of health, and bringing them into a finer condition for market, than is possible under circumstances where the land is allowed to remain in an unimproved condition.

Drainage of Hilly Moorlands.—As in the fences of those lands, so in the drainage of them, it is found that what may be called the more scientifically arranged drains of low-lying and valuable lands have to be modified to meet the peculiar circumstances of these elevated and rougher districts. Thus, in many parts the drainage water, the result of the sudden and heavy showers,—if such a gentle term can be applied to the heavy downfalls, waterspout almost in their action,—collects so suddenly and in such bulk, that the ‘refined’ system of the tubular drain of more favoured districts would not act promptly and efficiently enough to carry off the water. The open or surface drain, generally used in draining hilly sheep pasture land, may sometimes be used with good effect in very steep parts; but for the permanent drains, the stone-filled drains, of which a modification is used by Mr. Smith (see in chapter on ‘Reclamation of Waste Lands,’ par. ‘Hilly Moorlands’), will be found by far the most effectual. Generally the inclination or slope of

the surface of the land in hilly districts is the point chiefly attended to in the drainage of such districts; but Mr. Smith tells, as the result of his experience, that this is of ‘less importance than the dip of the strata.’ We have not space to give even a *resumé* of his remarks on the general condition of the strata of hilly moorland; suffice it to say that springs are formed in them, which either ooze out at certain points, or, what is worse, ‘extend at a uniform level for a long distance along a hill-side, poisoning all the ground below this.’ The object of the drainage of such districts is, then, not to catch the surface water, but that which flows from the spring-head. To do this a deep ‘open’ drain is cut from the bottom to the top of the valley. On reaching the *head* of the bog or swamp, care must be taken to ‘drive up’ a deep and efficient level for the spring-head, in order to tap and carry away the stream that there rises from the ‘light rocks.’ This done, the work must be allowed to settle, to afford time in order to see what may yet have to be done. To prevent the possibility of the water slipping or missing the drains, the drains should be cut not only through the peaty soil, but fully six inches into the fixed strata. And in all lands which have been formed by a succession of deposits, the drains must, as an invariable rule, be cut into the bed below, to a depth of from 6 to 8 inches, so that when stone-filled, the drains will be sure to be under the old course or current of water. In ordinary cases the drains should be cut across the line of strata at right angles; those cut with or on the line of the strata have done little or no good. In fig. 7, Plate 35, we give a section of the partially stone-filled drains illustrated by Mr. Smith (see chapter on ‘Reclamation of Waste Lands,’ par. on ‘Hilly Moorlands’).

Improvement of Watercourses in Drainage Plans.—In close connection with the drainage of fields, as well as in the setting out of these, either *de novo*, or in amending or improving those which have been formed under older and less careful systems, the alteration of watercourses is a useful part of the improvement of landed property. In many instances, especially in low-lying districts, these watercourses are the cause of considerable damage being done to the adjacent land, in consequence of the water, in times of flood,

overflowing the adjacent lands. Sometimes this enforced irrigation is beneficial enough, but in others it is the reverse. A good deal can be done in obviating the evil, as, for example, by straightening the course of the channel, getting rid of curved parts, which form projections and materially affect the onward flow of the stream. The great object is to provide for all occasions when superfluous waters are likely to come down, so that these will be carried off as quickly as possible without undue scouring of the bed of the channel. To secure this, and in addition to what has been already stated, all natural obstructions, such as vegetation, the branches of overhanging trees, etc., should be got rid of. These impede the flow of water to a much greater extent than is generally supposed, while at the same time they form points or nuclei at and around which mud and other materials collect, still further adding to the opposition to the steady and rapid flow of the water. Bad as the influence of improperly attended to watercourses is, especially in the case of small ones, it is much worse in that of large, the obstructions being more numerous and of a more difficult character to be overcome. These need not be specified, as unfortunately those of our readers who have ill-regulated watercourses passing through any part of their property know too well their nature and the mischief they give rise to. By a careful survey of the run of these watercourses it will, we think, be found as a rule, that by attending to the conditions of the streams in the way we have indicated, and by adjusting the flow, sufficient fall can be obtained in the majority of cases to prevent any undue flooding. By the mere cutting off of sharp bends, not only will the forms of the adjacent fields or lands be improved,—a point of great importance

in those under arable culture,—but by giving a regular and uniform inclination to the bed of the course, great improvements may be anticipated. The shallowness of the stream is a fruitful source of evil, and this may be overcome to a large extent by a very simple method of confining the banks, such as by planking, or fascines, or faggots with earth backing. In small watercourses, the depth at the points where the worst natural obstacles are met with should not be less than 3 or 4 feet, and in all cases the sharp angles or bends should be changed into easy curves of as wide a radius as possible. This expedient, bringing the course as nearly as possible into a straight line, which is the best of all, would alone go far to remove the evils complained of; while not only would the form of the fields be improved, but a large addition to their cultivable surface be obtained. So little attention has been paid to this department of property improvement, and so marked would be the advantages of attending to it, that if the cases throughout the country, unfortunately too numerous, were taken in hand, the mere addition to the area of land available for agricultural purposes, now utterly lost, would form an item which would astonish not a few. And this is altogether apart from the great damage which is done to the adjacent lands,—damage which, unfortunately, often arises at the worst possible time,—damage, moreover, which cannot be prevented under the present system. Another advantage obtainable by improving such watercourses, in the case of those passing through grass land, would be that the irrigation would be materially facilitated. Under every aspect, therefore, of the case, it is assuredly worth the attention of those connected with property, and one which ought at once to be taken in hand.

CHAPTER V.

IRRIGATION.

Classes of Irrigation.—The necessities of an increased and an ever and a rapidly increasing population have of late and are now giving specially marked prominence to all schemes by which the fertility of the land can be increased, upon which so much depends for the raising of our food, whether that be in the form of ‘crops’ or of ‘cattle,’ and not only so with reference to those lands already under cultivation, but also with reference to those which, known by the term of ‘waste,’ have given rise to much, and as yet mainly, if not altogether, unprofitable discussion. Much of this unfortunately negative result may, we fear, have arisen from the ignorance of many of the practical details of the subject by those who have entered upon this discussion; this ignorance giving rise to a not merely exaggerated estimate of the extent of waste land throughout the kingdom capable of improvement, but also to the no less exaggerated views as to the ease, and also the economy, with which these waste lands can be brought into cultivation, and maintained in a high state of fertility. While, therefore, it may be accepted as a truth that a wide area of waste land exists which can be cultivated with profit, it may no less be accepted as a truth that there are some of them about which this cannot be said with any reasonable hope of its ever being realized. And, moreover, the fact remains, that there are lands now under cultivation of which it may be said, and this without fear of contradiction even from those who belong to the class who maintain that ‘whatever is, is right,’ that a large percentage of them are still capable of being so far improved that they could yet bear larger crops of produce, or maintain more extensive flocks of sheep or herds of cattle. And further, that of the wide

tracts of waste land at present lying wholly unproductive, a large percentage could be brought under profitable cultivation, by the expenditure of sums not difficult to be raised by a people whose spare cash—and cash not easily to be spared—is too often engulfed in the thousand-and-one schemes which, being of a somewhat ‘airy’ nature, are, in appropriate enough terms, stated in the daily papers to have been ‘floated’ in the market, and of which not a few of them are destined to be ‘sunk,’ taking with them the hard-earned gains of the saving and the prudent, no less than the more easily attackable funds of the scheming capitalists, who are ever ready to ‘go in,’ as the phrase is, for anything.

Amongst the powers at the command of the farmer by which the fertility of land at present under cultivation can be increased, and waste lands brought into cultivation, irrigation may be named as one possessed of no small value. Although of this value there is but one opinion amongst authorities, it is a somewhat curious and suggestive fact that it is one which is by no means so readily and largely made use of as it might be, and as, we unhesitatingly say, it ought. It would, did time and space permit, open up some practically useful points, to inquire why this should be; enough for our purpose to draw attention to the fact that it is. Indeed, it may be said that, so far from being on the increase, irrigation is less practised now than it formerly was, this holding true of countries other than our own. But it is, on the other hand, gratifying to know that an increased attention is being given to the subject; and it is to be hoped that, before very long, lands, which at present are in every sense of the term ‘waste,’ will be covered with the grass which ‘yieldeth food for cattle,’ or

waving with the corn which 'giveth strength to man.' We thus see that water plays an important part in the creation and maintenance of rich pasture; but its application presents so many difficulties, that one must call to aid the most minute attention to details, and especially an exact observation of atmospheric circumstances. There are certain rules, however, the application of which, in some cases, rests on the sagacity of the employer. The mode of irrigation varies according to the effect desired, also according to the different periods during which it works. Sometimes water is desirable at all times; in other cases it has a bad effect upon meadow lands, and causes an inferior crop of hay. It is often easier to obtain a satisfactory crop from a new meadow, than to renew every year the wonderful produce of old meadows. Irrigation increases the fertility of the soil, bestowing nutritive elements, and replacing those taken away by the former crops. It is to this we must devote our attention. Generally the action of water is useful to meadows when the season is fresh and cold, and the temperature of the liquid higher than the air. This is the case in autumn; hence the advantage of irrigation at that season. The efficacy of this operation in autumn, besides, depends on another circumstance worthy of mention. The autumn rain carries from the fields much nutritive element, and deposits it as mud on the surface watered, which richly manures the fields. Water can never injure the meadows at this season; indeed, all farmers are agreed on the great advantage gained by the autumn irrigation, which should commence in October. It is sufficiently watered when the surface becomes black, and acquires a softness which leaves the mark of the feet. The following year a marked increase in the pasture will be seen. Sometimes the irrigation fails from a want of water. However, the case is contrary when the land is made inclined, which deceives the eye, and we do not perceive the full amount of water poured on the soil. Where the water has been too abundant, noxious weeds grow, and it is long before the meadow gains its original quality. On the other hand, when too little watered at one, but too much at the same place, certain plants, as the *Agrostis stolonifera* and *Poa pratensis*, grow to such a height

that it is impossible to cut them down before winter. This speedy growth cannot fail to hurt the grass, the season being too far advanced to convert these herbs into hay. They contain too little nutriment to be given to the cattle green. In all cases this tardy cutting down is very prejudicial to the meadow, as the frost might come on immediately, which would cause a considerable diminution in the crop. When the water is very scarce, and autumn cold, it is advisable to keep the channels full in those parts which cannot be watered, which will compensate in some degree for the frost. The channels must be emptied from time to time, and the meadows dried up. When all the surface has been watered, begin again, and continue thus till the water freezes. These operations need not be stopped for a slight frost, but during the severe frosts the water must not be allowed to flow on the meadows. When thaw comes, the irrigation may commence again. When the effects of frost are felt at a great depth in the soil, it is time to stop irrigation for the season, and leave the meadow to its winter repose—that is to say, allow the water to escape from all the channels and ditches. Although the months of January and February should bring abundance of water rich in fertilizing matter, we must resist the temptation, remembering the proverb, 'Those who water in January have meadows, but no hay.' Atmospheric influences have a great effect on the soil. This operation must not be thought of when snow covers the ground, or when it begins to melt under the influence of the rain. But in spring, when the rays of the sun melt the snow, causing the plants to spring naturally, it is necessary to water plentifully, not sparing even the trouble of sweeping away the snow. If, on the contrary, there are cold draughts, which have penetrated deeply into the soil, we must not water till the frost has disappeared, or, thanks to the advanced time of the year, it becomes possible to destroy the effects of this temperature by means of irrigation. Marshy pastures are usually behind good, firm, meadow soil. It is at the beginning of spring that the irrigations are made which act on the soil as manure. So long as the season is cold and rainy, we must water vigorously, though not so abundantly as

in autumn. Too abundant irrigation would be very hurtful.

In carrying plans of irrigation out, we thus see there are many points to be considered. Thus the quality or kind of water used is a point of considerable importance; although it may be stated, as a general rule, that there are comparatively few qualities but what may be used, there being what may be called only two exceptions to this,—(1) that containing iron, and (2) that flowing from the surface of 'white peaty' or 'black moory' soils. This latter, however, can be very much improved in quality by causing it to traverse long distances before using it, its coming in contact with various soils of better character than the original one from which it is obtained, giving new and favourable qualities, but chiefly from the atmosphere having a long time to act upon it. In hilly districts, the water, which flows rapidly from the high levels to the low-lying land at the foot of hills, and which, if allowed to remain stagnant there, forms bogs and mosses, may be considered an exception, if a deep drain can be run in the subsoil so that the bog can be tapped, and the water used before it becomes contaminated by the peat. Indeed, it may be stated as a general rule having few exceptions, that all waters derived from deep drainage may be used for irrigation. There are some indications on which irrigators place considerable reliance as to the water which may be used; thus, that in which water-cresses grow is considered good, as well as that of streams, etc., the stones of which become covered with mossy or vegetable growth. Warm springs, as they are often termed, or which rarely freeze, are also esteemed. In carrying out plans of irrigation, it is essential that the land should be thoroughly drained, stagnation of the water being quite antagonistic to the principle, which may be briefly stated as passing continuously over the surface a thin stream of water. This, however, is only continuous in a sense, that is, during the time when the irrigation is carried on. Perhaps the best plan is to commence watering somewhere about the end of September, but not later than the first week of November, and carry on till the circumstances already named decide when it ought to be stopped, October being considered the best month to

begin; the exact periods will, however, depend upon circumstances of locality and climate. The flow of water, however, is not continuous even during this period, being alternative, a general rule being the keeping of it on for six days and shutting it off for three days. But on all these points, circumstances of weather, etc. will modify the practice. Thus, if at the time when the water should be shut off, and frost should set in and cause the formation of a thin sheet of ice, the water must be kept flowing in as thin a sheet or stream as possible; but should the ice thoroughly form, so as to cover the irrigated surfaces, the water must be then shut off. In the warmer months greater attention to the management is required, and special care should be taken to prevent anything like stagnation of the flowing sheet, as a thin scum will likely be found on the surface, exceedingly prejudicial to vegetation. In warm weather, the intervals during which the water is kept on are shorter than in winter. The produce of irrigated meadows is used in different ways, the almost universal plan, however, being the mowing of it either for green food on the stall-feeding or soiling system, or for haymaking. The first crop, however, after the formation of the meadows is generally eaten off by sheep, this consolidating and so enriching the soil that succeeding crops may be mown for a considerable period without any manure being applied. The rate at which the water flows over the surface will, of course, depend upon its inclination; and this, again, upon the nature of the soil, a dry one having a lower rate of declivity, and requiring less water, than a wet and heavy one. As a rule, the flow should be quick rather than slow. A quick run, in fact, produces the finest grass. It is difficult to estimate, therefore, the quantity of water required, but, on the average, 2000 gallons per minute may be allowed for. Such may be stated as some of the leading points in irrigation practice. We have now to describe briefly the principal methods of laying out the land; perhaps the oldest, at least nearly the oldest, system was that carried out in hilly districts, and now known as the catchwater meadow, or hill-side irrigation.

'Catch Meadows,' or 'Hill-side' Irrigation.—Various circumstances, elsewhere alluded to, having

brought about continually increasing demands for supplies of animal food, the amount of which seems ever to keep up in a higher ratio than the supplies themselves, render every plan by which the live stock of the kingdom can be increased in number a matter of most vital importance to the nation. And great as have been the improvements in breeding, and in the methods of feeding our cattle, — methods which, by taking advantage of the teachings of science and the lessons of experience, have succeeded in so economizing material, or making it do a far higher duty than was ever anticipated, that what took four or five years of time to bring an animal forward to a certain condition, takes now but two and a half or three years, and in some cases less,—still, notwithstanding all this, the practical difficulties are not so much in increasing or obtaining the required number of animals,—although these are great enough,—as the means or materials for maintaining them; and it is to the latter point that the attention of our stock-keepers is mainly at present directed. Hence the importance of all means by which the food supplies of stock can be increased, and hence also the urgency with which many are putting forward the absolute necessity there is for taking advantage of every means of doing so. It is not so much the fact, which the most advanced of our agriculturists have again and again of late stated, that the produce even of our best cultivated lands, by still more improved modes of treatment than have yet been introduced, can be increased, that we would here draw attention to, as the fact that there exists in many districts of the kingdom sources from which large supplies of cattle-feeding material can be raised. This is, indeed, indicated more or less directly in the very title of this section, which proposes to deal with the method of utilizing the water supplies in hilly districts, the soil of which and the climate in which they are situated being alike more or less favourable to their practical utilization. What is done, and done so well, in one district, may obviously be done in another, with, of course, such modifications as changes in natural circumstances may bring about. Thus the late Mr. Smith of Exmoor, whose name will ever be associated with some of our most practical agricultural developments, and with none, perhaps, more

strikingly than that named in the title of the present section, states that in removing from the east to the west of England, nothing could exceed his admiration of the water meadows of the western districts in early spring, a period when in the eastern he had been wont to value a blade of green grass as a rare production. 'To see,' he says, 'the Exmoor ewes, with their early lambs, in January, feeding upon the verdant meadow, to me was a miracle,—first, the early period of lambing; and, secondly, the green meadow at such an inclement season. But if we turn to nature as our guide, we find the green grasses ever springing at the water's edge, and yet daily verdant at the springs, even at the very summit of our forest hills, at an elevation of one thousand feet. Thus these practices of agricultural art are dictated to us, and are alone waiting the skill and enterprise of man to cultivate and extend them.' To this extension Mr. Smith devoted his best energies, and this work of ours will not have been written in vain if it be the means of drawing attention to a system which is assuredly applicable to many districts in the kingdom,—a system which promises, with no small degree of certainty, to make as sources of agricultural wealth, streams and soils which at present are running to, and remaining in a state of nearly absolute waste.

As some of our readers will be unacquainted with the principle upon which 'hill-side,' or, as it is more generally and better known, 'catch-water meadow irrigation,' is founded, we deem it right to describe here very briefly its leading details. These will be found illustrated in the rough plan in fig. 1, Plate 52, in which *A B* is a plan, and *a* a section. Thus, suppose in *A*, *a* to be a watercourse or rivulet winding along the side of a hill, and, of course, taking in its flow the general contour or level of the same in the direction laterally, or its length; this, at some convenient point in its length, if obstructed or dammed up by some contrivance more or less simple, naturally causes the water to overflow the channel at its lower side, *b*, and to flow down and over the surface of the subjacent land, *c*, at a lower level. Suppose, further, that at a certain point of this stretch of inclined land, *c*, a small drain or carrier, *d*, is cut, running more or less

parallel to the main source of supply, *a*, this drain or carrier, *d*, 'catches' the water which has flowed over the stretch of land, *c*, above it, and according to the level of the land laterally along which the drain, *d*, runs, is the rate of flow or inclination of its collected water. Supposing, then, this drain, *d*, to be dammed up at one convenient point, the water will overflow the lower edge and be shed over the surface of the stretch of inclined land, *c*, at a lower level. The water flowing over *d* may again be arrested by a second drain, *f*, running more or less parallel to the drain or 'carrier' *d*, which, if again dammed up at some convenient point, causes it to shed the water over a third stretch of land, *g*, placed at a still lower level than the preceding stretches, *e* and *c*; this third stretch, *g*, may be supposed to be the last of the series of stretches thus irrigated, the water of which is delivered finally to the rivulet or carrier, *h*, which flows on uninterruptedly to its outfall. Or, in place of so doing, if the land below it, as *i*, be suitable, the water from *h* may be used for irrigating that land by the system of the 'ridge-and-furrow' irrigation, elsewhere in this chapter illustrated and described, as shown at *jj* in elevation A, fig. 1, Plate 52, and *jj* in plan B, same figure. Such may be taken as a brief popular description of the 'catchwater' meadow irrigation system, one which on hill-side land has certainly the advantage of cheapness in its favour, as the same quantity of water will irrigate more land than any other. 'The hill-side,' as Mr. Smith remarks, 'being already formed by nature to our hands, the spirit-level beautifully traces the varied slopes, and marks the onward course for the gutterer or waterman, who should be a man of taste in the art of levelling, as the marking out of the intermediate spaces upon irregular ground is found to be a nice point, that the water may flow in an even stream over the sides of the gutters.' The arrangement of the main water-carriages or channels (as at *aa*, in fig. 1, Plate 52) are formed (if made specially, and the natural rivulets not used, or not available at the desired points, and which carriages are, of course, supplied from these rivulets) three feet wide and six inches in depth at the lower side, the depth of the upper side varying according to the slope or inclination of the hill-side, the fall or inclina-

tion being at the rate of one in 396, or two inches in a 'chain' of 22 yards long. This fall is rather rapid for general purposes, but Mr. Smith adopts it in order to clear the carriages of the soil, etc., which he conveys to the lower meadows through the agency of the water, according to the method which will be presently described. The arrangement of these main water-carriages is, of course, dependent solely on the formation of the land and the supply of the water; and when this is derived from a small brooklet or stream, these carriages take their lead from this 'in due succession, whereby the required supply of water is kept up, and are so arranged that in crossing the valleys or otherwise they pass below the hill-side springs, that these may be tapped and drained into them,' which, as Mr. Smith says, is a 'good and cheap process.' The small water-carriers, as *d* and *f*, figs. *a* and *b*, Plate 52, are cut for width of 18 inches, and have a depth of 5; the distances between these carriers are generally uniform, and this is made so that the distance is three-fifths from the upper carriage and two-fifths from the lower. As the majority of these water-carriers are laid out upon the land just as nature has formed and left it; in order to form the better qualities of grass and to eradicate such mossy surface as generally exists in land which has been at one time under wood, Mr. Smith finds it the better plan to let the water flow over it freely for five or six days in succession at first, as a thin flow has but little effect. The watering is repeated at intervals of a month, more or less, according to circumstances; but care must be taken not to allow it to flow too long over the same surface, as this encourages the growth of coarse water grasses, such as grow near springs. In the second season, when a certain amount of improvement has taken place, the water may be more thinly spread over the surfaces, and during shorter periods; but these and other details can alone be decided according to circumstances of locality, etc., and the experience which the waterman alone can gain by observation of the peculiar circumstances. In addition to the irrigation of meadows by the catchwater system just described, Mr. Smith struck out an idea, as bold as it was original, and carried it into practical effect with striking results. Paving a close

attention to all the circumstances under which the system was ordinarily carried out, Mr. Smith perceived that from the very character of the water-carriers, and the routes which they took in descending from the higher to the lower regions of the land, there was afforded what we call a splendid opportunity for making these carriers for reconveying any quantity of the accumulated soil in the valley to the poor and neglected hill-sides, which have been robbed, deprived as they have been of this deposit by the long-continued and ungovernable washing away of it during a succession of rainy seasons. When the valleys are drained, the soil becomes decomposed and dries, and a rich 'black mould' is formed, which is dug from the upper side of the carriage, chopped rather small, thrown into the stream, and, if water can be made to come down with a rapid fall even for a short distance, it will reduce itself so small as to mix with the stream. In order that the soil may be properly placed and distributed over the surface of the meadow land, the 'waterman' is in attendance at the meadow, in order that the rush of soil and water may be changed as the work proceeds. The irrigation of flat meadows at the foot of the hill may be conducted on the same plan; but a heavier soil must be used if it can be obtained, as the composition of these bottoms is chiefly black or other friable soil. Of course the carrying out of this plan will depend much on local circumstances; the period when the waters are highest, that is, after long-continued rains, being chosen for washing down the soil, especially when placed at a distance, or where the situation presents difficulties for its easy 'swelling away.' As some of the waters in many of these hilly districts are not well calculated for irrigating purposes, such as impure boggy waters, care should be taken to arrange the carriers of these so that they will have a considerable distance to traverse, as the longer the distance peaty water, for example, has to run, 'the better it becomes for irrigation, as a sediment is deposited in its onward course, hence the water gradually purifies and improves.' But to effect a greater improvement, and bring about a more decided change in the character of the water, Mr. Smith hit upon another addition to his plan, by which the carriers were made the

vehicles of conveying not only manure from the irrigated meadows themselves, on which young cattle were fed, and on which sheds were placed for their reception and shelter, which produced it, but also of conveying from the farm-yard its supplies of manures without the necessity of employing horse power. The sheds for the young cattle above alluded to are placed at the higher part of the meadows, a short distance above the water-carriers, thus leaving space between for the cattle to pass to and fro. Opposite the sheds, and on the line of the main water-carrier, a small pond is formed, into which the manure is thrown, so that the water, as it passes along, carries with it the manure from the shed and distributes it over the land, which is thus, as may be conceived, greatly benefited thereby. When the season for irrigation has passed, the cattle are removed to other fields, the meadows effectually cleaned, sown with grass seeds if necessary, brush harrowed, rolled, and laid up for hay; and the pond is cleaned out, its contents thrown up into a heap in order to decompose, over which a layer of peat earth may be thrown, and the heap turned over twice during the summer months. By the time the irrigation season arrives, the compost heap, sufficiently decomposed, is thrown into the pond on the main carrier, and by the water conveyed to the surface of the meadows. The pond or pit may be further utilized during the summer months, when empty, by storing up in it the soil, sediment, etc., taken out from the carriers when cleaning and repairing them. Mr. Smith still further utilizes the irrigating water as a carrier of manure, soil, etc., by having the water of a convenient brook to work in the first place the water-wheel of the farm steading, after working which the water is passed through the yards and buildings, collecting and washing out 'the sewage of the whole establishment, then passing it away to a pond at the outside of the buildings, from which the adjacent meadows are watered.' The advantages derived from this plan have been very marked, a portion of hill-side over which the water was passed becoming covered with green and daily improving grasses, the chief of which was white clover, while not a single seed was sown upon the land. Further, by means of water passing through the farm-yards, any portion

of the farm-yard dung may be thrown into it and conveyed to the meadows, and this at periods when horse labour might be valuable for other work of the farm. We have heard much of the value of water as a carrier in the case of town sewage, and Mr. Smith has done good service in drawing attention to methods of utilizing the same medium for the cheap conveyance of manurial matters from one part of the farm to another. Nor is the cheapness alone of the method its principal feature, but the *uniformity* with which a manure is distributed over the surface of the land constitutes, in our opinion, one not less valuable; and it is obvious that the plan could be extended to the amelioration of poor soils by conveying to them supplies of richer ones, which have all the advantage of being distributed uniformly over the surface; in fact, we see the value of the principle of 'warping' land, elsewhere described in this work, and which will be there seen as producing land of what might almost be called inexhaustible fertility. For many districts, therefore, there lies (apart from the great advantages derivable from the system of irrigation conjoined with it) in this method a future of improvement for lands now of the poorest, which will yield, if it be judiciously carried out, large supplies of the food for stock which is daily becoming a greater and greater necessity in a national point of view. The practical stock-keeper, who is thoroughly versed in all the details of his calling, knows well the advantages derivable from a 'change of bite,' as it is technically called, to his cattle,—that is, changing them at due intervals from one field to another. This, as a natural consequence, involves the principle of having a good many fields, and this again the advantage of having more of small dimensions or area than fewer of a larger. Mr. Smith, in view of this, found that the most convenient size for his water meadows was from five to six acres,—a size which admitted of the desirable change, and also the easiest way of watering them in succession. He also draws attention to the value of the ponds we have described, as affording means of storing up water which can be made available for turning for a brief period water on to meadow land when the hay is removed from it, or to pasture lands in dry

seasons, thus giving a great impulse to the growth of grass when required. They can also be made available for making good the deficiencies of water supply, where that under ordinary circumstances is less than that which would be required for full irrigation, care being taken to have these ponds placed at convenient points,—as, for instance, where small streams or water-carriers meet. By this plan a small quantity of water will irrigate as much as from eight to ten acres of land. In conjunction with the water-carriers, Mr. Smith adopted the plan of having 'sod fences.' These were, like the watercourses, laid carefully out with the spirit-level, so that while some were 'found to collect' the surface water from the upper lands to a certain point most eligible for a pond, others were arranged to convey the water from the pond to the nearest meadows. By this plan the water-carriages are made when the sod fence is erected, and are consequently included in its cost, saving at least one shilling per chain; if the carriage is formed in an otherwise useless dike, the land is saved on which the carriage would otherwise have been cut. This system has also the immense advantage of enabling the farmer to control the results of the immensely heavy falls of rain in hilly districts, and to save and utilize the particles of soil, manure, etc., washed down from the higher levels, by leading them to points where they can be rendered practically available in the way we have already described.

A modification of the ordinary catchwater meadow as described above, and which is esteemed highly by practical authorities, has been introduced by Mr. Bickford, of which the following brief description will give an idea. The main feature of the system is the method by which the drains are laid down, with great expedition, over a surface, no matter how irregular that may be, and by which the drains follow these irregularities with the utmost precision. In this system, therefore, no parallelization of the drains is attempted, although this, of course, may happen at certain parts of the surface. The instrument for finding the levels is extremely simple, and is in form precisely like a pair of compasses, kept open at a certain stretch by means of a cross bar, in the centre of which is placed a plumb-line which hangs from the central joint of the instrument

(a spirit-level may be substituted for the plumb-line, being placed on, and at the centre of, the cross bar). The height of the instrument is about 5 feet 4 inches, being the width between the lower ends. The method of using this is as follows:—The workman, taking the instrument, fixes the extremity of one leg at any point of the land's surface at which the carrier or drain may be desired to commence; and by a series of trials he keeps moving the other leg, and placing it at different points of the surface, till he finds a point at which, when at rest, the plumb-line hangs straight, or the spirit-level indicates that the two legs are resting on a surface at points precisely on the same level. A small peg is then driven in at the point shown by the second leg, and this affords another starting-point, at which one of the legs is fixed in the ground, until, by a second series of trials, a second point is found at the same level. Proceeding thus, a series of points will be obtained, some four feet apart, all on the same level, but the line of which may be exceedingly tortuous. Of course, it is necessary in commencing the work to decide upon the point at which the drain terminates, as well as that at which it commences. A series of lines, at any desired distance from each other, may thus be pegged out over the surface of the land, and along which, by means of a simple plough, also invented by Mr. Bickford, the drains or water-carriers can be cut to the desired depth. In place of pegs, the level points may be indicated by cutting out a small sod. Parts on the surface of the land may be reached at which it is not possible to find a level corresponding with the last taken. In this case it is necessary to stop the drain, which may be stopped by a sod, and a new line for level points started either above or below the old one. An important part of the system is the getting the water quickly off from the land. To effect this, 'gutters are cut in the direction of the inclination of the ground, *i.e.* in the exact same line along which the water would flow if left to itself to run.' If the gutters take any other direction, swerving too much to the right or the left, they will cut off the water from some of the land on one side or the other. There are other points connected with the laying down of the main

carriers and drawing-off gutters, full details of which will be found in a pamphlet, published by Mr. Ridgway, Piccadilly, London, republished from the *Journal of the Bath and West of England Society*. But what we have given will sufficiently explain, in connection with the two plans given in Plate 22, the general features of the system; these we have adapted from two plans given in the *Journal* above named. Fig. 10 is the plan of part of a hill-side laid out as a steep water meadow, which lies between two little rivulets as shown. That on the left, as *a c*, is good water improved by the drainage matter of a house and stable. It is added to by the water of a good spring, *g*; that on the right hand, as *w w*, is poor cold water issuing from an alder bed and bog. This, as will be observed from the plan, is not used for irrigation, but is carried under the good water or left-hand stream, *c e*, which continues to flow in the direction as shown by a trunk at *t*, and carried on towards a pond, where, after being exposed to the air, it becomes improved and fitted for irrigating purposes at a lower level. The left-hand stream, *c e*, is conveyed from north to south in a gutter, *a b*, having a rapid fall. It is confined on the north side by the gutter, *a c*, in the hollow, and on the south by a special channel, *b b*, in order to keep it out of the bog-water stream, *w w*. The mouth of the main outfall of some underground drains, *p p*, is placed at the point *d, c* being a similar outlet for the drains, *o o*, indicated by the dotted lines. All these streams are combined and carried over the trunk at *t*, to be used for irrigation in another meadow to the south-west and south, below the coppice or wood indicated at *y y*. On the north side the stream may be led away to a projecting knoll flanking the valley and swelling to the north-west. *x* indicates dry ground on a porous rock. These undulations fairly represent the configuration of a mountainous country. It is easy to see what perfect mastery over the water is thus obtained, how completely it can be concentrated on any particular section, and how quickly and directly it can be conveyed to the desired point; and this may be all done by following the undulations of the land, without levelling the surface. The double lines part, as *a b c d*, represents the

carriers; and these when tapering, as at *ss p*, begin to irrigate. In fig. 11 we give a rough plan of a level water meadow, representing a field the soil of which is alluvial deposit, and situated at a river-side. The stream enters at the point *a*, is carried for some way up stream, and in the direction *a b*, in order to irrigate the knoll situated at *b c d*. This plan of going up stream is sometimes practised on a large scale, in order to lead a warm, rich stream from a lateral valley over a river-side meadow, when the use of the river water would be comparatively unprofitable. For this purpose an embankment is thrown up against the bank of the river, to carry the supply upwards to the head of the meadow; the outlet waters, after irrigation, pass under the embankment in culverts. This arrangement may be noticed on a fine meadow between Tiverton and Dulverton, on the banks of the Exe, a little way above the Exeter Inn. The stream is distributed in the way we have described over the general slopes, and is again separately led out to the point at *e*, where the radiating carriers, *e f g*, may command the projecting elevation, and each of which gradually tapers, so that, as the stream advances, the lessening capacity of the carriers causes the water to overflow to the right and left. The marks $> \times$ indicate the course of the emptying or drying gutters. Where a cross supply gutter and a drying gutter become so rapidly level, they are merged in the system of level contours, and become irrigators.

Irrigation for Level or Flat Districts or Surfaces of Land.—The plan or method in use for these districts, and that which is most commonly adopted in this country, is known as the ‘ridge-and-furrow’ system. There are modifications of this to suit the peculiarities of certain localities; and sometimes a combination of this method, and the ‘catchwater’ system last described, is adopted at points where hilly lands merge into flat ones at their base. There are other systems adopted for level land, but these are principally met with on the Continent, where, indeed, irrigation is carried out to a much greater extent than it is with us; and so great attention is paid to its defects, that its practice has reached the highest state of perfection. For this reason, and also from the fact that the details of methods there practised are not widely

known,—specially, at least, the details of the one named above, the ‘ridge-and-furrow,’—we shall do our readers a practical service by describing and illustrating them.

Marked, indeed, as have been the benefits in districts in this country, we have but to cross the Channel to find in the rich and fertile fields of our continental neighbours what irrigation can do, alike on the smallest and on the largest scale. Mr. James Howard, the well-known agricultural engineer of Bedford, in his admirable paper, read some years ago before the local Farmers’ Club, on ‘Continental Farming,’ refers with approbation to the beneficial effects which irrigation has exercised, in various places on the Continent, in raising the cultivation to a comparatively high state of perfection. There is, perhaps, no part of the Continent which has been so signally benefited by irrigation as that district of Belgium known as the Campines, the most interesting part of which can be reached in a few hours from Antwerp by taking the railway to Turnhout. The traveller, as he journeys on towards this town, will pass through a country which, in its general aspects, presents to him at once the features of a spare, barren, and wild sterility rarely equalled in any of the wildest districts, and of a fertility singularly striking in its beauty, even to an unpractised eye. The sterility illustrates what the condition of the land throughout nearly the whole of the district was once, and in large tracts still is; the fertility that which it is fast presenting under improved and improving cultivation. On one side one will see nothing but sand, so light that it is driven into heaps or scattered like snow-drift before the wind, with here and there only stunted shrubs and patches of heather and wild-flowers; on the other will be seen waving corn or green grass, and all the evidences of abundant fertility. One great cause of the change which has taken place in a large measure in the condition of the soil, and which is daily extending, is the system of irrigation, which has been so carefully and extensively carried out in the province. There are many methods of irrigation employed, but the first we shall describe is identical, as we have already said, in its features with that known among us as the ‘ridge-and-furrow’ system, in which the

land is divided into a series of sloping surfaces, over which the water is shed or distributed from the gutter, *a*, at the apex of the ridge, *x x*, fig. 6, Plate 52, and taken up by the gutters, *b b*, at each end of its base. Great skill is shown in the setting out of the land to be irrigated on this method, and in working so that the soil taken out from the cuttings shall be used to the best advantage in the embankments or raised parts forming the sloping surfaces. The land is laid out into compartments some seventy or eighty feet long, the length of these being in the direction of the general slope of the land. We present our readers with the working plans and sections of a field laid out on the system practised in Belgium, these being taken from a report on the subject by Mr. T. Keelhoff, engineer in charge of the service of irrigation of the Campines. Fig. 1, Plate 53, is the plan of the upper part, and fig. 2 of the lower part of the field. This, as will be perceived, is laid out in lengths angular in section, as shown in the transverse section in figs. 2 and 3, Plate 52. Of these angular parts, *a' a'*, Plate 53, is the apex, along which the channel for leading the water is placed; this overflowing, flows down the sloping sides in the direction of the arrows, and is received by the channels *b' b'*, figs. 1 and 2, Plate 53. The channels all lead into the large drain or watercourse B B. The channels, *a a*, at the top of the ridge, receive their supply from the watercourse A, fig. 4, Plate 53, which runs at right angles to them. The whole field is divided into 'compartments,' in each of which there are five of the ridged parts, so to call them; and each of the compartments is divided from the other, so that each can be irrigated independently of the other. To aid in this, a small sluice is made at the point R. See fig. 1, Plate 53. The 'compartments,' each of which, as above stated, comprises five of the ridged parts, are placed so that the length of the channels, as *a a*, fig. 2, Plate 53, runs transversely to the general inclination of the whole field, so that the channels *a a* and B B have a gentle flow or inclination over the whole field throughout their length. It will be observed, on inspecting fig. 2, Plate 53, that the channel B, which receives the water flowing from *a' a'* over the sides of the ridged part, bends round and flows between the

two compartments, and then delivers its water to the channel A, fig. 1, Plate 53, which thus is the channel of supply for the channels, *a' a'*, of the ridged parts of the second compartment. A small sluice is placed at the bend of the channel B, at the point R, fig. 1, Plate 53. The main source of the supply of the channels A A is the large drain or channel at *g g*, which runs at right angles to *a a*, and parallel to *a' a' b' b'*. Fig. 2, Plate 52, is a section of fig. 1, Plate 53; fig. 3, Plate 52, of fig. 2, Plate 53, on a line parallel to the channels A A, and at right angles to the ridged parts, *a' a' b' b'*. Fig. 4, Plate 52, is a section in a line at right angles to the channels A A, or along the length of the ridged parts, *a' a' b' b'*, and the upper end of the field, of which fig. 2, Plate 53, is the plan. Fig. 5, Plate 54, is the section of the lower part of the field plan in fig. 2, Plate 53; and fig. 6 is a cross section of one of the ridged parts. The length of the ridged part is 25 metres (a metre is 3·330 feet); the breadth of one of the sides of the ridged part, as *c d*, is 5 metres. The width of the channel *a' a'*, at the top of the ridge, is 25 centimetres; the depth, 6·05 centimetres. The width of the channels *b' b'*, 25 centimetres; and depth, 20 centimetres. The width of the channels *a a*, 50 centimetres (half a metre) at the bottom (they have inclined or sloping sides, as shown in section fig. 4, Plate 52), and 1 metre at the top; the depth is 25 centimetres. The channels B B have a width at bottom of half a metre; at top, of a metre and a half, with a depth of half a metre. The width of the slopes *e e*, figs. 4 and 5, Plate 53, is 3 metres. Some of the leading measurements we have given approximate to our own measurements.

The fourth method of irrigating land is illustrated in fig. 2, Plate 55, and is applicable to land so disposed as to present a series of alternate depressions and elevations. The channels of distribution, as *a a*, are placed at the height of the elevation or rising part of the ground, running in the direction of the slope or declivity of the land. These channels of distribution receive their supply from the main channel, Y Y, fig. 2, Plate 54, which runs along the upper part of the land. The channels of distribution gradually die out, as shown in fig. 2, towards the end

of their flow, and between each two, as 1 1 2 2, fig. 2, Plate 54, which occupy the tops of the high parts of the land, the third, as 3 3, is placed, occupying the lowest level between the other two. This, it will be observed, is narrow (or dies out) at the upper, but widens at the lower end, where it joins or delivers the water to the channel *b b b b*, which may either lead the water away, or act, such as Y Y, as another channel of supply, X X, to irrigate another plot, as B B, at a lower level. Spreading or radiating from the channels of distribution, as *a a*, right and left are smaller channels, *c c c c*, which run down the sloping sides of the heights, shedding the water over the surface, and which is finally taken up by the intermediate channels, as *c c*. These small channels, as *c c*, are wider where they start from the channels *a a*, as at the point 4, but gradually die out as they approach the bottom of the incline. The fifth and last method we have to describe is that illustrated in fig. 1, Plate 54, in plan at A A, and in section at B B. This method is a modification of the first method we have described in fig. 1, Plate 53, and is adopted in cases where the inclination of the land is too small for that system (fig. 1) to be adopted, or nearly flat. The inclination best adapted for this system (fig. 1, Plate 54) is 0.05 m. per metre. It consists, as seen in section at B B, fig. 1, Plate 54, of a series of plots, one above another, these being level in the direction of their length, but inclined in the direction of their breadth, as in the section B B. On one side is the channel of supply, as A A A in the plan in fig. 1, Plate 54; this channel is subdivided by sluices at C C C, according to the number of the plots into which the land is divided. These sluices serve to shut off the water from, or to let it on to the different plots as required. As will be seen from the plan A' A', each plot, as *d e f*, is surrounded at the two ends by part of the channel of supply A' A', at the ends by part of the channel *b' b'*, and at the sides by the channels *a a b b*. The water supplied by A' A' flows along the distributing channel *a a*, and is shed over its lower edge and flows over the surface of the first plot, *d*, returning by the channel *b b* to the channel of supply A' A'. Small sluices are also placed at the points *g g* (in plan) between the channels of two plots in contiguity. The arrows

in plan and section show the direction in which the water flows. Fig. 3, Plate 54, illustrates a section of the first stretch of land on the 'catch-water system' (see fig. 1, Plate 53) next the main carrier, A; fig. 4, a section of one of the sub-carriers of the same section.

Details of Irrigation Work.—A few of the points connected with irrigation work remain to be noticed at this point, and first, as to the form of the channels or carriers by which the water is led from one point to another. In a great number of cases the minor channels are very simple, as also the sluices or stops by which the water is led off to the various divisions, being merely small courses cut by the spade, or in many instances, as in catchwater irrigation, by the plough, and the stops formed by turf or by small boards sliding in grooves. The main watercourses are, however, more complicated, both in their form, their construction, and in the sluices which regulate the distribution. Figs. 1 to 5, Plate 55, show different forms, which vary according to the soil through which they pass. The more compact the latter is, the steeper may be the sides. Thus, taking fig. 1 to represent a channel of distribution passing through a heavy and compact soil, it may be in some cases made with sides almost perpendicular, as *a c d b*; or, taking the depth in all the examples to be uniform, the slope may be equal to one-third of that, *d f*, fig. 2, which is one-third of the depth, *d b*. In less compact soils it may be one-half, as in fig. 1, or one-fourth, as in fig. 3. In setting out the channels, the breadth of bottom, as *a b*, is invariably equal to the height, *b d*; and perpendiculars, *a b d c*, should be raised from the points *a b*, and a line, as *c f*, should be drawn at right angles to these, on which to set off the slope. Where the channel is large, and where the soil through which it passes varies at different points in quality, the sides may have at certain parts to be set out, as at *f g j c h i*, in fig. 4, with a depth of between 2 and 2½ yards; the width of the horizontal parts, as *f g*, from 18 to 24 inches. In many cases the channels are made with perpendicular sides, which are protected in various ways. One method is shown in fig. 6, Plate 55, by driving in at intervals sharp piles, *a a*, backed by planking, *b b*, and connected by

wales or cross-pieces, as *c e*. This is shown in plan in fig. 7; figs. 8 and 9 give the details, showing how these cross-pieces are fixed on to the longitudinal parts, *d d*, fig. 6, connecting the piles together. In Plate 56, in fig. 1 we give a method of protecting the perpendicular sides of distributing channels by means of fascines, as *a*, in place of the planking, *b*, as in fig. 6, preceding plate. The piles, *b b*, are connected by cross-pieces, *c*, as shown in detail at *d* and *e*. In fig. 2, Plate 56, another method of protecting the sides is shown, in which twigs or osiers, *a a*, are intertwined between, and supported by piles, *b b*, driven in at intervals, and supported by cross-pieces in the same manner as in fig. 1, details being shown at *d e*. Sluices, as already stated, are in some cases of the simplest, but in others are of a construction more or less complicated. The simplest form consists of two side-pieces in which central grooves are cut, these being driven into the soil and connected at the top by a cross-piece, in the centre of which a rectangular slit is cut. The sluice or gate, so to call it, consists of a simple board at its lower part, which passes into the groove of the side timbers, and is provided at its upper part with what may be called a shank or handle, passing through the slit in the cross part. The shank has a number of holes, into which a pin is passed, which rests upon the cross timber and keeps the sluice or board open at any desired height, and thus regulates the flow of water. In more complicated but still simple forms of the sluice, in place of a pin being used and perforated shank, a screwed bolt is substituted, and a large nut bearing on the cross-piece;—by turning this, the board is raised or lowered. In larger channels of distribution, more complicated forms of sluices are used, one of which, much used abroad,—where, we have said, irrigation is carried out on a more extensive and systematic plan than is here adopted,—is illustrated in figs. 3 to 6 inclusive, in Plate 56. Fig. 3 gives a general sketch of the arrangement and distribution of the parts of this, in which *a a b b* is the channel, which is widened below the sluice at *c d* before it is narrowed at *b b* to the original breadth, *a a*. The upper part, *e*, is boarded over in order to enable the workmen to operate the

sluice, the apparatus of which is fixed on the cross beam, *f f*; the part below the sluice is also boarded, either in the manner shown at *d* or at *e*. The sides, *d c*, are protected or lined with sheet piling, part of which is shown at *a a* in fig. 4. In some cases this sheet piling has its place taken by ordinary piles, as at *b b* in the same figure. The sheet piling is capped, as shown at *c c*, on which the flooring rests. The sheet piling, *a a*, fig. 4, terminates in a vertical beam, cross section of which is shown at *d*, a similar one being placed at the opposite side, at the sluice opening at *g* in fig. 3. Between the two a row of sheet piling supports the flooring or sill of the sluice, and is continued onwards on both sides of the opening for some distance, as shown partly at *c c* in fig. 4. The last piles of this row, as well as of the side row *a a*, are notched or grooved into the beam *d*. The flooring, *e*, in fig. 3, is supported on cross beams stretching across the opening *a a*, fig. 3; part of the beams, which rest on vertical piles, secured by a mortice and tenon, *g*, are shown at *f g h f*; *i i*, fig. 4, are part of two of the planks of the flooring, *e e*, fig. 3. Two cross beams, as *j*, fig. 4, are placed in front of the sluice in order to carry the planking, and are supported by four or five piles, the tops of the tenons of which are shown on the beam *j* at *k k*, fig. 4. Fig. 6 shows part of the side elevation partly in section, taken through the line *h* in fig. 3. Fig. 5 is part of front elevation across the lower face of beam *f f*, fig. 3. In fig. 4, *a a* shows part of the flooring; in fig. 6, *a a* is part of the sluice timbers, *b b* the side corresponding to *a a*, fig. 4, on the other side of the opening *e d*, fig. 3.

Irrigation by Steam Power.—We have now to describe a method as efficient as it is novel in principle and simple in detail, the invention of Mr. Isaac Brown, of Edinburgh. Briefly described, this system consists in forcing water by steam power through a series of pipes laid at intervals over the surface of the land to be irrigated, placed at certain intervals apart, according to circumstances. The pipes are perforated along the upper side of their length in such a way that the streams, which are of very small diameter, cross each other, and are thrown over the intervening spaces, somewhat after the style shown in

fig. 5, Plate 54. Fig. 6 may be supposed to be the disposition of the pipes, *a a*, over the field, *b b* being the main supply-pipe, through which water is forced at a pressure, and which may be supposed to be derived from a river bordering the field. This method has been applied in several instances with marked success, a very noted example being that at Stoke Park, and carried out under the direction of the well-known agriculturist, Mr. John Coleman. It might be supposed that the small apertures in the pipes would be apt to be stopped up very speedily by soil, etc., but this is not found in practice to be the case; the pressure at which the water is driven through them prevents this happening. We have examined the system in operation under a variety of circumstances, paying particular attention to the condition of the apertures, but failed to discover one as having been completely filled up. A few had obstructions which caused the streams to be deflected from their exact course; but this could scarcely be said to be a fault, inasmuch as the water was directed over the land. To prevent the filling up of the apertures by corrosion, *lead* pipes are used. At Stoke Park the pipes are laid at a distance of 16 yards apart, and the water forced through them by means of a 12-horse-power engine, working one of Tangye's pumps at a pressure of 60 lbs. to 70 lbs. on the square inch, equivalent to a head or column of water 120 feet in height. It throws a shower over a plot of one and a half acres at a rate of 10 tons in 15 minutes. Six acres are thus laid out, and plot after plot is taken in rotation, the watering being done at night to avoid any bad effects on the grass from the sun heat. We have used the word shower, as it most accurately describes the effect produced by the minute streams crossing each other from the same pipe, and intersected by the streams from the adjoining pipes, producing what may be described as a perfect artificial shower. One must see it in order to observe how completely the effects of a *gentle summer rain* is imitated by the apparatus. There can be no doubt that, when properly carried out, the system bids fair almost to revolutionize the practice of sheep-feeding, although it is obviously applicable to other live stock, either soiled on green

cut food or fed on lay. Taking the plots in rotation, Mr. Brown, we may add, has rendered the system of folding as easy as it can well be by the invention of a new form of hurdle, having a central bar, from which project other bars forming a large square cross, and which can be rolled along the ground, wheel fashion, in a most expeditious manner.

Drainage Water for Irrigating Purposes.—The water obtained as the result of drainage of certain lands may often be utilized for the purposes of irrigation. Mr. Smith (see description of 'catchwater' meadows) describes a plan for draining lands formed at the feet of valleys, which, containing many springs at the sides and feet of the several hills, have formed, from their long and unmolested course, dangerous bogs. This process is a cheap one, and the water is put into immediate use for irrigating the lands below. The plan adopted is, by taking the level for the water-carriages (used in irrigating) from a point at which a level may be driven up to the spring at a proper depth, to effectually carry off its water into the water-carriage below; and it thus mixes with the passing water, and at once takes its part in redeeming the grasses of its late and nearest neighbouring bog below, which had been tapped upon the same plan, and dispersing its water in an onward direction for a similar improvement. Care should be taken to tap these springs deep enough, as they are much increased by irrigating the upper hill-sides, especially on porous soils.

Town Sewage Irrigation.—In treating of this subject we shall only glance at what may be called its peculiar features as distinguished from that of ordinary irrigation, as the details of both may be said to be nearly, if not altogether, identical; so that a plan for applying the water, as met with in its ordinary condition, will be applicable, with but trifling modifications,—if any, indeed, be demanded,—to one for using the other material. The difference between the two systems lies, in fact, in this—that while the one deals with water in its pure or ordinary condition, the other takes in hand the treatment of that which is rendered impure by the circumstances connected with the towns which produce it. These modifications run, therefore, more in the direction of points connected with the supply,

and the crops to which that can be or is made available. The discussion of this department revolves more round these and cognate points than those connected with the practical working details. While irrigation, *per se*, has been carried on from a period dating far beyond that of which we have written records, irrigation by or with the agency of town refuse in its liquid state is, as our readers do not require to be told, but a thing of yesterday. But notwithstanding its recent origin, there is no question connected with our social development which has created so much discussion, and about which so many opposing facts, or assumed facts, have been stated, and so many conflicting claims made. And yet, looking at the subject from what may be called the national point of view, it might be reasonably supposed that the application of liquid sewage to the fertilization of land by one or other of the known methods of irrigation would just be as simple and free from complicated questions as those have been found in practice to present. But in looking closer into it, we find that the difficulties arise just in the way we have already hinted at, from the peculiar circumstances connected with urban arrangements; so that the difficulties present themselves before, not after, the liquid is supplied to the land upon which it is proposed to be used. Taking this view, one would say, then, that those interested in the land should have little reason to concern themselves with any circumstances connected with the supply, but should simply confine themselves to making arrangements by which that supply could be utilized. But it is just from the fact that there is such a close connection between the urban circumstances affecting the supply, and the methods of using it on the lands, that those interested in the latter find that they must concern themselves with the former. This, however, may, from another point of view, be said to depend upon the way in which they look at the whole subject; for if they are content to look upon the supply of town liquid refuse as just so much water, to deal with in the ordinary way of irrigation, *plus* such fertilizing matters as may be passed into or come along with it to their land, the difficulties above alluded to will be very much lessened, although by no means got rid of.

But if, on the other hand, they prefer to look at the subject from what may be called the popular point of view, that sewage is to be considered valuable almost wholly on account of its being a manure, but only in a liquid form, then the difficulties will be found to present themselves in their most aggravated forms, and will have to be dealt with, and in so dealing with them not a little trouble will devolve upon those who attempt to utilize it. For it is just in connection with this very point of considering sewage as a manure of great value, that the opposing facts and conflicting claims we have alluded to take their rise; and what these have been and are, and how much they have retarded the progress of an important movement, affecting in the closest way large bodies of the community, those only know who are intimately acquainted with the history of its details, and have traced these from the earliest period of its inauguration up till now. For example, farmers have been told that they were guilty of the purest folly in paying high prices for manures brought to them from foreign lands, while they had quite as valuable a supply passing, so to say, their very doors, in a large and ever-increasing stream, which they had merely to arrest and apply its liquid treasures to their land, which could be done, if not in the easiest, at least in a very easy way, and at a cost infinitely below that which they paid for the higher priced materials. In brief, while all the difficulties—as difficulties which could not be ignored or overlooked—connected with the subject, or, to use the popular phrase, with the ‘utilization of town sewage,’ were made the least of, all its advantages or valuable features were made the most of. And, as a natural result of this mode of dealing with the subject, the corporate bodies of those towns who had—as every town had—large volumes of this liquid sewage to dispose of, were known to hold most exaggerated views of its value,—to revel, so to say, in golden dreams of profits so great as to constitute to them a vast source of wealth; and as a further result, this only added to the difficulties, and prevented them from being met and dealt with in a common-sense way. For, apart from the point as to whether the sewage was or was not so valuable to farmers as the popular party, so

to call it, which looked at all the points of the subject as tinted with the *couleur de rose*, maintained it was, they led the corporations to overlook and quite forget a very essential consideration—namely, that before farmers could possibly avail themselves of this valuable manure, it was necessary that it should be taken to them. But here, again, the difficulty was made light of, and assertions were freely made that this transportation of the refuse of the towns to the fields of the farmer could be made not only with the greatest ease, but in the cheapest of ways; for the very nature of the refuse—its liquid form—presented, it was confidently stated, the exact circumstances under which its movement from one place to another could be best, most quickly, and most cheaply done. From the first we held, as we hold now, that the common-sense principles of ordinary commercial dealing should be applied to this subject, as well as to others in which men are concerned with one another; so that we considered farmers were in relation to corporations simply customers, who might or might not buy the sewage the latter had to dispose of. But before they could be purchasers, it was but a common-sense view to take of the relationship, that the sewage at least should be placed within their reach, and that proof should be given them of its presumed value, which proof it lay with the seller to produce. We therefore cleared the farmer of the inconsistent charge of folly or blameworthiness laid to him of purchasing foreign and dear manures, neglecting a cheap and home-made one, so to call it; and if there was folly at all, it was on the side of those who expected him to buy a manure of which, if he was disposed to purchase, he could not obtain possession. And as against what we conceive to be the highly exaggerated value which was popularly attributed to town sewage viewed as a manure, we held that this value was not so great as was thus stated, but that there were certain circumstances of a grave and special nature which tended greatly to reduce this manurial value, and that if these considerations were overlooked, then no report published or opinion given on the subject of sewage utilization could be trustworthy in the true scientific sense of the term. Still

further, while admitting freely enough that the manurial constituents of sewage, being in the liquid form, presented great facilities, in an engineering point of view, for its quick and easy transmission from one point to another, we, on the other hand, held that the very large bulk of water present in sewage in its normal condition tended greatly to reduce its agricultural value as a manure, and introduced, moreover, other farming difficulties, to which we shall presently allude. So decided was this difficulty, that many of those who adhered to what we shall, for convenience sake, continue to term the 'popular' side of the question, endeavoured, if not to get rid, at least to lessen it, by adopting methods of dealing with the sewage by which its solid particles or constituents should be separated from it, treated in such a way as to form a solid manure, leaving, at the same time, the liquid so clear and pure that the sanitary difficulty connected with it in its original impure condition would be got rid of, inasmuch as it could then be sent into streams and rivers without contaminating them. Chemical investigations, however, put the point beyond all doubt, that no process could extract from sewage the solid substances in such a way that a paying manure could be formed of them. For, apart from other difficulties connected with such processes, there remained this unfortunate one—unfortunate for the hopes of their projectors—that the most valuable manurial constituents of sewage remained in the liquid left after the extracting process, and that these its most valuable constituents could not, by any process which would pay, be obtained from it. In view of these facts, about which much could be written if space permitted, we hold that in dealing with the difficulties to which they gave rise, and in endeavouring to get rid of them, whatever might be the plan which would be found in the majority of cases to be the best adapted to them, that plan would be in the direction of utilizing sewage in its ordinary condition, by one or other of the plans of irrigation; but that, even so far as irrigation was concerned, we maintained that the chances of that being adopted, so as to give the most economical results, would depend very materially upon circumstances of locality. And, further, that in view of the

enormous bulk of the matter to be dealt with in the case of large towns, it might be possible that some modification of the water-carrying system of drainage would have to be introduced before the difficulties attendant upon the question could be met. Still further, it was held by some that the experience of one district or locality in its treatment of town sewage agriculturally would not be an unfailing guide as to what would be the experience of another district; that the circumstances of soil, climate, and locality exercised a potent influence either for good or evil, and were those which would come into play, and must be met and dealt with in considering the chances of success of any scheme of town sewage utilization. Finally, it was held that, taking all these various points now named into consideration, the great probability was that, for some years to come, there would be no general realization of schemes for utilization of town sewage; that comparatively few would be carried out; that, when carried out, they would not be greatly, if at all, remunerative in a commercial sense; and that, in place of the difficulties connected with the question being lessened by the experience of advancing years, the great probability was that they would continue to be universally felt. Such were the opinions we held years ago, and it is, at all events, suggestive of grave consideration when it is now stated that the experience of the past decade has proved, to a very remarkable extent, the general accuracy of the conclusions we have above stated. The town sewage question is still a 'vexed one;' it is not surrounded with fewer, but what we conceive to be as great difficulties as before. Certainly—and we put this issue very clearly and decidedly—the difficulties are not easily to be overcome.

These difficulties, however, we conceive it to be the part of the corporate body of towns to deal with, and we shall only allude to them so far as they may affect the practical details of the method adopted for utilizing sewage. From what we have said, the reader will of course understand that we propose to consider the method of irrigation as the best by which this can be effected, simply assuming that those who purpose applying sewage have at their command supplies of it, without considering by

what means, or upon what terms, that supply may be obtained. Leaving, then, all consideration of the question whether irrigation is the best mode of dealing with town sewage, let it be granted that it is so, not only in an engineering sense, but that, agriculturally speaking, it is entirely successful in raising crops of all kinds upon all soils,—points which all are by no means agreed upon,—the question here arises, Is there no difficulty, or are there no difficulties, in the way of using this method, or such means as these by which we can utilize the mass of sewage which practically we have to deal with? Were a reader for the first time to act upon certain reports and papers,—and they are pretty numerous,—he would be convinced that in connection with this method of utilization all was *coulcur de rose*; that there were no difficulties in the way, or rather, that there was not a difficulty in the way. Let us see if this be so or not; and here it will not be amiss to glance for a moment at one point, to which allusion has been made, namely, whether it would not serve some practical purpose if, under the auspices of Government—although that we can scarcely hope for—or of one or other or all of our leading agricultural societies, a series of experiments were instituted for the purpose of getting some facts as to the results of land irrigated with water in its ordinary condition, and with sewage as it comes from towns in which manufactures and industrial processes were carried on. Those acquainted with the minutæ of the question will see that such a series might set at rest various points which have risen, not merely with reference to the effects of irrigation, with and without sewage constituents in it, but also with reference to the value for feeding purposes of the produce raised. It would add to the value of such results if the experiments were extended to the raising of the same crops on land not irrigated at all—that is, cultivated on the usual plan. Those acquainted with the art of irrigation *per se* know that there are more than one or two points connected with it which might receive elucidation, about which we can only at present conjecture. One point, probably, would be set at rest, if, as would be essential, the experiments were conducted in various parts of the king-

dom, and on various classes of soils, as it is believed by many that irrigation, although well adapted for certain localities, is not adapted for all, and that in certain seasons it is required only for very few localities and soils.

This brings us to the question, What is the proportion which land to be irrigated should bear to the sewage used for irrigation? in other words, what quantity per acre should be applied? The importance of the question is abundantly evident in view of what we have above stated; and when we inform the reader, whom we suppose to be ignorant of the facts of the sewage question, that no definite trustworthy answer can be given to the question, he will perhaps agree with us that it is another evidence of what at the outset we plainly stated, that the sewage question has not as yet been thoroughly investigated. For, notwithstanding all that has been done in the way of experiments, and in the more practical work of sewage irrigation, in the neighbourhood of many towns, we cannot get a definite guide as to the quantity of sewage to be applied to a given area of land. When testimony on this point is obtained, we find it of the most conflicting character, and the general result of inquiry may be said to be simply, 'Find it out for yourself.' A remarkable example of this is to be met with in the experience of the Sewage Inquiry Committee of the town of Birmingham. The committee, in pursuance of the object they had in view,—namely, the investigation of the whole subject, the inspection of sewage works already in existence, and the inquiry into new plans and projects brought forward in connection with it,—visited several sewage farms, and addressed a number of inquiries to the authorities of places they did not visit, with a view to gather such information of a practical character as might aid them in coming to a decision on the plan they would recommend the corporation of Birmingham to adopt. Amongst other queries they put, was one bearing upon this point of the area of land required to utilize the sewage of a given number of persons, and the number of tons of sewage applied per acre per year. In this, as in all the other branches of their inquiry, they found, as we should have expected, the most conflict-

ing testimony and the most discrepant results. It might at first sight be supposed that the relation of the number of persons the sewage of which was applied to an acre, and the number of tons of sewage applied to an acre, would bear a close relation; and that if discrepancy in the results were observable in the column connected with the one, there would be a similar discrepancy in regard to the other. But the information gained by the committee, and published in a condensed form as a table, showed that this is not so, but that with regard to the number of tons per acre used there was, upon the whole, a fair amount of equality. We say a fair amount, for it will be observed that there is, in fact, considerable difference in the results experienced, one using 9400 tons, and another only 3324 tons per acre per year.

With the results which the committee ascertained, the committee could only average the seven towns, and this gave 5768 tons of sewage to an acre of land. This, it will be observed, gave no rule or law of any practical value, for it is evident that the consumption of sewage is dependent, first, upon the quality of the soil to which it is to be applied, and, secondly, upon the kind of crops grown on it. These—both land and crops—have their own special capacity, so to say, for consumption; their appetite varies with circumstances. What the committee had to do was, first, to know the soil they had to deal with and the crops it was to bear, and then see if the experience of other towns would help them to a rule for their own guidance. We have repeatedly, in this volume and elsewhere, drawn attention to the fact, too often overlooked, and which when so gives rise to many grave errors and mistakes in practice, in connection with agriculture as a science, that it is not a fixed one; that it did not deal with known qualities, so to say, with invariable laws and circumstances; that, on the contrary, it had to deal with circumstances of an ever-varying character; and that consequently—to put the matter as briefly as it can be put—the results of one trial of any particular experiment or mode of working gave no index as to what would be the result of another trial, and that this even held good very frequently where, as far as could be

obtained, all the circumstances were exactly alike. There is in connection with the operation of certain manures on certain crops, under certain conditions of soil, locality, and character, a something which men of science have not as yet been, which possibly they never will be, able to grasp, which sets all reasonable conjectures as to the result at defiance. Practical agriculturists have of late years been alive to this, but the overlooking of it has done much to hinder agricultural progress, and in the case of the town sewage question has done more to retard real progress than anything else. This difficult element, to be met with in all agricultural experience, will be found exemplified in the table alluded to, and as connected with the position we have supposed the committee who drew it up to have been placed in; for, granting that they had a soil precisely similar to that to be met with in the towns of Romford and Bury, and were determined to grow similar crops, what could they have done with the answer to the question, What is the amount of sewage per acre per year you apply? For, apparently under the same circumstances of soil and cropping, one, the town of Bury, uses 9400 tons; the other, the town of Romford, uses only a little more than a third of this, namely 3324 tons. Wherein lies the secret of the great difference here existing? We ask, but get no reply. Falling back, therefore, on the only available data which the experience of these seven towns afforded them, and taking 5768 tons as the number per acre they would require to provide for, the committee found on calculation that no fewer than 4800, nay, 5000 acres would be required for the town of Birmingham. With regard to the getting of this vast extent of land, the committee put the case very summarily out of court, stating that it was manifestly absurd to suppose that an area of this extent 'could be devoted to such a system of farming,'—this system being the cropping of the land with rye grass and vegetables, these being the crops which consume or require the largest amount of sewage. But the amount of land shown to be, or likely to be, necessary for Birmingham—and the point holds good for all other places—was made on an assumption that the 6000 tons were needed per acre per year; but if experience showed

that only half this quantity was necessary—as experience might show—it is clear the difficulty as to the land would be doubled. But it is not merely the difficulty as to the procuring of the quantity of land necessary to utilize the sewage of a town that is to be met with in practising irrigation, but that of obtaining the quality of land best calculated to utilize large quantities of sewage.

The opinions adverse to the applicability of sewage to all crops, through the experience which has been gained in the interval of the last ten years, are now much modified, and in some cases, those who held it was not so applicable have become convinced that they were wrong. Still, just as it is true that one soil suits a certain crop better than another soil, so it still holds, and will likely ever hold true, that sewage will be more successful when applied to some soils than when applied to others. This is a point which cannot be disputed. Further, we believe that even in the case of soils the most favourably disposed, so to say, to stand applications of sewage, an alternation of solid manure with the liquid sewage will be beneficial. We were the first, we believe, to point this out, and that years ago, basing our opinion on the fact well known to practical farmers and agricultural chemists, that, especially in the case of strong soils, a mechanical effect was required to be performed upon the soil by the manure in opening up its pores and allowing it to be influenced by the atmospheric agencies. This has, singularly enough, been greatly overlooked in considering the application of liquid sewage to land; but we are glad to observe that it has been taken notice of in a practical way at the sewage farm at Barking. In a recent report issued by Mr. Morgan, in connection with this farm, we find the following suggestive sentence:—'We are by degrees establishing a regular system, by which the different plots on the farm will receive a good dressing of dung in succession, my often expressed opinion that such *revival* of land is necessary to the successful working of it under sewage having been confirmed by increased experience; and I am satisfied that, had we always followed this system, the crops would have better withstood the tedious "dropping," from which, 1

trust, we are now escaping.' Take in connection with the above, and the word revival, which we have italicised, and also with what we have said as to irrigation *per se*, and the practical reader will be able to gather something of importance relative to the effect upon land, either of a long continued or too heavy application to it of liquid manure, without the addition, either at long or short intervals, of the solid dung or manure we believe to be essential to successful farming, whether that be sewage or not, especially in the case of heavy or close soils. 'There is no doubt that sewage farmers have a great advantage over ordinary market-garden farmers in years of drought; but in what we have learned to call "dropping-years," this advantage either diminishes, or, in cases of excessive rain, disappears altogether. *The crops usually grown can only take a certain quantity of water, whether it be rain or sewage water; more than this will always keep them wet, and rot them or kill them.*' We have italicised this last sentence, as it bears most closely upon what we have said on the subject of irrigation *per se*, and that, again, applied to the utilization of town sewage. We are most desirous that the reader should be made acquainted with all the phases of the question, and this cannot be done without giving matter which may be favourable as well as unfavourable, and *vice versa*, in connection with any particular scheme which may be under review.

Courses or Channels as Sources of Water Supply in Irrigation Plans.—The kinds and forms of the watercourses used in irrigation for conducting the water from one point to another vary according to circumstances and the nature of the soil, from the simplest rut or plough furrow, up to those which, passing through districts and soils of a different and treacherous character, demand works of a character so complicated, more or less, that they may be said to come under the head of the higher class of engineering work. Such illustrations as we have given will comprehend only what may be called the simpler classes of water channels, and will be applicable alike to ordinary irrigation, and to that where town sewage is employed; and our descriptions of these will be of a general character, the nature of our work precluding our giving elaborate

details and complicated calculations as to the quantity or the volume of water passed through or along them in a given time. These are, indeed, not necessary, unless in the case of irrigation works taking in extensive districts of country; for under the circumstances of ordinary farming, where irrigation is carried out, one is compelled, so to say, to be content with and make the most, in a somewhat rough-and-ready way, of such supplies as may be at command. Roughly stated, however, we may here state that the quantity of water passed by any main channel of supply—for it is only with this class that calculations are made, if calculations are considered necessary—may be estimated by multiplying the cross section of the channel, or rather the water taken at an average level, by the velocity with which it flows along it. This velocity can be most quickly ascertained by using a floating body of a density a little less than that of the water, so that it will give a sufficiently accurate indication of the current, and be, as it were, completely under its control. And this floating body should be used at a period when the water flows naturally, and is not influenced by winds blowing either against or with the current. A distance of any given length is then marked off, and the number of seconds noted which it takes to float from one end of this to the other. This velocity, of course, is but approximate, as that of the water varies at different points, not only at its surface in relation to the border or edges of the channel, but also to that of its depth; but a mean velocity of the whole body may be calculated at four-fifths of that at the surface. The depth of any channel should always be greater than that of the water, so that a certain depth of soil will be above the former, and thus prevent any damage being done to the banks when high winds are blowing, etc. The inclination of the sides of the channels will, of course, vary according to the nature of the soil through which they pass; the firmer and more adhesive the soil, as in clay, the sides being steeper, as, for example, in fig. 3, Plate 55, and increasing as the soil increases in lightness, as in the case of a sandy one, as illustrated in fig. 5. This gives the section of water-channels of the form of a trapezium, as in figs. 1 to 5. The

inclination of the sides may be taken in degrees, or any scale of equal parts; and as the soil may, and is very likely to, vary in any considerable length of channel, the inclination of the sides will vary in like manner, but the depth must be uniform. The depth is the guide to the breadth of the bottom of the channel, the two being equal, as the breadth $a b$, and the height $a e$, in figs. 1 to 5 inclusive. In marking out the template for cross section, from the points $a b$ erect perpendiculars, $a c$, $b d$, and draw a line, as $e f$, parallel to the bottom line $a b$; then from the points e and f any desired proportion of the width $a b$ is set off from the points $c d$

towards e and f , and lines are drawn from a and b to e and f , giving the inclination of the sides; the distance, as $d f$, may be twice $c e$, fig. 5, or three times for light soils, and varying from the same distance, as $a b$ in fig. 1, to one-fourth, as in fig. 3. In some cases where the breadth of channel is considerable, it may be necessary to scarp out the sides, as at $f g j$, or $e h i$, fig. 4, Plate 55. When this is done, a good proportion for the breadth of the scarp, $f g$, is one-third of the breadth, $a b$, the line $g j$ being parallel to $f b$. For other parts, see paragraph entitled 'Details of Irrigation Plans.'

CHAPTER VI.

SAVING, COLLECTING, AND STORING UP OF WATER—EMBANKMENTS FOR RESERVOIRS.

The Influence of Water on Animal Life.—In the varied subjects connected with the improvement of landed property which bear upon the carrying out of what may be called the inner departments of management, such as those of domestic and live stock, there is perhaps none which is treated with such indifference by the great majority of those who are specially interested in both, as that of the water supply. So treated is it by nearly all, that it is apparently considered by them that if water is obtained, it matters little in what condition it is; or, perhaps, to put the matter more correctly, they do not seem to consider that there may be good as well as bad qualities, and that it might be worth while to procure the one in preference to the other—the pure rather than the impure. There can be no doubt of the fact, physiologically considered, that the quality of the water habitually partaken of does exercise an important influence upon health. This may be at once conceded as true in the case of human organisms; it will not be so readily conceded, we fear, in the case of the stock of our farms. Indeed, there is not a more remarkable feature of farming than the notion which many engaged in it hold with reference to the powers of endurance, and the capability to resist bad or unhealthy influences, possessed by our cattle. Assuredly the popular notion is that they ‘can stand anything,’ as the phrase goes; and we see a peculiar outcome of this notion with respect to one of the animals of the farm in the phrase, ‘as strong as a horse,’ as if by this was meant to be conveyed an ability to undergo any trial of strength, or resist any influence for evil to which the animal might be subjected. Nor is this notion confined to the horse; it applies, unfortunately, to the cattle as well; and yet it is neither more nor less than the true statement of the fact,

to say that the animals of our farms have a most delicate organization, requiring the exercise of the greatest care on the part of those who keep them. The most advanced of our veterinary authorities have for long endeavoured to indoctrinate the popular mind with this notion, that our stock are not the hardy animals they are supposed to be, but that, peculiarly liable as they are to unhealthy influences, the greatest care should be taken in their general treatment—markedly so in the case of the food they eat, and, we may here add, in the water they drink. It should never be lost sight of, that in the general organization of animals there is much that resembles that of ourselves, and it is therefore reasonable to assume that they are possessed of many of our feelings, and influenced in a degree more or less by our likes and dislikes. Much might be said on this subject, and much that is peculiarly valuable as applied to the case of stock can be gathered from it; but at present we must be content with the general statements we have advanced, only noting—what, indeed, is evident—the close bearing they have on the immediate subject of our chapter. For, admitting, as may readily enough be admitted, that if water in the muddy and filthy state in which it is often supplied at our farms would be bad for us if we were habitually to partake of it, it cannot possibly have otherwise than a similar effect upon our cattle, seeing that much of their organism resembles so closely our own. But if analogy is forbidden us, we can call in the evidence afforded us by the direct inquiries of our veterinarians, who tell us in language unmistakable, that bad water, given habitually to the stock, exercises a most deleterious influence upon their health. We know well enough the danger that arises by

partaking of putrid food, or food that may be in the stages immediately preceding putridity, causing, as it does, those dangerous zymotic diseases unfortunately too widely known; and we have no doubt that, in consequence of the rapidity with which the putrid matters are assimilated, as compared with those in the solid form, putrid or bad water is more dangerous than putrid or bad meat. Those who have had practically to deal with stock know well enough how very rapidly their secretions are influenced by the nature of the food which they eat, and by the way in which that food is prepared. Indeed, we know of no department of stock-farming so suggestive as this is, and we should be glad to see more attention paid to it. We have known immediate results arise from the use of a certain class of water when partaken of. Nor is the question of water supply decided by merely supposing it connected with the drinking purposes of the stock, nor less marked, but unfortunately much less obvious, and consequently much more neglected, is the effect of water when used in the preparation of cattle food. In view of the fact that cooked and otherwise mixed or prepared food is largely used in farm economy, it is all the more important that the water be of good quality. It is difficult to say what are the losses sustained from the habit of giving stock bad food; and, as a practical fact, it matters little whether the bad food arises from the bad nature of its solid or its liquid constituents. No matter how good the solid constituents—food, in popular parlance—may be, if prepared with bad water, it is obvious enough that the practical result is as if the food had been bad in place of good. We have said enough for our purpose—not enough, if the full importance of the subject could be met by a thorough discussion of it—as to the necessity that exists for a supply of pure water, as well for the purposes of our cattle as for those of the inhabitants of our farm-houses or our cottages.

The Saving and Collecting of Water.—Much as has been written, printed, and said on this subject, and deeply apparently as this has impressed the minds of those directly interested in it, we have little hesitation in saying that its importance is not yet thoroughly comprehended; far less—and partly as a consequence

of this, partly from such points not having been so much brought forward—has the public mind any fair or adequate conception of the many advantages which would accrue to farmers and those connected with estates had they at all times a command of water in large bulk, and of easy and economical management or handling, if such a term can be used in connection with such a material. For it is not merely because this would be useful, and highly so, under the ordinary circumstances of work, where the whole subject carries with it so much that is of high practical importance; but because it can be made available in modes and under circumstances of which as yet it is only the more advanced of our engineers and agriculturists who have any adequate conception. As it is not the object of the present brief chapter to enter into any detail of these, or, indeed, of the subject generally, we content ourselves by having thrown out a hint or two merely, which may, by working in the minds of some, result in some of the very adaptations or uses to which we have alluded, and pass on to notice one or two practical points connected with the gathering or collecting and the storing up of the water so collected. As part of what we may have to say on these points may be applied to another department of land work, it will thus serve a double purpose, which purpose will be more fully shown as we proceed.

As to the gathering or collecting of water at present allowed to run to waste, a large and useful essay or paper could easily be written, and one which could be made to abound in notes of extreme value. We content ourselves by taking up one case of supposed circumstances in connection with this, giving a few hints of a practical character. In several districts where the land at all approaches to the character of hilly, and, indeed, in many where it is known as ‘rolling’ or of moderately unequal surface, there are valleys or depressions through which rivulets or streams flow; these at times being scarcely perceptible, so small and trilling is the water which passes along, but at other times rushing through the valley in the wild and tumultuous fashion of a flooded stream. In such localities, and under such circumstances, opportunities favourable for the most part are presented, by

which, at a comparatively trifling expense, water—and in such places it is generally of a good quality—may be stored up in such bulk as to put aside all fear on the part of the farmer, and, indeed, one may say of the surrounding neighbourhood, that times of excessive drought, which now and then come, and in which water both for man and beast is found to be indeed a ‘precious gift,’ will ever come to afflict the locality.

Reservoir Embankments.—We have said that under such circumstances of locality this storing up can be effected at a comparatively trifling cost. This, of course, greatly depends upon the way in which the work is gone about, there being in this, as in other departments of work, two ways,—the bad, which is the dear; the good, which is the cheap way, even although at first sight the latter may appear to be by far the most expensive of the two. But it is best not to be penny wise and pound foolish in work of this kind. The mere choice of the site at which the reservoir or storage place is to be made greatly influences the cost and efficiency of the work. The dam or embankment may be thrown across the valley or depression of the land at a point where not only will it take longest time to make, but where there may be a difficulty in getting materials to form it unless they are carted or wheeled from a distance. The position or site chosen, moreover, may be such that it will require the most expensive kind of work, while another site would offer many advantages, and yield facilities for the formation of the bank,—form, indeed, a part of it by some natural formation, bend, or curvature of the land. All these points should be carefully attended to before the work is begun. Where obtainable, the best site for a dam, stretching across a valley or depression, is where the valley narrows to a minimum width, with high and firm banks on either side, and where the land above the embankment trends outward from it, forming a kind of basin which gradually shallows in the upper edge and to the sides. A reservoir in such a place can be formed at the minimum of expense, other circumstances being equal.

A good deal of ignorance exists on the subject of raising embankments to resist the pressure of water, and many have been made by professional men of standing which have not been

successful; while others have been quite the reverse, although put up by the ordinary agents of the estate, who have laid no claim to special knowledge of the subject. Much, it is right to say, of the defective work to be met with arises from the peculiar nature of the soil or site, and also from the peculiarly treacherous nature of the material the makers have to contend with. The most careful attention is requisite in examining the soil of the site of the intended dam or embankment. This is all the more necessary, inasmuch as it must be remembered that that part of the valley or depression in which the stream or rivulet runs forms but a small portion, or takes up but a small part, of what may be called the base of the valley or hollow, stretching between the banks on either side, which form the sides of the reservoir, and the abutments, so to say, of the embankment against which its ends press. The consequence of this is, that the soil or base of the embankment bears a very large proportion to the width of the stream which it is to dam up, even in times of flood. There may be, and are, exceptions to this, in which the valley or depression is so narrow that the breadth of its base occupied by the stream is perhaps larger or wider than the unoccupied land on either side. But the cases met with in practice are, as a rule, distinguished by the characteristics named in the first instance; hence the necessity of seeing that the soil on which the base of the embankment rests is of a firm and sound character. The usual way to ascertain this is to sink trial or test holes along the centre line of embankment, and generally over its surface. But in connection with the work of embankments, there is none which has raised such a diversity of opinion as this same sinking of test holes. At first sight it appears to be the most common-sense way in which to ascertain the character of the soil on which the superstructure is to be raised; but, on the other hand, it should be remembered that the very sinking of these wells may be the means of causing disturbance in the strata, bringing about movements of perhaps shifting soils or quicksands, or, what is equally bad, if not worse, the exposing of subterranean springs, which, when thus opened up, are sources of annoyance and loss to the contractor, and often, indeed, test his patience to the

utmost. Hence, while there are those who hold that you ought to know the soil you are to build upon, there are others who maintain that, if the natural surface is firm, sound, and solid, it is by far the best way to use it as it is, with such precautions of a simple yet useful character, as ramming or beating the ground at various parts, to ascertain if possible if the ground is hollow beneath or of a mobile character;—an experienced ear can in many cases detect faults by this alone. The one, in fact, tries to find out faults; the other says, Be satisfied with the site as it is, presenting as it does—this being the supposition—all the appearances of being sound and firm; in short, better to bear the chances of future evil, than to adopt such plans as will bring into existence those which have none now, or of which we do not dream.

Still it should not be forgotten that, in many cases, the after plan of proceeding which the latter opinion necessitates, namely, putting down the embankment with its base simply resting upon the natural surface of the soil, will not suffice to secure a good foundation. For to those who know the exceedingly treacherous nature of water, how it acts, and how this action is continually going on night and day, it would seem to be a very hazardous experiment, involving many chances of after labour in the way of repair, or perhaps of the total destruction of the dam or embankment, to place the base simply on the natural soil. The position of the embankment being decided upon, the first thing to be done is to lay out its actual site. The line of an embankment is generally straight, although in some cases curved ones are adopted, and stretching across the valley in such a way that it will be the shortest straight line which could be adopted. But although this is the rule, there are circumstances which make exceptions to it. Thus, if one end of the embankment be opposite a part of the valley on the other side which does not offer the best 'abutment,' or butting-point, but a better being either higher up or lower down, the line of embankment should be made oblique, or stretch across the valley in a line not at right angles to it, so as to enable a firm foundation to be made, and the junction between the base of the embankment and the face

of the land, in the upper side of it, forming the bottom of the reservoir, to be perfectly water-tight.

The site of the foundation having been thus prepared, the next point is the raising of the embankment which it has to sustain. In this work the three principal points to be attended to are, first, 'the junction of the base with the site;' second, 'the finishing of the ends of the embankment;' and third, 'the raising of the superstructure.'

The junction of the base of the embankment with the site or trench of foundation is a work requiring the greatest care. The 'puddling clay' requires to be most particularly attended to in its preparation, so that no stones be left in, and specially no decaying matter, as turf, pieces of wood, small branches of trees, and the like. There is no 'enemy,' so to say, which works so insidiously and secretly as water, and it takes advantage of every weak point in the embankment, and weak points are soon made by the presence of the substances, especially the last, we have named. Subsidence leads to loosening, and thence to cracks and crannies; and these are entered by the water, the passage of which through the embankment is facilitated by foreign substances, round which it works. Hence the more solid the puddling clay is the better; and this can only be obtained by having good clay and putting it down well. This last is seldom properly attended to, and yet there is no difficulty in the work; great care and honest good work are all that are required. The thinner the layers of clay put down at a time, the more secure the puddling. In the contractor's or workman's anxiety to see an embankment rise rapidly, the clay is put down in layers of from 12 to 15 inches thick. Now it will at once be obvious that it is impossible to ram a deep mass of clay so firmly that all its particles cohere one with another, and no voids or spaces left, as when the layers are thin, and the power of the rammer felt through the whole mass. This is the great secret of puddling. Hence, layers of 9 inches deep or thick will give much better work than those of 12, and 6 inches better than 9. If the clay be in good condition, 9-inch layers will be a good medium thickness. The whole surface of the foundation trench should be brought

regularly up in uniformly thick layers, care being taken not to raise one part higher than another; in other words, the 'course' or layer should be laid down and finished over the whole breadth and length of the embankment before another is laid down. When the ground level of the bottom of what will be the reservoir is reached, the utmost care should be taken in forming a complete junction between the layer next laid down and the one below, so that the edges—the upper one obviously especially—be as water-tight as it is possible to make them. If care at other points of height in the embankment be grudged, it must not be grudged at this point, which may be called its 'testing' or crucial point. As the embankment rises in height, it is gradually 'taken in' in width, starting from the ground level till the proper width at the desired height is attained. This taking in must be adjusted by wood sets—'templates' or moulds—the size and outline, with slope of back and front faces, being the same as the cross section of the embankment.

The second point, 'the finishing of the ends of the embankments,' is one of great importance, when these 'butt' up or rest against the faces of the valley. In such cases it is a question whether the ends should not simply be laid down upon the natural surface, or the face be scarped or cut in, so as to form a species of vertical trench or opening. Much will depend upon circumstances. If the face against which the end butts be smooth grass, it will be the safest way to make the junction with a trench; but if it be rough and rocky, and not very uneven on the surface, as this will afford a good 'key' or hold for the puddle, it will be best to remain as it is. Theoretically, a perfect embankment may be supposed to be a continuation of the sides of the valley stretching across the open space, filling it solidly up, so that no joints or spaces be left at the ends. The more perfect, therefore, the junctions between the embankment and the valley sides at its ends, the better. In cases where there is a valley side, or 'butting' point, as high or higher than the embankment at one side only, and the other side crops out till it reaches the adjacent ground level, then the outer end towards this side must be gradually reduced in height, sloping gently downwards and outwards

till it reaches the ground level outside (see fig. 14, Plate 57, at c). Here, again, the question comes up, Is it better to cut a trench in the ground to receive the base of the sloping end, as in fig. 8, or simply to commence the puddling on the ordinary surface of the land? What we have said on this point with reference to the main part of the embankment will apply to this case.

But in whatever way the junction between the natural soil and the base of the embankment be made, as well as its ends or terminating points, it will be of essential importance to see that the line of junction be well puddled; this being required more especially at the upper or water side, so that the water cannot escape from the reservoir through openings to the main part of the puddling. And the facility and certainty with which this can be done when a trench is cut to receive the base, as compared with the plan of simply resting the puddling of the embankment on the natural surface, is the best argument in favour of its adoption. The difference between the two will be obvious. When the embankment rests simply on the surface, the water is much more apt to get below the base when having to pass merely along the surface to reach any defective part in the line of junction, than when a trench is used, as it has first to descend through the puddle before it can reach the base. And it is much more difficult to ram the puddle well up and into the junction in the first than in the latter case.

We now come to the rearing of the superstructure, or upper part of the embankment above the ground level, and the method of finishing off the surface, etc. Much of what has to be done with this has been already given in connection with the raising of the ends, and the filling up of the trench of the base of the central part of the embankment, for the work is throughout very much of the same character. The puddling is to be raised in successive layers, and in the manner already described. These layers may be a little thicker nearer the centre of the embankment than those in the base; but as the main object is to have the structure as uniform as possible, the materials forming a solid structure, it will be advisable to have the whole carried up in the same style from base to top.

An important part of the work of embanking is the method to be employed in finishing off its surface. A variety of opinions are given on this point. Some advocate the facing of both water and the free or lower sides throughout with stone; some with turf, afterwards sown with seeds of grasses which have long roots; some with wood. Some confine the facing to the water side only, with the exception of the top and a small part down from the top of the lower side; while others merely cover the top and a part of the sides, on both upper and lower sides, with stone. On each of these we shall have a word or two to offer.

First, as regards the facing of the whole embankment with stone. We have already alluded to the abrading or wearing down and insinuating power of water. Now, as puddle at the best can scarcely claim to be a solid material, however carefully done, it is obvious that it will be dangerous to expose it too freely to the water action. Hence the value of facing the embankment with a material, over the surface of which the water, in time of floods, will pass harmlessly, as regards the top and lower side, and which on the water side will at all times protect the puddle below it. Great art is required to lay the stones if these be of unequal size—as rubble or undressed stones, or large pebble blocks—so that they will bond well together, and present a surface offering as few interstices as possible. In no case should one stone ride over another, but each and all should be well based and secured to the puddle below, and present, when finished, a surface as uniform as possible, with few or no projecting parts. Where coursed rubble or tool-dressed stones are used, the laying will be comparatively easy, as they will run in courses or even lines. The top lining requires to be done with special care; and to give a free and easy passage to the water at the corners where it joins with the side facings, wood balks or sills may be let in; although the best material, and one which could be moulded, so to say, into the best form, would be Portland cement concrete. With some, after the stone facings are finished, a heap of stones is thrown loosely down at the base or 'toe' of the embankment on the water side, and extending for some two or three

feet inward. This acts as an 'apron,' or protecting heap, to the 'toe,' and prevents the wasting action of the water on the puddle at the junction line with the ground.

The plan of facing the embankment with grassy turf is very often followed, and when well done, and the joints get filled up in course of time and covered over with vegetation, it forms a good facing for the lower side, the top, and part of the way down from this on the water side, the remaining or lower part of the water side being faced with stone or wood. In laying the turf, the slices or cuts should be so placed, with relation to each other, that the joining points shall 'break joint,' as it is technically termed,—that is, the solid part of one cut or piece of turf, say in the centre of its length, should be placed next the joints formed by the two pieces next contiguous above and below. A good supply of turf will have been obtained by taking off the surface in opening the base trench of the embankment; and as they are taken off in carefully cut pieces, they should be built up at some point within easy reach. The pieces or cuts should be rather short than long, as they will be laid more easily and uniformly. When laid, the surface, or, at all events, the parts near the joints, should be well rammed down with a broad-faced rammer.

Turf-faced embankments present generally a very smooth surface, over which the water glides very easily, without much of a tendency to wear it down or penetrate into holes or crannies; this last being greatly prevented by the grassy blades covering over and lying upon, and being pressed down upon the openings by the force of the water itself. One great objection, however, to turf-faced embankments is the ease with which vermin, as rats and mice, rabbits, etc., burrow their way through it, and, what is worse, into the very centre of the embankment. There is no remedy for this, and all that can be done is to examine the surface frequently, get the vermin out, if possible, and make good the holes they have made by ramming them well up with puddle.

To give the turf a good hold of the face of the embankment, some recommend the sowing of the surface with grass seeds having long,

penetrating, and reticulated roots, such as the 'couch' or common twitch grass (*Triticum repens*). This is a doubtful plan, for the roots have a tendency to loosen the puddle, and when they die, their decay allows of settlement. In view, indeed, of the importance of keeping all decaying matter out of the puddle forming the embankment, some engineers keep all vegetation as much as possible from embankments; and there can be no doubt that the standard of efficiency to be carried out is the having the whole bulk of the embankment composed throughout of material incapable of organic changes.

We now come to wood facing. This is economical, easily laid down, and, if the pieces be well laid down and secured, and previously 'Bethelized,' or soaked in coal tar or some other preservative, will last some time. The pieces or planks require to be laid carefully down, and to break joint, and laid so as to have their length in the direction of a line from top to bottom of the embankment. It will be a question merely of expense as to whether the facings we have described will cover the whole or only part of the embankment surface; as to the question of efficiency of the first-named plan there being no doubt. If only part be covered, then the part must, as essential to the safety of the structure, embrace the top and part of the way down of both sides. In such a case, 'aprons' of loose stones will be required at both outside and inside 'toes' or feet of the embankment.

The appliance to be made for leading off water from the reservoir to any other point, more or less distant, must be carried out with the greatest care, especially if this be a pipe passing through the embankment from the water to the lower side. The water, however, may be led off by an open dam, the sluice opening being made, not in the embankment itself, but at the side of the reservoir, some short distance from the embankment.

To ensure the safety of the embankment in times of sudden and heavy floods, when the mere running of the water over the top would not be sufficient to relieve the reservoir, or be too deep or in too large volume to be safe, it will be necessary to have a culvert or pipe near the base of the embankment, passing completely

through it, and provided with proper sluices and valves. This will also be useful in emptying the reservoir when it is required to be cleaned out; the deposit, being exceedingly useful in the formation of compost heaps, should be saved.

Of the two methods named above, the culvert of brick, and the pipe of cast iron, by far the safest is the culvert. It is exceedingly difficult to lay a pipe so that it will not be the means of forming crevices and allowing of settlements in the embankment. The difficulty is such that it can scarcely be overcome, and not a few accidents have happened by the employment of iron pipes supposed to be perfectly laid. There is scarcely a possibility of bedding the pipe in the puddle so that the water cannot pass between the two. If pipes be used, they should be laid in a small brick drain or culvert, the outside of this affording a good band between the bricks and the puddle, and admitting of little or no settlement.

Description of Illustrations of Details of Construction and Fittings of Embankments.—Fig. 1, Plate 57, illustrates a general form in section of an embankment, with a puddled centre, *a b c d*. This, however, is not always provided, although it greatly adds to the security of the bank. It may simply rest on the natural surface, as in fig. 1, or be stepped or benched in, as at fig. 7. In some soils it may be advisable to place a layer of stones beneath its base, but this may be usually dispensed with. The slope of the inner or water face, *c e*, of the bank, fig. 1, may be from 2 to 3 to 1, and that of the outer or lower face, *f e*, $1\frac{1}{2}$ to 1, or 1 to 1. The toe, *e*, may be protected with stones, as at fig. 8, the toe being benched in as shown. The water or inner face of the embankment is generally stone-faced, although in some cases, as in small banks, it is simply grass-covered or turfed. To protect the top of the puddle bank from the wash of the overflow, it is covered with stones, as at *b c*. The outer face, over which the overflow passes, is often simply turf-covered, the turf slices being laid so as to 'break joint,' as at fig. 11, and are frequently pegged down at intervals, as at fig. 12, till the roots get a firm hold of the face of the bank. In cases where turf is not used, the lower face of the bank is either wholly covered with stone, or partly

with this and partly with wood planking, the latter being towards the top of the bank, as at *g* in fig. 1. The planking is usually set downwards, as at *a* in fig. 13; sometimes across the face, as at *b*; or arranged as in fig. 10, Plate 57, the beams *a a* being disposed to form either square or rectangular spaces, which are filled up with stones as shown. We have said that a series of embankments may be made in a valley which admits of this disposition, beginning with a low one, as at *a* in fig. 1, Plate 51, and terminating at *b* with the highest. The spaces between each become gradually water-filled, as in fig. 2, Plate 57, the water from one passing partly, in times of flood, over the top, or led through culverts, as at *a* in fig. 2, Plate 57. In leading off the water for any of the purposes required, as there is always a great difficulty in getting a perfectly water-tight junction between the surface of the pipe and the material of the bank, if the nature of the land outside the reservoir will admit of it, it will be safer to lead the pipe, as in fig. 2, Plate 57, at *a a*, entering the reservoir at some convenient point, as *b*, rather than carrying it through the body of the bank, as at *c*. The solid natural ground being, in the first instance, above and under the pipe, as at *d* in fig. 3, no danger need be apprehended. It should never be forgotten that water is one of the most insidious enemies we have to contend with in such cases; the mere confining of the weight or bulk of it is, in comparison, 'mere child's play,' so to say, and the most appalling of accidents have been proved to have arisen from the plan of carrying a pipe *through* the bank, between the surface of which and the material of the bank there is no natural cohesion. And the slightest orifice or vacancy becomes gradually enlarged, and, by the pressure of the water, lengthened, till a passage is made from end to end. If the 'leading' pipe must be carried through the bank, a brick culvert will be the safer, as the clay, *b*, fig. 4, Plate 57, etc., of the bank can be better 'bonded,' so to say, between the interstices of the bricks, *a*, as shown at fig. 6. Where pipes are used,—and they possess so many advantages for the conveyance of water over brick culverts,—the safest way is to carry them through the interior of a brick sub-way, as *c c*, fig. 4, Plate 57, resting the pipe, *d*, upon saddles,

so that it can be got all round at the joints. It need scarcely be said that the same objections to the use of iron pipes obtain as to clay or earthenware ones, although not to the same degree, as the clay of the puddling, etc. adheres better to their surfaces than to those of iron. Fig. 3, Plate 51, shows two methods of fixing the pipe at its entrance to the reservoir, in the inner face. Fig. 5 shows two forms of earthenware tubes for the conveyance and leading off of the water, these being, in fact, acting sewer or drain tubes. The sides of reservoirs are generally left in their natural condition, that is, without any artificial lining of stone or brick. Where there are projecting parts at top, as at *a*, fig. 5, Plate 57, as these are apt to be washed down in time, it is best to cut them down; or when the sides are nearly perpendicular, as at *e*, they may be sloped as shown by the dotted line, *b c*. In large, or rather long reservoirs, this work of giving a uniform slope or face to the sides, although an improvement, cannot be done save at considerable expense throughout their whole extent, but only at parts. But in small reservoirs, or what may be called large open tanks, such as near the steading, this may be done with useful effect. At parts where the soil is of a loose and treacherous character, puddling the sides may be resorted to with beneficial effect, and at very bad points it may be necessary to line them with masonry, as at figs. 9 and 10, Plate 35. This may be rough rubble, as at *a b* in fig. 9, or coursed ditto in fig. 10. Part of the sides, as at *b b*, fig. 9, Plate 35, may be of timber planking, disposed either as at *a* and *b*, fig. 13, Plate 57, or timber beams, as at *a a*, fig. 10, may be used, with the spaces filled in with stones. This kind of finishing to the surface may be used either for the upper part or the whole of the surface of the outer face of the embankment, fig. 1, Plate 57. Fig. 7 is the section of a small reservoir or tank, designed for cases where the soil of the sides is of a peculiarly treacherous character, the sides having inwardly a curve, in place of a straight slope, and are backed carefully with puddle. The line *a* may be sufficient to represent the gangway thrown across, from which to work the sluice or stop-valve of the leading-pipe. The regulation of the water to the pipe may be done

either at the upper or lower face of the embankment; a 'stop' valve is the most convenient, and it is worked by various methods, one of which is shown at fig. 6, Plate 51, this being fixed to a gangway thrown across the embankment. Another method is shown in fig. 4, where the entrance to the pipe, and the stop-valve regulating the flow, are within a tower of brickwork carried up to the level of the gangway, the

valve being worked by a rod, as at *a*, and at top by an apparatus such as is shown in fig. 6. Water is admitted to the tower by port-holes, as at *b*, fig. 4, placed at intervals in its height. Fig. 9, Plate 57, is a diagram illustrating the relative values of 'puddling' in thick layers, as *a*, and thin, as *b*, for which see previous remarks on this important process.

CHAPTER VII.

RIVER AND SEA BANK IMPROVEMENTS.

General Consideration respecting River Bank Improvements.— Before commencing any work connected with the improvement of river banks, especially towards those parts which approach near to other property, or ‘march,’ that is, run alongside the property of an adjoining proprietor, it is essentially necessary that the agent should have a thorough understanding with all the proprietors whose lands are likely to be affected by the improvements, as these, as a rule, always bring about changes in what may be called river action. And this understanding should not be a merely verbal one; the whole details should be recorded in what, in popular phrase, is termed ‘black and white,’ or in regular legal form. This will save much trouble in the future, and, at all events, it is a wise thing to have a document to refer to, as men with the best memories are apt to forget what they said, or to assume that they did say ‘so and so;’ and this they may do at an after date with the most honest intention. The necessity of being very guarded in all matters relating to rivers and streams is all the more imperative on the part of the agent, as there is, perhaps, no point connected with landed property which is so much involved in difficulty and uncertainty as the law respecting river or water rights. The most conflicting verdicts have been given by juries, the most puzzling opinions delivered by judges, and to such an extent that it is really difficult to say what *is* the law. Considering the vast interests bound up in the question, the damage done to property by floods, etc., all tend to make it one to which the attention of the Legislature ought to be directed, and that speedily, in order to place it upon a proper and satisfactory basis.

Protection of River Banks.—Although work of this class comprises a very wide variety of cases,

it may be classified under two heads: first, those in which the river bank or margin is above; second, where it is about or even below the level of the water. Each of these cases embraces so many examples, one varying in kind and degree from the other, that the subject as a whole would require the area, so to say, of a special volume, in order to do justice to all the varying details. We can but glance at the leading features of the whole subject.

In either carrying out repairs, or in erecting new works for the *protection of river banks*, the great principle ever to be borne in mind essential to success is, that the freer from obstruction and projecting surfaces, or, to use a popular phrase, the smoother the surface, or rather, as it may be more clearly put, the more uniformly the surface is kept up or made of either the natural banks or of artificially constructed embankments, the more likely are the banks and works to withstand the action of swift-flowing and strong currents. All inequalities tending to arrest the flow have a tendency in proportion to increase its erosive action, indeed to create it; for a stream which will flow over a uniformly smooth surface, without in the least damaging it, will, in flowing over a rough one, do hurt, more or less proportionate to the obstructive points. The mere cutting down, therefore, of the faces of banks to a uniform surface, and to a moderately low level, will, if the material be at all cohesive, often arrest destructive action, still more effectively if covered with sward. This principle applies to all work, whether it comes under the first or the second class above stated. We shall take up the subject of river margins, the adjoining lands of which are, either on both sides or on one side only of the river, below its average level,—cases such as this requiring the employ-

ment of embankments. We have said so much under the head of 'Reservoir Embankments for the Storage of Water' in Chap. VI, and more will be given in the chapter treating of 'Sea Margin Embankments,' that little will require to be stated here save in a general way, as the details of embanking work are generally applicable to nearly all cases. The formation of embankments on river margins, and the difficulty or otherwise of their construction, will depend upon the nature of the circumstances. The most difficult will obviously be those in which the stream is of rapid flow, and subject to great and sudden rises in floods; the formation of those on the banks of rivers which flow through alluvial districts, and which are not rapid or subject to sudden floods, is a simple operation. But in laying it out, it should be borne in mind that it is always unsafe to contract the river too much for the mere sake of gaining an extra breadth of land. The two objects should be carried out, so to say, *pari passu*, the improvement of the river flow and the reclaiming of the land. All too sudden and over contraction of the bed of the stream must be avoided, and the position and form of the embankment should be such as to facilitate its flow, this being best done by arranging to throw the body of the water into the centre. Indeed, the major portion of river defects arise from the stream being deflected to the sides, necessitating special works to overcome the difficulties thus occasioned. At the end of the chapter will be found a description of the best form to be given to the embankment, as well as various details as to its construction. In work of the first class already named, in which the river is below the level of the banks, the cases are very numerous in which the attention of the engineer is required. If of a soft yielding nature on one side of the river, and of the opposite character on the other, the stream is often deflected from the firm side, and rapidly wears down the loose matter on the opposite. In cases of this kind the soft bank should be protected from the action of the deflected current by stones, and in bad cases by piling; while in other cases, 'groins,' such as at *a*, fig. 13, Plate 58, are sometimes thrown out, made of timber work and piling, and backed by stones, the object being to throw the water into

the centre of the stream as much as possible. Figs. 13 and 14, Plate 58, also illustrate the use of groins in protecting valuable projecting tongues of land, which are apt to be washed away in course of time. Great judgment is, however, necessary in putting down groins, as, in place of doing good, they often, on the contrary, create mischief, by forming currents which had previously no existence. Some engineers, therefore, discard their use altogether, and trust entirely to other methods of protecting banks which are liable to give way under the action of the water. Much also can be done by altering the forms of the banks, so as to lessen the corrosive action of the water, and thereafter protecting them by various expedients. In fig. 3, Plate 57, we give, by way of example, one way in which this may be done, in which we suppose the dotted lines *a* to indicate the bank, which projects outwards very much. In this case the action of the water is to keep corroding the soil beneath till the upper part falls down. The better way is to cut the face of the bank till it becomes straight, as shown by the dotted line *b*, the foot being protected by stones at point *c*, and, if the current is strong, by piles in front of these.

In *protecting the face of river banks* there are various modes in use. Some of these we have already alluded to, but in figs. 9, 10, and 11, Plate 58, we give illustrations of three classes of work, adapted from a paper by Mr. Stevenson, the consulting engineer to the Highland and Agricultural Society, in a paper on the subject in the *Transactions* of the Society. These methods are adapted to cases in which the average level of the water varies, and in which embankments form a feature of the construction; but they may be used for modified circumstances which will suggest themselves to the reader. For the facing work, poles and fascines, or bundles of twigs, stones, etc., are used, these being protected in front by sheet piling, as shown. Fig. 11 is a method adopted in cases where the stream is, on the average, low, passing through an alluvial soil, the land being protected by an embankment as shown. In fig. 9, Plate 58, the method illustrated is adapted to the case we have already alluded to, in which the strong current has formed 'an acute bend in the bank, and hollowed out a

deep pool in the bed.' In this the bank is faced with round piles, *a*, and cross planking, *b*, with piles and faggots or fascines, *c*, at back; other faggots, as *d*, are placed above, and at top of all a turf embankment. The piles are protected at foot by stones, *f*. *g* shows the level of lowest or summer water; the faggots at *c* are backed with clay puddling. Where the depth of water is not so great, the plans in figs. 10 and 11 may be adopted. In fig. 10 the width of turf embankment at top, *a*, is 3 feet 6 inches; the slope at back, $1\frac{1}{2}$ to 1 foot; the facing planking, *b*, is 2 inches thick; the cross-tie or brace, *c*, 8 inches by 3; the piles, 8 inches diameter; the part *d* is to be filled up to grass line, level. In fig. 11, *a* is 3 feet wide; slope of face *b*, 2 to 1; *c*, 1 to 1; *d*, grass level; *e*, ditto of summer water. Mr. Stevenson gives the useful hint that the planting in time, before much or any damage is done, of a 'few willow saplings' may do away with the necessity of driving many 'piles of full-grown timber.'

In the improvement of *Tidal Rivers*, independently of the value of the land which may be reclaimed, the navigation may be also improved; indeed, as the authority we have already quoted states, the 'interests of navigation and agriculture' are in such cases 'identical,' and the erection of training walls, such as we roughly indicate in the sketch in fig. 12, Plate 58, by guiding the river, and thus improving the navigation, may at the same time greatly promote the interests of agriculture, by rendering such wholesale destruction of the land by floods and the erosive action of rivers impossible, 'and by converting reclaimed marsh land into permanent property.' Numerous examples are now happily to be met with in the country to prove the truth of this, and many thousands of acres have been added by attention to it to the property of the kingdom. In fig. 12, Plate 58, the distance from *a* to *b* shows the outer margin of the marsh land; *b* to *c*, grass patches; *c* to *d*, slob or silt; *d* to *e*, sand; *e* *f* *g* *h*, the 'training walls' confining the river, *i*, in a certain channel. The line *a* *j* is that of high-water spring tides; *c* *k*, high-water neap tides.

Sea Banks, running at a low level along land, are frequently protected by running out timber 'groins' at right angles to the bank. The simplest form of groin is that shown in fig. 1, Plate

58, in which *a* *a* are the piles, *b* *b* the planking secured to the piles. The details in the larger scale, fig. 2, show the method where the planking is double, *d* *e*, enclosing the piles, as *f*, by collecting the beach stones, shingle, etc. in front at foot, and alongside the bank on either side of the groin. In many cases these 'groins' are more or less effective in protecting the bank by gathering and depositing in a pretty uniform style banks of shingle or sea-beach stones, sand, etc., which form a species of breakwater, tending to facilitate the easy ascent of the waves up, and their proportionately easy recession down the face; and also in measure more or less effective tend to throw back the waves from the bank. In Essex, where there is much sea embanking and shore protection work carried out, these groins go by the name of 'horses,' and are made generally as follows:—The piles are 6, and sometimes so large as 9 inches in section, and some 12 to 14 feet in length, and are driven into the soft mud below the bed of shingle with which the shore is generally covered, for a depth of at least 6 feet. Placed 3 feet or so apart, they are driven in what may be called zig-zag or alternate fashion, so as to admit of the placing between them of sets of planks, generally of elm, some $2\frac{1}{2}$ to 3 inches in thickness. The arrangement is illustrated in fig. 3, Plate 58. It is placed at right angles, *a* *a*, fig. 4, to the line of the shore, *b* *b*, which is found to answer better than when placed oblique, as has been tried, and as shown at *c* *c*. In fig. 3, *b* *b* are the piles, *a* *a* the planks, shown in plan and section. But in many cases, probably the majority, these groins in very exposed situations, and especially where the wind is prevalent in one direction, and that raising the strongest gales, or where the strongest set of tides run up, do not act as very effective protectors to the bank; often, indeed, in the contrary way; the stones, shingle, etc., of which the beach is composed, being so gathered and collected,—rather, in fact, more frequently so spread or unevenly distributed,—that the waves, in place of running easily up towards the bank, are drawn in and up towards the inner corner of the groin, and there act with signally destructive force in eroding or wearing and washing away the bank at that point and for some distance beyond it.

Even where the groins are much more elaborately constructed than as in fig. 1, Plate 58, so as to have a face of greater or less breadth up which the waves may run, they fail, and in one or other of the ways indicated, to afford protection to the bank. Mr. David Stevenson, the authority we have already quoted, in a very able and most suggestive paper in a recent volume of the *Transactions* (vol. vi. series 4th), on the 'Protection of Agricultural Land,' alludes to a case in the Bristol Channel, where jetties—groins of a more elaborate character being often so named—had failed to protect the land from the face and banks of which they were made to project. It was found that the best way to ensure protection was, in addition to a projecting groin, to have facing work to project inland, covering or protecting the surface of the bank horizontally as well as its face vertically, as shown at *aa* in fig. 5, Plate 58, and in fig. 6, the plan of fig. 5, Plate 58. In this arrangement the face of the bank is at *bb* 9 feet 6 inches above the line of high water-mark, *ff*, fig. 5, Plate 58, this being protected, as shown, by a line of sheet piling, from which stays or braces, *dd*, run back into the bank landwards; these braces, again, being strengthened by, and secured to, piles, as shown in the diagram. Planking, as *ee*, is placed on the top of the bank for some distance landwards, the whole being backed and filled in for a distance of 40 feet, as shown. The construction up to this point would seem to be well adapted to resist the force of the waves, by protecting the upper surface as well as the vertical face of the part of the bank across or along which the vertical piling, *bb*, and horizontal facing work, *dd* *ee*, figs. 5 and 6, Plate 56, was placed; but it was found necessary to throw out groins or jetties at occasional points, of considerable breadth or width on the face, as shown in plan, fig. 6. These collected the shingle in such a way as to act as breakwaters, greatly lessening the force of the waves against the bank, and also preventing the run of the sea in high tides from overtopping the bank and deluging the land inwards. Mr. Stevenson states that in all cases along a great length of low bank and beach, where the bank was not protected by the vertical facing of piles and inland planking, as at *bb* *ee*, in figs. 5 and 6, Plate 58, the sea, during a heavy storm,

invariably swept over the natural sloping bank inland, carrying drift timber far into the fields; where, in the parts protected by the works we have illustrated, the waves were thrown back, and it was mere spray which was sent inland over the fields. The groins, with their connecting stakes, so collected the shingle, that it was retained within the timber work, and not scoured out by the action of the waves. In proposing to erect groins for the protection of low-banked sea-margin lands, exposed to occasional if not repeated high tides and heavy running seas, the action of the sea ought to be well studied before any great expense is gone to. For this action is exceedingly capricious, so much so that it has frequently baffled the abilities and practical knowledge of our ablest engineers, and thrown all their calculations aside. Thus the 'set' of the tides will run for a long period in one direction, collecting the shingle beach stones, and depositing silt and sand in one direction only, to provide against which the engineer has perhaps only finished his work, when a sudden change in the 'set' of the tidal currents will cause the deposits to be made in quite another direction. The same caprice, so to call it, acts also in the tidal action in certain parts of the banks of an extended line of beach or coast, so that it will be advisable to put down or erect a trial groin or two, to see their effect before proceeding to more extended works. These sudden changes in tidal action here alluded to are rarely traced to their cause, although we would throw out the suggestion that they arise from changes in the form and position of deep-sea banks and shoals, thus changing the direction of the currents which flow inland. In fig. 7, Plate 58, we give an enlarged sketch, showing the position of piles and timber sheeting at the points *abc* in fig. 6.

Protection of and adding to the Land on the Margin of Tidal Rivers.—Groin work of the simple kind illustrated in fig. 1, Plate 58, in last paragraph, is very useful and effective in tidal rivers, where, as a rule, there is little or no heavy wave action, and where the main object is to add to the land by 'warping' or collecting the muddy silt, which forms highly valuable soil with the after treatment. A still more simple 'groin,'

used in parts of the tidal river where there is no strong current, is shown in fig. 8, Plate 58, this being but light stakes, *a a*, driven into the mud to a depth sufficient to give them a good hold, and between which there are smaller stakes,

or rather willow withes, etc., worked in as at *b b*. In the chapter on the 'Reclamation of Waste Land,' under the section 'Warping of Land,' further remarks will be found on this subject.

CHAPTER VIII.

SEA MARGIN EMBANKMENTS.

HAVING considered the subject of embankments used for the purpose of forming reservoirs for the storage of water, we are now to take up those connected with enclosing of land from the sea or from the margin of tidal rivers. Much of what we have given on the formation of the embankment used for the former will obviously be applicable, with greater or less modification, to the latter. In some cases there is, however, a clear distinction between the two kinds of embankments, especially in the case of coast lands much exposed to storms, as also in the case of tidal rivers, where the warping of land is resorted to. In the first of these cases the work to be done is generally of a more or less difficult character than that required for the storage of water. Indeed, where the coast-line is much exposed, and the prevalent winds blow from those quarters which raise the heaviest seas, the work demanded requires so many expedients to provide for contingencies, that experienced professional advice will require to be had, that which can only be reasonably expected from the manager of the estate not being likely in such cases to cope with the difficulties. Of this class of work, therefore, all the necessities of the present volume will be met if we give a few general outlines, detailed enough to enable the agricultural reader to gain a fair knowledge of the principal points to be attended to. In the erection of embankments for the reclamation of land on sea margins, there are certain points to be attended to in order to have the work done in the most efficient and economical way, and so that the largest area of land be enclosed without incurring the sacrifice of any of these. Some, in their anxiety to reclaim the largest area of land, place the embankment so near to the margin or high-water

line, that they are compelled, as it were, to have a foundation none of the safest,—often, indeed, of the most dangerous character, or which involves the necessity of future frequent repairs. A great and important object to be aimed at where land is reclaimed from the sea or from wide expansive reaches on the banks of tidal rivers, is having as wide or broad a margin of that comparatively solid land known in some districts as ‘saltings,’ and to which generally the name of ‘foreland’ is given. This foreland is formed by the slow and gradual accumulation of silted matter, brought down either from the upland or cultivated districts at a higher level than that of the sea by the agency of the drainage water or small rivulets or streams, and also by the various solid materials brought up by successive tides, and which, to a greater or less extent, are deposited and left on the surface when the tide recedes. As the rivulets, small streams, or drainage outfalls approach the area of the more or less swampy land running along the sea or tidal river margin, from the soft and yielding character of the soil which they meet, they naturally get divided into a series of small rivulets, which, as they go towards and fall into the sea, cut up, as it were, the foreland into what may be called a perfect network. These numerous rundlets or water outlets naturally have a bad influence upon the land which is to form the area of the embankment, and in providing for which no small amount of skill on the part of the constructor is called for. Where they are numerous and of comparatively small size, they are more easily dealt with naturally; but where they are larger, and assume more the form of streams, special means, such as culverts with appropriate sluices or valves, must be provided. Generally,

however, indeed as a rule, the evil which would arise from the cause here stated is reduced to a minimum by the plan adopted of concentrating, so to say, these numerous rundlets into one by forming a large cutting or ditch on the inland side of the embankment, and at some distance from it, the collected water in which is led to the sea at proper intervals by means of culverts. This inland ditch or cutting is known in Essex, and other parts where reclamation of land from sea margins is carried on on the most extensive scale, by the name of a 'delph.' The proper position, form, and dimensions of this will be illustrated and described in this section.

We have said that the form and construction of embankments at sea margins varies according to the opinions of different authorities, and also according to the peculiarities of the site. In fig. 1, Plate 59, we give the section of a bank which Mr. Orlander, in a paper read before the Society of Engineers, on the 'Enclosure of Lands from the Sea, and the Construction of Sea and other Banks,' describes as the best form. In this the slope or inclination of the bank seaward—that is, on the line *a b*—is as 4 to 1; the slope landward—that is, on the line *c d*— $1\frac{1}{2}$ to 1. The facing of the landward slope is formed of sods cut from the green covered part of the marsh, the depth of these being 6 inches; the facing of the seaward slope is composed, first, of a layer of strong clay 18 inches thick, above which is placed a layer of green marsh soil, *g g*, or flags, and above all a layer of clump stones, *h h*, the depth of which is 12 inches. The hearding, *i i*, which rests upon the original ground or foundation, *j j*, is composed of sand or warp material. Of the two, warp is preferred by Mr. Orlander, this being got from floor-pits cut in front of the bank. He would, however, prefer sea-marsh sods to be used in the formation of the hearding; only that, where the bank was extensive, an acre of such material would soon be cut away, so that extra expense would be incurred in consequence of the increased distance from which the material would have to be wheeled. The clay facing, *f f*, fig. 1, Plate 59, will depend upon circumstances of locality as to its quality. In sea marshy land, the sides of the creeks formed in the saltings

by the action of the rundlets or water outlets previously described are generally covered with a bluish clay, generally called 'butter-clay.' Although this is most easily obtained, it should not be used for the facing of the embankment, inasmuch as it is apt, as pointed out by Mr. Orlander, to be acted upon injuriously by the atmosphere, and to form large cracks or fissures, which are always sources of danger to the embankment; and from its soft nature, it is apt to slide down to the 'toe' or foot of it, and it is not easy to work it to a uniform surface on the slope. Good clay can be obtained generally from under the green marsh, and should be used for the hearding. The clumped stone or upper line of facing, *h h*, should be put on with great care by men accustomed to this kind of work, who have a wonderful knack in giving the stones a bond one with another in a very quick and satisfactory way. The importance of having good facing to embankments exposed to the action of water has been already pointed out, and by consequence that of executing every part of it with the greatest care. Some men seem to think that if the work be done well generally it is sufficient, forgetting that, as the strength of any structure lies in its weakest part, so if any portion, however small, be left carelessly done, it is but a mere question of time as to when the embankment is injured by the action of the waves, which act in a way as quick as it is powerful in destroying it. We cannot too often repeat, in connection with this subject, that there is no agency more insidious, and therefore requiring more to be guarded against, than water; for the moment it gains access to the interior of the embankment, from that moment its destruction begins. In fig. 4, Plate 59, we illustrate a method of forming the face of an embankment used in Holland, the clay, as *f f* in fig. 1, being finished off with a species of straw matting, to which is given the name 'cranmatting.' The method of facing embankments with this is as follows. Supposing that we look up the slope, a layer of loose straw one and a half inches thick is evenly distributed up and down the slope, after which straw bands are laid horizontally along the slope. 'The cranmatter, or man who undertakes the work, by the aid of a tool shown at *a*, fig. 3, Plate 59, thrusts

the band, in the form of a stitch in the clay, through the loose straw at every four or five inches. Before the second stitch is performed the workman will give the band a twist so as to keep it round, and then the thrust is repeated; sixty-four stitches go to the square yard.' This crammatting, as may be supposed, is by no means a lasting material, rotting, at the utmost, in three years. Flags are very often used therefore, instead, which is a permanent facing, and consolidates with age. Over this a costly fascine work is used for protecting the face in lieu of stone, and which is presumed to be an improvement on the old faggots. The process of forming this facing is thus described by Mr. Orlander: 'The fascines are 7 feet 6 inches long, and 6 inches diameter, and 1 foot diameter at the broom end, so that when compressed they form a layer about 6 inches thick. At every 1 foot 6 inches up and down the slope, and 1 foot 2 inches along the slope, pointed stakes (as shown at *a a*, fig. 2, Plate 59) are driven into the clay through the crammatting, 3 feet in length and of an average of $1\frac{1}{2}$ inches diameter, after which long twigs of about $\frac{3}{4}$ inch diameter, technically called binders, and about 8 to 10 feet in length, are wound in and out of each stake along the slope (say five on top of each other), after which keys (as *b* in fig. 2, Plate 59) are driven through the top of the stakes, and each stake driven down tight on the binders, and, of course, tight on the loose fascines, which fastens all down on the crammatting.' As regards the best site for an embankment, one authority maintains that it should be at the edge of the green marsh land, so as to leave a foreland of 50 or 40 feet, the site being ploughed in ordinary fashion, so as to leave a rough surface affording a bite to the base of the bank. Our remarks on this point when treating on reservoir banks may here be referred to. The author describes a nursing or warping bank, which we illustrate in section in fig. 4, Plate 59. In this the slope or inclination, *a b c d*, on both sides is the same, namely, $2\frac{1}{2}$ to 1; the hearting, *j j*, is composed of sand covered with clay 18 inches deep, marked *h h*; above this fascines, *i i*, 6 inches deep, and the facing composed of stones, *e e f f*, 1 foot deep; on the side *f f*, crammatting 2 inches deep is used; stakes are driven in at

intervals, as shown in the drawings, and *g g* shows the line of original ground.

'Saltings,' or tracts of marsh land at a comparatively high level above the ordinary tide run,—and the higher this level the better the chances of reclamation as a paying work,—are frequently intersected by deep cuttings, 'gulleys,' etc., through which the tidal waters or those of the inner drainage water or land streamlets flow with varying but generally considerable velocity. Where the saltings are to be utilized as cultivable or arable land, thus involving their embankment, they may for a long time, indeed permanently, be used as partial pastures, a good extent of grass bites being obtained from saltings generally. The crossing of these gulleys is often a work of some difficulty. The best method to pursue is not to endeavour to carry the embankment from end to end right across the gully at once, but to form a foundation from the bed of the gully on which the embankment can be raised. This will be done most efficiently by using materials in the first instance as the base through which the water can freely pass. Fig. 14, Plate 57, is a diagram which illustrates the principal points in the formation and construction of a *sea margin embankment* such as is used in many districts, such as in Kent. The seaward facing, *a*, has a slope or inclination of from 3 to 5 to 1; generally this varies very much, and is in many cases far too abrupt. The side is faced with stones, sometimes up to the top, *b*; but in many instances it stops short, as, say, at *c* in fig. 15, which may be taken as a fair illustration of the form of embankments at present existing in some districts, and the remaining portion of face up to top, *b*, fig. 15, is grass. In fig. 14 the top, *b*, is shown as finished with stone; in fig. 15 with turf or mud, as in figs. 18 and 19. The part from *a* to *b*, fig. 15, is often called the 'swash bank,' as it receives the wash or spray of the spent waves, the full force of which only exerts itself up to the point where the stone facing terminates. The slope of the 'swash bank' is sometimes greater than that of the other face of the bank, and in old or neglected banks this part, as *c*, fig. 15, becomes very depressed, forming quite a steep bank from the point *c* to *b*. In fig. 14 the part *c* is termed

the 'foreland,' and consists of the natural shore. This should be kept untouched seaward as far out as possible; and although the mud and the clay which underlie it in many districts are very tempting to workmen and contractors, either to be used in the formation of new banks or in the repair of old, this temptation should not be yielded to, but the surface of the 'foreland' left unbroken, especially near the 'toe' or outer termination of the bank, as this materially tends to keep the foundation of this sound and free from the inroad of water. Piles, as in figs. 16 and 17, Plate 57, in one or more rows, are driven in at the 'toe' and a little in front of it seaward, and these are generally packed up with stones or chalk. This packing frequently extends some distance up the lower part of the bank, covering the regular stone facing. The landward slope, *c*, fig. 14, is $1\frac{1}{2}$ to 1, and is almost always grass-covered. The flat, *f*, between the foot of the inner slope, *e*, and the 'delph,' *g*, ought to be a considerable breadth—say 30 to 40 feet. The material taken from the 'delph,' *g*, will be useful in forming the bank and in doing repairs, as 'topping' the bank, as in fig. 19. This 'topping' is, in old and neglected banks, a work which ought not to be neglected; the doing of it has saved many a district from floods. Of course it is not calculated to resist heavy storms; nevertheless we have found it, in work done under our directions, and when well executed, even in such times effectually to keep out the flood. If turf is used, the more carefully the turfs are laid the better, as at *a* in fig. 18, breaking joint with each other. When mud or clay or clayey mud is used, it is generally put on the top of the bank very irregularly; but the lumps, as at *a* in fig. 19, soon settle down and cohere, as at *b*, fig. 18, together as they get 'weathered;' and although they form rough walking, they get so well welded together—to use an expressive phrase—that they keep the water well out. The height of the topping is generally about 15 inches, and costs on the average 4s. 6d. the rod of 21 yards—an expense well worthy of being laid out. Although adding to the expense slightly, the work of top-

ping is all the better done if the old surface is first pick or spade worked, so as to effect a more perfect bond or junction between the old and new surfaces. Fig. 9, Plate 57, illustrates the effect of 'puddling' with thick layers, as at *a*, and thin, as at *b*. It requires no explanation; indeed, the point is so obvious that it seems almost an 'insult to the reader's understanding' to give it him, were it not that we have seen puddling so done that those concerned in it, although looked upon as greatly experienced in such work, clearly did not know its 'first principles.' If the top surface, with which the beater or rammer comes in contact, seems well and closely put together, then it seems as if all that was necessary were done, the workers being forgetful of the fact that the lower and centre portions, as really more important, were to be done rightly as well as the upper. Many a well-designed bank has been ruined by neglect of good puddling. It is a physical impossibility that the thick layer, as at *a* in fig. 9, can have all its particles brought under the influence of the beater as well as the thin layer in *b*. In leading off the inland drainage through a bank by a cast-iron pipe, as there is always great difficulty in effecting a perfectly water-tight joint between the outside of the pipe, *a*, as in figs. 4 and 5, Plate 57, and the material of which the bank is composed, it will, where the dimensions admit of their use, be better to employ earthenware drain-tubes. The best section is the egg-shaped, as at *a a*, fig. 5, Plate 51. Tubes of this section are now made specially fitted up with sluice flaps to open during ebb tide, to admit of the drainage water passing off from the 'delph,' *g*, fig. 14, Plate 57, and to close at the flow of the tide. A tube 20 inches long and of proportionate width will carry off the drainage water from a considerable extent of land. Where the drainage water is led off by a brick culvert, the egg-shaped will be still the best section. In fig. 5, Plate 51, the centres for striking the curves are shown. Our remarks as to the work connected with pipes passing through reservoir embankments (see Chap. VI.) will apply, with greater or less modification, to this department of sea banks.

DIVISION THIRD.

SOILS—LAYING OUT OF FIELDS—POSITION OF ROADS—PLANTATIONS—RECLAMATION OF WASTE LAND, ETC. ETC.

CHAPTER I.

SOILS.

The Origin of Soils.—Before entering upon the details connected with the classification of soils, considered from a purely farming point of view, it will not only be interesting, but will serve some practically useful purpose, if we glance, however briefly, at the way in which soils, to use the popular expression, are formed. If we take specimens of the various rocks which are strewed over the surface of the earth, or buried more or less deeply under it, and, after submitting them to certain preliminary processes more or less nearly approaching those which we know to be going on daily around us, analyse them or submit them to processes by which their constituents will be ascertained; and if, taking specimens of the soils, earth, or ground lying on the surface of the soil, we submit them to like analysis or investigation, we shall find the constituents to be the same as that which we found in the rock materials. This is but another and more precise way of saying that the soil which covers the surface of the earth has its origin in or from the rocks. It does not lie within our province to detail the various natural processes by which rocks, which seem on examination to be so hard and indestructible that the very name has come to be synonymous with all which indicates lasting durability, are changed into soft, friable, and more or less loose soil. Suffice it to say that this change has been brought about through a long course of years, and, in fact, ages, by the action chiefly of the atmospheric influences, as rain and air. These at first sight, and to a casual observer, would seem to be anything but powerful influences in reducing hard rock to grains and powdery soil, but closer observation serves to show that they are much more so than

could be well supposed. Moreover, they are continually at work, and when once the operation has begun, each portion operates upon those which succeed it, helping still further the process of disintegration. And, again, the action of water is very powerful in rubbing down stones which come in contact with one another, this being greatly aided where the disruption of the rocks takes place, presumably at the tops of mountains or the sides of high hills, by the friction caused by the rolling down of the detached parts from a high to a low level. To these causes, more or less powerful, must be added the potent one of frost, which rends large rocks asunder with amazing ease, and, of course, acts more speedily on blocks or particles of smaller size. But the debris or detritus of the rocks of the crust or shell of the earth does not alone make up the whole of what is popularly known as the 'land' or 'soil.' Analysis, and, for the matter of that, in many instances even but a comparatively cursory examination, will show that, along with what are clearly mineral, there are other constituents which are as obviously organic. These are the remains of various plants, which either, having found such nourishment, to use the popular phrase, in the rock detritus originally as enabled them to grow, died out in process of time, or at later stages of vegetable growth might be brought by the agency of water from other sources, more or less distant, and when the water subsided, deposited on the surface of the rock detritus. Further, as the soil thus got more and more enriched, and capable of bearing a wider variety and a richer and higher class of plants, the seeds of these either springing up, as some say, spontaneously, or in that strangely

mysterious and puzzling way which many must have noticed, and noticing, been struck with; or brought by birds and other agencies from a distance;— as these flourished and decayed, the thickness of the soil would proportionally increase, till, as in some districts, it would form those wide expanses of richest fertility, which bear crops of wonderful value for a long course of years, without requiring the addition of what in modern parlance are called manurial constituents.

Various speculations of a curious and suggestive kind have been made as to the way in which the rock debris or detritus has been furnished with its vegetable matter; for rock soil, so to call it, although possessing the constituents which plants require, and under a more advanced stage take up, is not capable, in its first stage or original condition, of being taken up or assimilated by plants. So that while in one sense it is, in another sense it is not a soil, popularly so called, being in point of fact a mere sand or powder of rock possessing only the constituents of the rock, whether it be the detritus of one only, or of those of several, collected together by some agency, almost invariably that of water. For, supposing a plant to be placed in material of this class which requires the manurial constituents present in rock soil of the kind just described, it would die, because the soluble parts which alone the plant could assimilate, although they might and would be present in the decomposed rock soil, would be carried away by water. It is only when a rock soil retains these soluble parts which the plants can take up, assimilate, and flourish upon, that it assumes the characteristics of a soil capable of supporting the higher classes of plant life, and this power of retention of the soluble parts is only brought into action through the medium of mixture of organic matter. But how comes this to be mixed with it? As we have just said, various speculations have been offered as to the primary source of this, — that it must have been derived from plants in the first instance, the very lowest in the scale of organic growing life—those, in fact, which seem to spring from, or to be furnished and supported by, the air

alone. These and other organisms, some of them of even a more advanced or higher class, may be called surface-soil plants, having no leaves and no roots which descend into the soil; while a still higher class, the aquatic plants, which have both roots and leaves, may be called water-surface plants, as both roots and leaves simply float upon it. But however first started, the formation of a superior soil would be surely carried on, however slowly, till at each successive stage, so to say, it would be capable of sustaining and nourishing a higher class of plant life; and each successive generation of such, as it died out and decayed, would still further enrich the soil, and provide it with those soluble substances which are capable of being taken up by plants of the higher order, which strike their roots into, and descend more or less deeply in the soil, deriving their constituents therefrom, and also, as we shall hereafter see, partly from the air.

The primary origin of all soils being, then, the rocks of the earth's crust, it might be supposed that, the geological formation of any particular district or part of a district being known, the soil would have only the constituents of the rock. In one sense it would be well if this were so, for it would, at all events, greatly simplify the classification of soils. The soils met with on the surface of the earth are derived from one or other of three classes of rock,—the sandstones, limestones, and clays, all of different degrees of hardness, and mixed up together often in various proportions. We thus have from the detritus of limestones or calcareous rocks, soils of a calcareous quality, varying in kind or degree according to circumstances; from the detritus of sandstones, sandy soils; and from that of clayey or shaley rock or stone, clayey soils more or less retentive. But geology teaches us, as indeed one of its first lessons, that these rocks are always placed in a certain way in the earth's crust, and assume naturally towards each other certain relative positions. The way is what we know as stratified, that is, placed in layers, or, if we may so say, plates or laminae, these being known as strata; and the positions which the rocks bear to each other are in this order limestone, sandstone, and clay, or shaley or

slatey rock. Geology also teaches us that by a variety of causes the rock strata, which we suppose to be horizontally superimposed one upon another, are upheaved or distorted, and so as to give to the surface of the earth a rolling or waving character, varying according to circumstances. This naturally changes the relative position of the strata, and mixes them, so to say, one with another. Hence, again, we find the horizontal system of strata changed into strata lying at a great variety of angles one to another, still further changing their relative position one to another. Here, then, we see two causes at work bringing about the great diversity in the rock surface in different districts which we know to exist everywhere around us, according to the particular class of rock which is upheaved so as to come nearer to the surface; and, at the same time, by mixing them up together, as we see they sometimes are, when, by the atmospheric influences already noticed, crumbled into soil, this possesses a corresponding diversity in the characteristics of its different components. But we have other agencies at work which bring about this remarkable diversity in the nature of soils,—a diversity which is met with not merely as extending over a district, but often in a comparatively limited portion of it, nay, even within the bounds of a small field. One of these agencies, and a very powerful one, which is in continual operation, is that of water. This brings down from the higher regions continual supplies of detritus, which, along with the other agencies at work, and which we have already noticed, it helps to form, and, for the reasons just stated, a mixture, so to say, derived from different kinds of rocks. This is deposited in the lower regions in a variety of ways, and in what may be said to be an infinite variety of positions. Further, the action of rapidly flowing rivers, or of strong currents in tidal ones, upon the banks, and which they often overflow, carrying with their waters suspended earthy matter or 'silt;' this is deposited, as the waters subside, at distances more or less remote from the banks, leaving what in time dries and consolidates more or less firmly into a soil, the components of which may be easily conceived to vary not only in character, according to the rocks from which they

are derived, but in point of position or relation to one another. The reader, therefore, who comes newly to the consideration of the subject, will be able now to understand how it is that the extraordinary diversity in the nature of soils met with, often within the very narrowest of local limits, comes about; and how, as a consequence, arise those puzzling circumstances connected with the cultivation of such soils, or rather of any given extent of land in which this diversity as regards their character is met with, so far as regards their produce and the action of manurial substances,—circumstances which, to those not acquainted with the true nature of the case, are set down too often as the result either of the stupidity of farmers or of their ignorance. And hence, also, arises this other puzzling thing to those ignorant of the scientific aspects of farming connected with the cultivation of soils, that the result of a certain mode of operation in one season,—as, for example, the application of a certain manure,—may, through the action of certain climatic or local influences acting upon the different soils, give results in another season of perhaps quite an opposite, or at least of a very conflicting nature.

We thus see how, by the agencies at work which we have noticed, and these extending over periods of varying length, and some even for ages, the wide variety of soils we meet with in practice is produced; and how difficult it is to classify them with a rigid degree of precision, the constituents of one variety mixing with those of another, so that at the best but an approximate classification can be arrived at, of which we may here say that there are several, according to various authorities, but all, of course, starting from the same primary point. If this section was concerned with the relation of geology to agriculture, which it is not, save so far as the source and general formation of soils is concerned, we could point out some very interesting facts,—not only interesting, but also having a close practical bearing upon farming and the improvement of property; but we must, for the present at least, defer them.

While, however, the diversity of soils we have thus seen to exist in practice makes that of farming somewhat uncertain in its special results, it, on the other hand, brings about a state or con-

dition of matters of very considerable value. Thus the mere admixture of soils, which we have seen to be caused by various agencies, tends in many instances to render poor soils of a better quality; as, for example, where a too light or sandy soil is enriched by being mixed with a clayey one which has been brought in contact with it, or *vice versa*, or a soil deficient in lime made good by the addition of a calcareous soil.

A very important point to be considered with soils is the nature of what is called the subsoil, that is, the layer or layers of earthy matter which lie immediately underneath the surface soil. It is somewhat difficult to define precisely what the subsoil is, for in one sense it may be said to form part of the upper or surface soil. Some, indeed, hold the subsoil to be simply that part of the soil proper which is not touched by or brought under the operation of the plough or cultivating implement, inasmuch as cultivation ultimately makes it of the same character as that of the surface soil. This, however, makes the position of the subsoil with relation to the surface, or what may be called the soil proper, a variable one, entirely dependent upon the circumstances of cultivation. Some, again, define the subsoil to be that kind or character of rocky detritus which is essentially different from that of the upper or surface soil, which owes its origin to another class of rocks. Others, again, holding the middle course between these two, simply define the subsoil to be that which lies quite beyond the possible reach even of the most deeply penetrating implements which could be worked by the power of steam. The second of these definitions implies that the subsoil is sometimes, if not often, of quite a different character in constituents from those of the upper or surface soil. Thus the upper surface soil may be clayey, but this may rest upon a bed of gravel or of sand; or the reverse may be the relative positions of the two. Here the element of depth is not taken into account, and here also there would seem to be a little difficulty in deciding which is to be called the 'soil' (proper), and which the 'subsoil;' where there is a distinct special difference between the two, and which difference often introduces elements of difficulty in cultivating the soil deeply, when it so happens that there is comparatively little difference between the

depth of the soil and the subsoil, so that the latter may be brought up and mixed with the former, which may be, and often is, not desirable. This point will, however, receive further and fuller consideration under the head of 'Deep Cultivation and Deep Ploughing of the Soil,' in its special paragraph in this work. And just as we have seen that a variety of causes introduce elements of difference in the components of the soil,—considered as the soil proper,—so also do we find these bringing about differences in the components or composition of the subsoil. So that, taking both soil and subsoil together as forming one whole, which may at one time, or under a different system of cultivation, be worked together or partly so, it will be perceived how much the elements of difficulty and uncertainty are increased, not merely with regard to the classification of both, which is a matter of comparatively little, but with regard to their cultivation, which is a matter of the highest practical importance. We shall see further on how this difference between surface soil and the subsoil—which latter may be, according to its position under one or other of the definitions or categories under which it is classed, workable with the surface or soil proper—brings about some very peculiar circumstances in bringing the land into a higher state of cultivation.

Having thus, in a very general way, glanced at the leading peculiarities connected with the origin and characteristics of soils, we shall now do so as regards their classification. The most obvious, simple, and what might be called the natural way of doing this, is ranging them under heads suggested by their popular characteristics and the crops for which they are best adapted. Classing the crops under the two leading divisions as grain or cereal and seed, and green or forage and root crops, and taking the grain crops first, all farmers know and understand that for the most important of these, namely the wheat, a heavy soil, or clay of a medium density, is better than a light and sandy one. This soil should contain certain inorganic constituents, of which silica is an important one, as also alkalis. This so far as the chemical points are concerned, the mechanical ones necessary being freedom from excess of moisture,—to which lauds of this kind are liable,

—and a fair degree of firm texture, so as to secure a consolidated seed-bed, which the wheat requires. The bean, which may be classed as a seed crop, also requires a heavy soil, possessed of much the same characteristics as that for wheat. These soils, in fact, are very generally spoken of as wheat and bean soils, by way of a marked distinction between them and those possessed of other characteristics; as, for example, that which is known as a 'barley soil,' which requires to have lime in its composition, and, mechanically considered, requires to be dry and porous. An 'oat soil' is that having a combination of certain mineral constituents and a pretty large proportion of well-decomposed vegetable matter; mechanically the crop requires conditions pretty closely resembling that of a barley soil. 'Rye,' which as a cereal crop is seldom cultivated as part of regular rotations in this country to be ripened as wheat, barley, or oats, but is chiefly grown to be cut as a green or forage crop for spring and summer feeding of live stock, does best in light sandy soils, but it does well also in loamy soils (for description of which soil see further on). 'Pease' require a moderately heavy soil,—not so heavy or retentive of moisture as that for beans,—and lime must be a mineral constituent present in it. 'Vetches,' another of the 'seed crops,' generally sown, like rye, to be cut green as a forage crop, do best in a loamy soil, although they may be grown in the same soil which suits the rye; indeed, the two are usually sown together, the rye stems affording climbers for the vetches to grow up on, so that in one sense it is a matter of regret that the two crops require or do best in different soils.

Coming now to the soils classified as root, green, or forage crop soils, we find that that adapted for the staple root crop of the country, on which stock-keepers chiefly depend,—the turnip,—in its best condition, is what may be called a friable loam, easily worked to the desired depth, and rich in manurial constituents. The soil suitable for the turnip may be said generally to be so for all the other roots and the green and forage crops, with such differences as circumstances may bring about, and of which notice will presently be taken.

The seeds of all our cultivated and cultivable

crops,—a distinction too often lost sight of,—crops which have to develop roots, stems, leaves, and ultimately reproduce seeds in the case of cereals, or of ripened roots, leaves, etc. in the case of other crops,—require to find from certain sources sundry constituents, which are termed manurial or otherwise plant constituents. These are derived from three sources primarily before man appears upon the scene, or at least does much in the way of producing his own food from the soil in which he digs his cave or on which he rears his hut. The air also supplies certain constituents, and, by peculiar processes, makes those constituents in the soil available to and by the plants which grow in it. The last source—and it is co-existent with an advanced stage in the history of man as a producer of food for himself and neighbours—is certain substances added to the soil, and which are called manures.

If we take any plant which has grown to maturity, and submit it to an analytical process in the laboratory, in which heat of a high temperature plays an essential part, we shall find a certain proportion of its components pass off in the form of vapour or gas, which, being collected and submitted to investigation, will be found to contain certain constituents. This part of the plant, which is capable of being consumed, is called its 'organic part.' Those components which, resisting the action of heat, are left behind in the retort or vessel, are called the 'inorganic' part or 'ash' of the plant. And it is in the ash of the plant that analysis discovers the mineral constituents present in the soil, or which are taken up and assimilated by the plant. Before these can be taken up by the plants, they must be in a soluble condition in the soil, and in the primary condition or early stages of soil formation they are insoluble; and it is only by the addition of organized matter to the soil, obtained from the sources we have already described, that in process of time the constituents become soluble. And being thus capable of being taken up by plants, each one of which, so to say, may be presumed to be of a higher range of organic life than the preceding one, the soil bears more valuable products, which, decaying, in time add to the richness of its constituents, so that we thus see at once a mutual relation between

them, the one helping the other. At first these soluble substances have, as it were, no hold of the soil, being liable to be, and are, indeed, removed by the agency of water; and it is only when, as time goes on and certain processes are completed, that the soil acquires the power or capability to retain those soluble substances and give them out to the plants, that it assumes a higher rank in soils, and may be said to become, as it does, a perfect soil, able to support plants and carry them on to the point of full maturity.

As the range of plant life extends, some are found to grow which draw largely from the surrounding atmosphere, thus yielding a supply of carbonic acid to the soil, still further decomposing it, and adding to its power of retaining and adding to the store of soluble constituents within it.

But even under the most favourable circumstances of natural formation of soils, as here generally and popularly sketched, the amount of the soluble constituents obtained from different sources, and prepared by different processes, is unfortunately far below the amount of those required by plants grown upon it for the production of food either for man or for cattle. And the difficulty is increased by the exigencies of the styles of modern farming in many of its phases, in which the soil is, by a forcing system, still more rapidly deprived of its manurial constituents, and which are but too often not again returned to it in the form of abundant and judiciously chosen manures. Hence it is that a large area of our soils, under management like this, is becoming year after year poorer and more poor, till at last the dream or prophecy of the far-famed German agricultural chemist, Liebig, is likely to be realized, when such soils will be reduced to hopeless sterility, incapable of bearing crops till put under a more scientific and rational system.

This manuring of soils is a process of the highest importance. This is, however, greatly influenced by the peculiarities of the soils, and these very much by their mechanical qualities. But, at the same time, soils act in other ways and influence other agricultural departments, as we shall presently see. Thus a soil which, on analysis, shows that it is possessed of the mineral con-

stituents necessary for the support of certain plants,—analyses showing the relative fitness of both,—may nevertheless, from certain defects or peculiarities, which for lack of a better and a more accurate word we term mechanical, be found incapable of growing these plants, or grow them but poorly. It may, for example, be so close and retentive that the air does not penetrate into its particles; or water may not be retained in it long enough for the requirements of the plants, through qualities of the very opposite character. These and other peculiarities greatly influence the cultural results; and there are others, again, dependent upon the plants themselves. Some have not the capacity, so to say, of adapting themselves to the mechanical conditions of the soil in which they are attempted to be grown. As a rule, soils which may be placed at the extremes of any particular class, such as a very heavy, retentive soil on the one hand, or a very light and porous one on the other, are found to be the most difficult to deal with, alike in their mechanical, manurial, and plant-supporting or growing peculiarities; while from this may be deduced, as a corollary, that soils coming under the intermediate class are the most easily dealt with. Hence, too, the practice of mixing soils of opposite qualities, so as to get the intermediate admixture required,—an agricultural process yet in its infancy, and to the extension of which on an extensive scale, far beyond even the dreams of most advanced agriculturists, we shall yet witness mechanical applications of a character which, while in one sense novel so far as farming is concerned, are not so in relation to other branches of industry,—applications which we shall hereafter notice,—bringing in their train possibilities of most extensive utility.

The mechanical fitness of soils to grow a wider range of plants, and in a more economical because more productive way, is also much influenced by certain processes through which they are put, such as drainage and deeper storing of its particles. To these operations, and the principles upon which they depend, we in other parts of this work refer. Then, again, the character of the rocks and the subsoil, the relation they have to the soil, especially in their powers to convey moisture to the latter, has a very marked influence

upon the produce. Rocks and subsoils differ much in their capability of conveying moisture, or, to use a more easily understood popular expression, of drawing it from the surface soil; and in this difference lies, perhaps, more of the varying character of plants which certain soils support than is at times supposed.

Considerations connected with the Chemical Condition of Soils.—We have said it is generally assumed that the value of a soil can be ascertained by analyzing it, this proceeding on the apparent assumption that all parts of the mass will give equal results, and that the constituents which the analysis showed to be present in it would be the same throughout, and that the plants grown in it would be capable of taking up and assimilating its fertilizing constituents. But the soil, in place of being in reality a uniform mass, is, as a rule, what may be called a compound, consisting of more than one class of matter. Popularly, soil may be considered in the aspect of a cultivating agent, serving three distinct purposes,—first, as a mechanical agent, for the support of vegetable growth; second, a medium by which the fertilizing constituents derived from various sources can be applied to the plants; and, third, a vehicle by which such manurial substances as are artificially applied to, and more or less intimately mixed with it, can be conveyed to the plants, or which may be derived from sources external to the mass of soil, as from rain and the atmosphere. In this way the soil, in the second of these characteristics, may be said to give to the plants what it always possesses naturally in itself; and by the third it gives to the plants what has been supplied to it by external means. This definition is accurate enough so far as it goes; but it is apt to convey the idea that the soil, acting in the second way, is, as we have in another sentence above said, of a uniform character, whereas it exists in three conditions, which we now notice. As stated elsewhere, all soil is derived from the rocks forming part of the earth's crust. These, through various causes, are broken up, and ultimately arrive at that pulverized condition which is popularly known as the ground, land, or soil. This process of disintegration is not the result of a single operation, but of several operations, the

consequence of which is that there are several stages, so to call them, before the mass of material can arrive at that point when it can be said to be of uniform consistency. The result of scientific investigations has shown that the consequence of these successive stages of disintegration is, that soil is divided into three classes, each of which differs from the others in condition. The first of these is the result of the preliminary operation of the causes which are constantly at work in breaking down, so to say, the original rocky bodies, from which all soil is derived, into a state more or less rough, and which derives its name from the mechanical property it possesses, and is therefore called the 'gritty' portion or class of the three conditions of soil. By the continuation of the disintegrating influences at work, the particles of the soil necessarily get into a finer state, which, forming a higher stage in the process, has been called the 'dormant' matter of the soil. This is so called because its particles, so to say, are in a condition not fitted to be taken up and assimilated by the plants, inasmuch as they are not soluble in water. The process still continuing, this dormant matter, or part of it, is carried on to a higher stage. This, being the final one, in which its particles, being soluble in water, are therefore capable of being taken up by the plant, has received the designation of the 'active' part of soils.

The constituents of these three distinct classes of the soil, considered as a mass, are obviously capable of being again subdivided and classified according to their nature, this process being that of analysis. But it is also obvious that any analysis of a portion of the mass of the soil cannot give an accurate knowledge of its value agriculturally,—that is, in how far it is valuable for the fertilization of plants; in other words, its value as a plant-producing medium. For what, in fact, should be analyzed is the active part of the soil, that being, as we have above shown, the only part which can be assimilated by the plants at the time when the analysis is taken. For it is also obvious, or at all events, so far as we can judge, is likely to be so, that the other two classes possess all the elements of fertility, which only wait the expiry of the period through which they have to pass before they get into the condition in

which they also can be taken up by and minister to the growth of plants. It is chiefly for certain convenient purposes that three divisions have been named of which soil consists, for it may be divided strictly into two,—first, the dormant, consisting of two sub-classes; second, the active. And from what has been said, it will be seen that the object of cultivation is to bring as rapidly and economically as possible the dormant into the active part of the soil. Dr. Daubeny—to whom we, in common with the agricultural world, are so much indebted for our knowledge of the scientific points connected with soils—simplifies the classification, and puts the dormant and the active under one class, which he names the ‘available’ constituents. And as there are other constituents or particles, which ‘from their state of combination in the mass can never be expected to contribute to the growth of plants,’ he designates these the ‘passive’ ones. This, however, does not exclude the possibility of so treating the soil that the particles of the third class, which we have stated to be called the ‘gritty,’ may be brought ultimately to form part of the available constituents.

We have said that the soil is formed by certain agencies from the original rocks, and that of these agencies the atmospheric influences play an important part; it is therefore obvious that the more we can expose such particles of any mass of soil which has been hitherto closed or shut up, so to say, to these influences, the more quickly will we bring them into the condition of available constituents. It is in this way that all the operations of culture or tillage, such as ploughing, grubbing, harrowing, etc., are so valuable, but it is only the recent expositions of science which have made known the principles on which this value rests. Thus rain, which has access through the interstices between the particles of soil brought into existence by the tillage operations, carries along with it certain volumes, so to express it, of the ordinary air, and also of carbonic acid gas, which it has found in the atmosphere of the upper regions, and which it has dissolved. This carbonic acid gas and the oxygen of the air, which the rain has carried down into the soil, perform certain chemical functions, the result of which is the changing of its gritty portions into the avail-

able constituents, and enable also such plants as may either be growing naturally, or purposely put there by the farmer, to assimilate these latter or available constituents. The action of those agents which we have above noticed is further promoted by the changes of temperature in the air, the alternations of which have a very powerful influence,—the best known of which, because the most easily observed, is that of frost. This will help to pulverize a soil and form it into a good seed-bed generally much more quickly, and certainly more efficaciously, than can be done by any of the tillage operations performed by man. Only it should be observed, and it is but fair to man to note it, that by his tillage operations he opens or can open the soil up, and place it to be so exposed as to allow the frost to operate in the most direct and efficient manner. Hence the value of autumnal cultivation of the soil by ploughing or grubbing, leaving it in a rough and open condition, exposed to the action of the winter's frost, etc.

We have said at the opening of our remarks under this head, that the soil may be considered in the light of a vehicle for holding certain organic substances, or those capable of decay. These may be either given to the soil through the agency of manures specially supplied to it by man, or as the result of the presence of vegetation, planted there, so to say, by nature, or of substances conveyed to and deposited by birds or animals, etc. The decomposition of these organic matters in the soil is effected by the action of the atmospheric influences, the rain, etc., putting them into that condition in which they can be assimilated by the crops. But a double advantage is obtained by this decomposition, for it also aids the conversion of the dormant matter of the soil into its active or available condition; and it will be obvious that the more perfect its tillage, the more readily will the atmospheric influences act upon it. But the advantage of such does not rest here alone, valuable as the results are, but they further prepare the soil to take from the atmosphere fertilizing matter contained in it, and to store it up amongst the soil's particles, to be available for future use by the crops. We have already stated that carbonic acid gas and atmospheric air, with its

oxygen, are carried down and lodged in the opened up soil, which act upon its particles so as to increase the amount of available constituents. But the atmosphere contains or has present in it nitric acid and ammonia, the latter of which, as it is the most expensive, is the most valuable of all our manurial agents; but by so treating the soil we can gain supplies of it from the atmosphere, supplies at all times available. The atmosphere gives up these to the soil, and the nitric acid referred to above, first through its absorbent properties, and by the rain passing into it and dissolving them. The rain plays an exceedingly important part, for it not only acts as a direct agent in collecting and bringing down the fertilizing constituents of the atmosphere; but if the soil be so prepared that it can gain entrance to it, so to say, it places them in the position in which its absorptive powers come best into play. Here we see the value of drainage, which, although popularly supposed to be useful only as a means of conveying away the stagnant water from the soil, or such superabundant supplies which it may receive from surface drains, etc., is here seen to act also as the means by which the atmosphere conveys or carries into it supplies of fertilizing agents.

We have thus shown in what way the soil can not only be increased in value as regards the amount of its available constituents, but rendered still more valuable for the production of crops by the addition to it of manurial matters. Of these, either present in the soil naturally or supplied artificially, some play more than a single part; as lime, for example, which increases the absorbent powers of the soil, separates ammonia from the rain and the atmosphere, and stores up these till they are required by plants. It does not come within the scope of our work to enter into a detail of the chemical processes carried out by the combined action of the soil, the manure of the air, and that applied by man, but we may direct the attention of the reader to the importance of studying the action of the double silicates. Of these, the silicate of lime possesses the power of separating ammonia from the air. But although certain fertilizing constituents may be said to be gained for nothing by merely taking advantage of the stores contained in the

atmosphere, and of such as may be present naturally in the soil, it is nevertheless necessary to apply other manures, inasmuch as we know that each separate crop requires its own fertilizer, which may not be present in the air. Of the various manures at the command of the farmer, the most important is that of the farm-yard, or dung. One of the principal objects served by this, or of some other artificial manure, is to supply the constituents which are present only in small quantities naturally in our soils. Of these the phosphates are most important. Hence will be seen the importance of collecting and storing up, in order to preserve in the best possible way, the supplies which the farmer by careful management can secure of organic substances, whether obtained from animal or vegetable sources. In another section of this work we have shown how this can be done in describing dung stances, liquid-manure tanks, and compost heaps. As to the importance of this saving and storing up of organic matters as manures, Dr. Daubeny has the following pregnant and suggestive remarks:— ‘Such substances, indeed, contain the products which nature has, with so large a consumption of time, and by such a number of complicated operations, elaborated from the raw materials contained in the soil, and has at length brought into the condition in which they are the most soluble, and therefore best fitted to be assimilated by the organs of plants.’

To waste them is therefore to undo what has been expressly prepared for our use by a beautiful system of contrivances, and to place ourselves under the necessity of performing, by an expenditure of our own labour and capital, those very processes which nature had already accomplished for us without cost, by aid of those animate or inanimate agents which she has at her disposal. Before dismissing the subject of manures, we again refer to the point already noticed, that one object in supplying the above organic matters to the soil was to make up for the deficiency of phosphates in it. But Dr. Daubeny is of opinion that these phosphates exist in certain soils to a much larger extent than is generally supposed, and points in proof of this to the advantages which we all know are derivable, especially in heavy soils, from the method of fallowing, or allowing the

land to rest for a period without bearing crops,—‘a method which,’ as he says, ‘would be absurd if the alkalies, phosphates, and other of the more scanty ingredients were absolutely wanting, but which would be likely to prove efficient if they were only locked up within the recesses of the soil, and required time to call them into activity. . . . At any rate, it may be important for the farmer to be assured, that at the very time he is ransacking the most distant quarters of the globe for certain of the mineral ingredients required for his crops, he has lying beneath his feet in many instances an almost inexhaustible supply of the same. For there seems no reason to doubt that the whole mass of rock which constitutes the subsoil in the secondary and tertiary districts of this country, is nearly as rich in phosphates and in alkalies as the vegetable mould derived from its decomposition. And although the soil in which the experiments in my garden were conducted possessed a depth perhaps three times as great as the average of those in which farm produce is generally raised, yet, on the other hand, the amount of phosphates and of alkaline ingredients reported to be present in the latter appears in many instances greater than that determined in the case before us. . . . We need not therefore resort to South America for bones, if means could be found for extracting this ingredient economically from the rocks of our own country.’

This last remark of this able exponent of agricultural science will naturally suggest to the mind of the reader the importance of the most recent improvements connected with the preparation of the soil, namely, deep culture. To this we have drawn special attention in a separate part of this work, to which we refer the reader for details. In carrying out this deep stirring of the soil, which these remarks we have now presented to the reader on its dormant and available constituents show the universal importance of to the farmer, it is fortunate for him that, knowing this, he has in the system of steam cultivation the precise power which is necessary for him to carry the system out, and without which it would have been hopelessly unavailable.

We have thus seen how certain processes and operations all tend to increase the value of our soils as crop producers. These are not indepen-

dent, but are linked together, so to say, in a continuous chain, the neglect or overlooking any one of which is sure to be attended by loss. No doubt there are varieties of sub-classes in some of these, as, for example, in tillage operations; still it rests with the farmer to consider which of them he will adopt as best suited to promote the object he has in view. As regards the actual condition of the soil itself, it is obvious that the points which we have brought before the reader open up new subjects for the consideration of the farmer, which he cannot now, if alive to his own interest, overlook; for it by no means follows that, although a soil may apparently be deficient in certain constituents, these may not be actually absent from it, but be merely, as we have shown, in that condition which has been designated as ‘dormant’ or ‘passive,’ and to make them ‘available’ the farmer has but to employ one or other or all of the methods we have pointed out.

Mechanical Condition of the Soil required by or suitable for different Crops.—Having now discussed the ways in which soil may be improved, which ways we may, for convenience sake, class under one head as *chemical*, and by which the soil can bear richer crops, we have now to take up the consideration of the points connected with the *mechanical* condition in which it should be placed to suit the habits of growth of the different classes of these crops.

In treating of the mechanical condition of the soil required by the various crops of the farm, space, unfortunately, is not at our disposal to enable us to enter into the consideration of the points bearing upon and influencing the germination of seeds. We have therefore to refer the reader to works in which these form a more special and appropriate part than the present. Suffice it to say that there are three conditions of soil necessary to germination,—air, moisture, and warmth, to which some add light. But of the value of this agency there are various opinions; indeed, the majority of facts would go to prove that, in place of possessing a value, it on the contrary exercises an injurious or retarding influence on the germination of seeds. Leaving these points with regret, for interesting and suggestive to a high degree they are, and passing on to our special subject, we take up *wheat*, the most

important of all our farm crops used directly as food for man.

The mechanical condition of the soil required for this crop may be said to have two characteristics,—depth, and firmness of soil. The depth of stirred soil is required to enable the roots of the plant to penetrate far down in search of food, present there as mineral constituents chiefly; while the firmness may be said to be confined to the upper part or seed-bed, both aiding the peculiar habits of growth of the plant. Wheat cannot do well in a soil, however favourable to it otherwise, ‘unless it can root firmly; and it is for this reason that, where one ploughing will do, it is always desirable to avoid a second immediately before the sowing.’ Where wheat is sown on the heavy soil best suited to it, as, for instance, on clays, it is comparatively an easy matter to secure the necessary firmness. Perhaps the chief exception to this in such cases is where vetches have preceded it, these having a tendency to open up the soil. When not cut for green forage food, the best way will be to feed them off the land with sheep, the treading of which will give the necessary consolidation. Where wheat is grown on light soils, the crops which precede it being often common turnips or rape, the difficulty of having the firm seed-bed is decidedly increased, and special care is necessary in preparing the land. The best way is to consume the crops on the land by sheep, following up with the land presser, allowing the soil to remain for some time to settle down. Of course it is scarcely necessary to be said that the ploughing precedes the pressing. Even then, however, the soil fails to have the necessary firmness, and in this case by far the better way is to change the cropping; and of all, the crop best suited for the purpose in view is clover. When this precedes the wheat, there is no better seed-bed obtained for it on light land than the clover ley, this not only giving a firm furrow, but the roots of the clover tend also to consolidate the soil. When wheat is grown upon very light lands, which, however, are really unfitted for it, the difficulty of getting a firm seed-bed is still more increased.

The mechanical condition of the soil required for *barley* is essentially different from that re-

quired for wheat. The root-growth or development, in place of taking the long vertical direction of wheat, assumes a lateral one, spreading out and taking the form of what may be called a flattish bunch of rootlets. The soil must therefore be free to admit of this development, the best being loams easily worked into a condition of fine tilth. The methods of preparing the soil vary, of course, with its nature, general qualities, and the crops which have preceded it. As regards the latter point, however, a root crop is now almost universally taken off the land before the barley. The preparation of the soil for the roots is precisely that which favours the mechanical condition necessary for barley, while the heavy manuring gives the necessary richness to it. Great care is necessary to prepare the soil for barley so as to have a fine tilth; many farmers, in their anxiety to get the seed in, neglecting its proper working in spring, and thus losing the chance of having a superior crop, through not having time to give the land the extra working which it requires. In strong loamy soils, from which the preceding root-crop has been eaten up by sheep, which necessarily consolidates the land too much, it is advisable to adopt autumnal cultivation, so that the soil will be acted upon during the winter by the atmospheric influences. But this must be done in the best way; for if the land be ploughed so as to be closed rather than opened up, thus preventing the frost, etc. from acting upon its particles, a large amount of extra tillage work is necessitated in the endeavour to bring the soil into good, free, and open tilth,—an endeavour which, as a rule, does not meet with the desired success. A barley soil, we again repeat, must have these characteristics, otherwise the crop will be confined to feeding purposes, the high quality for malting, which obtains the best price, not being secured.

The habit of growth of *oats* closely resembles in the root development that of wheat. The condition of the soil required to favour in the best way the germination of the seed at first starting, and its after development, is one ‘well charged with vegetable matter, firm beneath, yet easy of penetration for the rooting of the plant, with the surface light and free.’ The crop is

generally taken either after roots, or upon a turf of grass or of clover ley. As the great authority on soils remarks, 'Nothing suits the oat better than a turf ploughed down; and conversely, as a general rule, there is nothing preferable to the oat than strong turf. In the north of England, where the turf even of a clover ley becomes too rank for wheat, the oat comes in as the substitute; and cases are very rare in which either wheat or barley can displace the oat from old and rich turf newly ploughed up. I do not here include clover leys, and such artificial grass turf; but I think, with these exceptions, there is no corn crop which will penetrate and break up an old turf as well as the oat. The reason is, because turf presents just that condition of soil which meets the requirements of its roots; and if the seed requires a light covering, this is generally produced by an exposure of the soil to frost, and a light tillage of the land. To favour this result, the turf should be ploughed whilst moderately moist, but the surface should not be broken down for sowing until it is in dry working order. The same degree of moisture which favours the solidity of the turf would, if the surface be cultivated at the same time, render it close and adhesive, and quite unfavourable to the germination of the seed.'

Wheat soils are usually spoken of also as *bean* soils; and as the habit of growth of this crop is also very similar to that of the wheat, the mechanical condition in which the soil is required to be placed is also very similar. Beans are almost always grown upon stubble land; and from what we have said, it will be seen that this should be put under autumn culture, so that the land be left in a rough condition to be pulverized by the action of the frost, etc., to form the upper part of the soil into a good tilth for the seed-bed, while the under part will be firm to suit the root development. Should autumn culture not be carried out, and ploughing delayed till spring, this should be done as early as possible, in order to admit of the soil settling down and consolidating. To secure this, some prefer to sow in this early-made furrow without breaking it up. This plan may be adopted also in soils of a lighter character than those which are considered true bean ones.

These remarks apply to spring-sown beans, and also to winter-sown, the difference being only as regards time. The ploughing must be done in September, or as early as possible after the grain crop is taken off the land, the sowing being done some four weeks afterwards. In these two, as, indeed, in all other cases of soil and cropping, the object is to have the firm seed-bed which is essential to the crop. As barley is in relation to the wheat as regards the soils and their mechanical conditions, so *pease* are to beans, this crop requiring a free, loose soil, deeply stirred and well manured. The best system of preparing the land involves the adoption of autumnal culture; and as the crop generally follows a cereal, the ploughing should be done as soon after the corn crop is taken off the land as possible.

Of the root crops of the farm the most important is the *turnip*, and of the varieties grown the *Sweet*. The preparation of the soil for this crop forms, therefore, one of the most important departments of farm work; and although the details vary in different districts, the mechanical condition of the soil best suited for the habits of the crop is the same in all. These habits necessitate a very finely wrought and pulverized condition, to allow not merely the numerous rootlets which the bulb sends out to gain access to the stores of fertilizing constituents present in it, but also to facilitate the lateral, or what may be called the circumferential, development of the fleshy part of the bulb in its natural or normal form. This latter point is one of greater importance than is supposed; for the parts of all abnormal growths are in quality of flesh greatly inferior to true growth, being either hard, woolly, or fibrous, or diseased; or both of these conditions may be at the same time the result. Hence it will be seen that heavy, close, and adhesive soils are not capable of yielding the best crops, but that those are got out of land in the fine and deep state of tilth above described, and which therefore is known as turnip soil. This latter, obviously, is more easy to cultivate than the heavier. Cleanness, or freedom from weeds, is absolutely essential, so that where the land has been allowed to get into a foul condition, the workings necessitated are both varied and frequently repeated until the

requisite cleanness is secured. There is great diversity of opinion as to whether turnip land should be worked so that the final seed-bed be left in a moist or dry condition. The balance of scientific investigation into this point seems to be in favour of having a dry soil for the deposit of the seed. If the weather be dry, it will thus remain uninjured; and when the rains come, both soil and seed will be placed in the most favourable condition for quick germination, and that rapid pushing on of the plants into that condition of rough leaf in which the attacks of the turnip-fly need no longer be feared.

Another important root-crop is the *mangold wurzel*. Although the form of this root obviously points to such a mechanical condition of the soil as to admit of its penetrating deeply into it, and therefore requiring a loose, friable state, still it is found that it will do with stronger and more adhesive soil than will the turnip. Nevertheless, while this is so, a good tilth is essential, which may be secured without involving the repeated workings of the soil which the turnip demands. In the case of this latter crop, as, indeed, may be said of all other crops, autumn cultivation will give the best results.

The carrot does best in a very deep and friable soil, but well manured and kept thoroughly free from weeds, to secure which they best follow another root-crop, as turnips, the culture of which involves the necessity of attending to these points. If a corn crop precedes the carrot, great care is required to have the land thoroughly cleaned and deeply stirred. A root-crop which is too seldom grown, considering its value as a food for live stock of all kinds, is the *parsnip*. Although this in form is similar to the carrot, it may be nevertheless grown in soils stronger and more adhesive than that root; but, in fact, the parsnip has singular powers of adaptability to any class of soil, and generally the mechanical condition and general culture, etc., may be taken as that required for carrots. Another point in its favour is, that it may be sown at almost any period of the year. The mechanical state of soils required for grass seed may be conceived, from their light, small, and weak constitution, as something very different to that demanded by the seeds of other crops already noticed. If deeply sown, germination would not

take place, so that a thin covering or stratum is only required; indeed, some merely placed on the surface, covering them in with a light bush-harrow. In other cases the roller is used after sowing, to secure the somewhat delicate condition of seed-bed. Should the surface of the soil be encrusted, as after rain, it should be opened up with a light turn of the chain or the bush-harrow, before the seed is sown. Where the roller is used, it must be very carefully, and only when the soil is dry. Grass seed is usually sown down with corn crops, barley, or oats. It is a disputed point whether they should be sown at the same time as the corn, or after the corn has reached that condition at which the plants are well rooted in the soil. The balance of opinion seems to point in favour of the latter plan.

The Influence of Soils upon the Health of Stock pastured on them.—Up to a certain period in the history of agriculture, and, indeed, prevailing to a very large extent now amongst those connected with its practice, so little attention was paid to the subject of soils, and their relation to what grew upon their surfaces, that the graphic phrase, ‘Oh, soils are soils, and grass is grass,’ may be taken as an exposition of the general ignorance on the subject, and indicating the general indifference to the fact that there might be a law or laws regulating the relationship above alluded to, and which was therefore possibly of first practical importance. Of late years, and especially within the last eight or ten, special attention has been directed to the subject, and a large amount of information connected with it has been collected, showing that there does exist a very close and intimate relation between soils and the herbage which grows upon them, and, further, which is the most important point, upon the health of the stock pastured thereon.

In one sense it is somewhat surprising that this investigation had not been entered into long before. Not but what hints had been thrown out and suggestions offered upon the subject; for so thoroughly had the constituents of soils and of grasses, natural and artificial alike, been analyzed, —with special reference to the latter as containing the chemical constituents upon which their nutritive qualities depended,—and further, and not less important, so well had the relation of those

qualities to the animals fed upon them, both from a chemical as well as a physiological point of view, been investigated, that one would have felt sure that investigations into the relation which soils bear to the crops they produce would have been pushed as far as these others we have alluded to. But although what may be called the necessary dependence of all the three links of the chain—the soil, the food, the animal—would have been so clear that the one could scarcely be well thought of without involving the thinking of the other, still it was not done, at least to the extent it ought to have been. It is not always easy to account for those lapses in scientific investigations of which this is but an example out of many, but they often occur, and greatly to the loss of those immediately concerned in the solution of the problems which they include within their range. It is satisfactory, however, to know that the investigations are now going on, and have been taken up by those well calculated to place their results before the public intelligently, and to deduce rules or suggestions from them of practical value. What we have here to say upon the point must, from what has been already stated, be seen to be of a very general character, and more by way of pointing out that the facts, scanty as they are, all go to prove the very great importance of the landed proprietor or farmer having a thorough knowledge of the geological formation of all parts of the estate, and this in addition to a knowledge—the more profound the better—of the sister sciences of chemistry and physiology, as applicable specially to plant and animal life. When this knowledge becomes wide-spread, and applied with judgment to the soils, etc. of the properties of the country, such a mass of facts will be brought to light as will enable farmers to predict with wonderful accuracy what the soils of their farms are capable of producing, and what the value of this produce as applied to their live stock is likely to be. The more closely we find this system carried out, and the more extensively, the more shall we find ourselves approaching that period in the history of agriculture, long ago prophesied, long looked forward to by the most earnest of its followers, when every step in the working of farms will be taken with an accuracy and precision as far

removed in its phases from the ‘happy-go-lucky,’ ‘rule of thumb,’ ‘let us do as our forefathers did’ system, now so prevalent, as the pecuniary results of the new will be as far removed by their striking increase from those of the old plan, with all its varied and uncertain, because unknown, chances of loss. And just as we know that the proprietors of large chemical manufacturing establishments keep for each a chemist of ability to look after their products, and find the large expenditure abundantly justified by the larger profits arising from the system, so do we believe that it would in every sense pay, if a large landed proprietor engaged an ‘expert’ thoroughly capable of making known the various conditions of the soils of the property, etc., and their relative values. And the expense might be lessened by proprietors of adjoining properties joining in securing and paying for the services of such a great help in making known the hidden value of the soils, etc. This will be deemed as but a specimen of the propositions of the ‘most advanced of advanced’ agriculturists; we nevertheless venture to believe that the time will come when it will not be an unusual thing to witness. Societies might, but in truth societies could not, do this work; for to obtain satisfactory results, the ‘expert’ would require to reside on the property being thus examined into and reported upon, so that he would have a thorough knowledge of its whole peculiarities of soil, climate, locality, etc. What societies could do, and what they should begin to do now, would be to train up, or assist in training up, under their auspices, a class of men who could be sent where their services were required; and we believe that if one only was put down within a large district, so marked would be the advantages flowing from his labours, that demands for his services would come rapidly in from other parts. As yet we have, so to say, but merely had the name of ‘agricultural chemists’ amongst us; and able as these have been and now are, and enormous as has been the value of their contributions to the science, still they have not had the field open to them which it is most desirable to cultivate, closed as it has been by a variety of circumstances, not the least potent of which has been that this outlying work cannot possibly be so

remunerative in the first instance as that wider one in which they have hitherto laboured. But such outlying districts would be the fields in which young men of ability would win their spurs, and make knights, yet untitled, to undertake work of higher value, if such indeed could be.

The principle of the investigation of soils, with reference to their influence upon the herbage and the health of stock feeding on them, may be briefly stated thus:—Analyses of the herbage which is known to be good and health-sustaining food indicate the presence of certain constituents, these being classed generally under two great divisions, the organic or vegetable, capable of being wholly burned or consumed; and, second, the inorganic, which leaves on combustion an ash residue; this ash residue indicates on analysis the presence of certain substances, as saline, iron, phosphates, etc. Analyzing the chief parts which go to make up the body of an animal, the analysis indicates the presence of certain constituents which find their prototypes, so to say, in, or are in fact identical with, similar constituents found on analyzing herbage. Although the point might easily have been guessed at from mere common-sense observations and considerations, still this conjecture, while it showed the close relationship existing between animals and the food they lived upon, and also between these and the soils which produced them, gave no precise indication of the relative values of some soils as compared with others. Another step had to be taken, of which presently. Going on to note that the relationship was fairly enough indicated by what had been done, and what might safely be conjectured, a series of rough and ready investigations in the produce of different soils was entered upon. From these, as an important result, it was deduced that the herbage grown upon certain soils was in every respect superior to that grown upon other soils, not only for feeding or fattening purposes, but for sustaining the health of the animals. Classifying in the same ready way the facts based upon, the first general deduction made was that the soils formed from—in the manner described in preceding paragraph on soils—what are called the primary formations or igneous rocks, of which the granitic and trappean rocks are well-known

examples, give better food than that produced by soils from the secondary formation, such as clay, old red sandstone, etc. Here was a most important fact established, and it was amply corroborated by a series of observations made in different districts, and scientifically proved by analyses either of the soils of certain districts themselves, or by analyses long ago published by various agricultural authorities of rocks of a corresponding character. These showed, taken in conjunction with the other analyses already referred to, a clear chain of connection between soil, produce, and the condition of the animals consuming this. We have already shown in paragraphs on soils, that the character of the geological formations or rocks of a district which underlie the surface soils gives no correct or trustworthy data by which to estimate that of those soils. We have there pointed out that from various agencies at work, operating through long and unknown periods, and often in ways at which we can but guess, a soil will overlie the lower formation, the origin of which is from rocks of quite a different character from those upon which they rest. Hence will be seen the importance, nay, necessity, of not trusting to indications of what is the lower formation of the districts in which the fields, etc. are, but to a special examination of the lower formation of soils themselves. Otherwise grave errors may arise. But this fact also brings up another of importance bearing on the subject, namely:

The Influence of the Water passing through or over the Surface Soil upon the Animals pastured thereon.—Singular to say, and it is now somewhat difficult to comprehend how it could be decided upon, when the analyses of foods used by cattle were thoroughly entered upon with a view to support the theories of animal nutrition, water was set aside, and in these analyses treated as valueless from a feeding point of view. Brought forward under the cover of theories of nutrition, which were so brilliantly elucidated, and which, on the whole, were wonderfully accurate, this quiet relegation of the water in agricultural produce to a point of utter uselessness was accepted quietly. But in process of time there were those who began to question the accuracy of such a proceeding from

scientific points of view, while others came more easily, but just in the main as accurately, to the same conclusion, basing it upon what they believed to be common-sense and incontrovertible facts, derived from everyday experience and observation. This is not the place further to pursue the subject from a scientific point of view; those who wish to go into this will find in our volume, in the series entitled, *Outline of Modern Farming* (London: Crosby Lockwood & Co.), a fully detailed *resumé* of all the opinions *pro* and *con* on the subject, with some remarks of our own thereon. Suffice it here to say, that we know water to be an important element in the food of all animals; that, in one respect, it may be considered a food itself, or may be the vehicle of conveying certain constituents absent in solid foods themselves. This can be proved in a variety of ways, and is strikingly so in connection with the subject of soils, now under discussion. Water being very much influenced in its character and quality by the nature of the rocks from which it springs, or from the rocks and soils over which it flows, it follows that we ought to find, as in practice we do find, that water will contain constituents of the like character, so that one may predicate almost the soils or rocks over which water has flowed by the constituents found in it. It also follows that the constituents of water flowing through a field may possess those of which the herbage of that field may be destitute; as, indeed, from the short extent of flow in some cases might easily be conceived. But the water so flowing may have passed over rocks or soils, so that it will contain the very constituents of which the herbage of the field through which it passes is deficient. Hence the wants of the herbage may be made up or supplemented by the supply of the water. That water, despite the *dicta* of some authorities who still maintain the theory we have already alluded to, is not merely an aliment, nourishing and supporting animal life, is true; but it will have been deduced from what we have said, that being so ready a medium or vehicle by which good and healthy constituents may be conveyed in it, it must be no less potent in the way of conveying or containing constituents which may be noxious.

Hence the necessity of looking after this important department of water supply to live stock of the farm pastured on fields. We have little more to say on a subject so interesting and practical, than that it seems established at once by the facts of experience and the teachings of science, that soils do exercise a remarkable influence in the way we have shown. But while admitting this, we have said enough to warn the improver of property of the danger of rushing to rapid conclusions from generalizations as hastily made. The remarkable diversities in the natural peculiarities and characteristics of the soils, not only of a district, but of a single field, and the way in which these are brought about, should induce caution as to deciding the nature of a soil from the rocks on which it lies, and indeed *vice versa*; for accurate examination can alone decide to which certain peculiarities of herbage, water, etc. are due. Then, again, the effects of any particular cause may be and are greatly modified by local circumstances, such as climate, exposure to unhealthy winds, and also the mere way in which work is carried out; so that one has to be guarded in coming to a quick conclusion on any point of farm management before he has thoroughly taken into consideration all the circumstances. As we have again and again pointed out, agriculture is not a fixed science, with its rules and axioms which cannot be denied, and which can always be depended upon; on the contrary, if there be one on which little dependence can be placed, so far as the results of the workings of to-day will allow us to decide with certainty those of tomorrow, agriculture is the science. It is in its practice subjected to so many disturbing elements, that it is not easy to say to which of these any particular circumstance owes its origin, how they are produced, and how they may be controlled and modified. We would counsel the reader who desires to know fuller details on this subject than the scope of our work admits of, to examine carefully two admirable papers in the 7th volume of the 4th series of the *Transactions of the Highland Society*, which are full of suggestive and practical matter on the points merely opened up. Although both papers have special reference to sheep as affected by soils, the facts given embrace within their scope, it

need scarcely be said, points referring to live stock in general. The first paper is by Mr. John McCulloch, Agnew Crescent, Stranraer; the second, which is the more extended of the two, and goes fully into many details—to some of which we own our indebtedness—is from the pen of Mr. John McMillan, Halketheths, Castle-Douglas.

We have thus shown how the soils which constitute the cropping part of the earth's surface are exceedingly varied in their chemical constituents, as well as in their physical or mechanical characteristics. It is in the way in which these various characteristics are, so to say, blended together in what is known as the 'seed-bed;' in the working of them by various operations, so as to reduce the hard, unyielding clods of heavy clay soil into the condition known to all as a 'fine tilth;' or to raise it, as in the case of light, shifting, sandy soils, to the necessary degree of firmness and compression; to mix the soil thus prepared with the proper supply of manurial substances;—it is in all this, and much more than this, that what is called 'cultivation of the soil' consists.

Deep Culture and Stirring of the Soil.—Of all the recently introduced methods of preparing our soils for crops, and for putting them into that condition best fitted to enable them to draw from it those manurial constituents the value of which agricultural chemists have in modern times so clearly proved, and which experience in many forms has so fully demonstrated, that of *deep culture* is perhaps the most important. This, in conjunction with the system of autumnal cultivation or rather preparation of the soil, and the two aided so powerfully by the recently introduced forms of steam cultivating mechanism, has brought about a change in the farming operations connected with the soil, so remarkable in its scientific phases, and so striking in its practical results, that it may be said to have completely revolutionized the work of soil preparation for crops. It would, however, be perhaps the more correct way to say that it will, or bids fair to revolutionize this department of farm practice, inasmuch as, unfortunately, although the theory and the facts gained from experience of the new system are established beyond all

dispute, the practice has not been extended so rapidly as certainly those interested in the progress of agriculture would like to see. But it has ever been thus, alike in agriculture as in other arts. New things are but slowly taken up; and it only remains to be hoped that this one will form an exception to the rule, and be quickly spread over all the districts of the kingdom. The sooner this is done, the more fully developed will the resources of the soil be, and its products largely increased both in quantity and quality.

One reason,—and it is well always to see whether there be a reason, or the working of mere prejudice only, why a new and a good thing is not quickly adopted,—one reason why deep culture has not been so extensively adopted as it deserves to be, is that with it is associated in many minds the idea that more harm is done by its adoption than good, and in this manner. Soil, agriculturally considered, may be divided into two zones or strata,—the upper soil, or that which is placed and maintained from year to year under cultivation, either as bearing a succession of annual crops of various kinds or of grasses, which under the alternate husbandry system may be two, three, or four years on the ground, or in the case of regular meadow and pasture land permanently so, and is generally known as the soil, popularly the ground. The second zone or stratum is the subsoil. Both soil and subsoil originally contained what are called the mineral constituents, in varying qualities according to circumstances, as the nature varies of the rocks or geological formations which gave or yielded the materials or particles of which they were composed. The mineral constituents are withdrawn from the soil by the plants which grow or are cultivated upon it, and this more quickly or slowly according to the number of crops taken within a certain period from it, and the nature and amount of extraneous or added manurial substances applied to and along with the crops in order to increase their produce. This addition of extraneous manures, which contain fertilizing substances of various kinds, is for the purpose of keeping up the fertility of the soil, which would otherwise fail from the withdrawal of its original

constituents, which are only of a fixed or determined amount.

The depth of the soil or upper stratum is very limited, this being determined by the depth to which the cultivating implements, as the plough, go in preparing the soil. This depth has not been easy to increase, in consequence of mechanical difficulties in the way. The lower stratum or subsoil contains, of course, manurial constituents valuable for and available by plants, if only their roots and rootlets could get access to them. This, however, is prevented by a variety of circumstances; and knowing the fertilizing richness of the subsoil, the idea occurred to some thinking men,—if the difficulties in the way of so preparing the soil that the roots of the plants may get down to the subsoil, to draw from it the fertilizing riches which it possesses, are such that they cannot with the mechanical aids at our command be overcome, there might be some way of reversing the condition of the problem, by bringing the subsoil nearer to, or to mix with, the soil or upper stratum, thus affording an exemplification of the old saying, 'If Mahomet cannot get to the mountain, the mountain must be brought to Mahomet.'

This was tried, and although in some instances with signal and marked success, yet in others with results so precisely the reverse, that grave doubts were thrown upon the whole scheme of deep culture; and as men's minds seem to have an inherent attraction towards difficulties, these, of course, were made more of than the methods by which they were to be overcome, so that, as we have already stated, deep culture was, to borrow an appropriate simile, 'deep buried in the soil,' and was for long but seldom spoken of, or if so, only to be condemned with strong censure, or 'damned' with equal potency 'by faint praise.' The difficulties arose from the fact that the subsoils of various lands varied in composition as well as in mechanical or inherent peculiarities; some were good, some were crude and sour, and could only be rendered beneficial to the plants by being brought under the ameliorating influences of cultivation. But still the fact that the upper and all too shallow stratum of soil was every year becoming more and more exhausted of its mineral constituents—large areas

of it, indeed, utterly destitute of them, unless supplied by large and expensive additions of farm-yard or artificial manures—haunted the minds of men who thought at all on the subject; nor less the other fact, that below this exhausted soil lay a stratum of subsoil, filled, so to say, to repletion with the riches of untouched fertility. And the result was, that at last the system of a compromise of difficulties—that grand principle by which difficulties in many things are overcome—was thought of, and finally, as now, this took form in the method of so working, that the subsoil was deeply stirred, and its hitherto close bound and root and air fast particles, so to say, opened up to the passage or entrance of the roots and rootlets of the plants grown in the upper soil. And further, by a gradual system the subsoil was brought up to and mixed with the upper soil in a series of what might be called instalments, thus enriching it with a supply of fresh soil, as yet deprived but to a small extent of its mineral constituents.

This system of working solved the difficulties, and deep culture became an established fact, and only awaited, as it awaits in too many instances and on too many farms, to be taken advantage of when undue prejudices shall give way to truths which are now incontrovertibly established. Nor was it a less remarkable, as it assuredly was a most fortunate circumstance, that coincident with this discovery, as it may well be called,—the full value and importance of which to the nation, as bringing with it a power which can and will largely increase the produce of our farms, is yet to be appreciated by the public,—came the introduction of improved mechanical appliances. These, worked by steam, enable the subsoil to be stirred to a depth which by our ancestors, nay, even by those who but a few years ago were considered by farmers generally as but 'dreamy enthusiasts,' as indeed they were called, would have been set down as a work impossible to be achieved. Two feet, and even two feet six inches, can be got of thoroughly stirred subsoil, by the use of one of John Fowler & Co.'s patent knives or grubbers; and by the subsequent use of their subsoiler, this soil can, in proper time and judicious quantities, be brought up to and mixed with the soil or upper stratum, thus giving ultimately a wonderful depth

of fairly stirred soil, in which plants can be grown and developed fully, and from which they can draw large supplies of mineral constituents. And this without involving any of the objections, considered by some to be so great, of bringing up and at once mixing the subsoil with the surface soil.

Nor does the mere addition of this large supply of mineral constituents, valuable as it is, exhaust the benefits which this new system of deep culture brings with it in its train. To gardeners the advantages obtainable from so working the soil that it will be exposed as much as possible to the action of sun-heat, air, rain, and light, or to what we now know as, and is summed up in the term, 'atmospheric influences,' have been long known and fully made use of; these being all the more decided in their action when the soil is so worked at the latter end of the year that it can lie exposed all the winter, and have in addition to these influences above named the further and greater advantages of being exposed to the action of frost, and manured, so to say, by good layers of snow. Yet, strange to say, fully as has been established the value of the atmospheric influences—and amongst these very remarkably that of frost, which breaks up and disintegrates the soil into fine particles—by the practice of gardeners, farmers have been so slow to adopt the same system, modified, no doubt, as it must be, by the difference in methods of working, that if they are really convinced of the truths concerning the influence of the atmosphere, etc., they show comparatively few symptoms that they desire to reduce them to practice.

And still more striking is the apathy of many, displayed in their neglect of the system of late or 'autumn cultivation,' as it is called, by which the frost can so operate upon the soil as to bring it into the condition known to farmers as a fine 'tilth.' Now, although there are certain degrees of openness of texture or 'tilth' of the soil required,—for example, for wheat a firmer soil than for turnips or barley,—still all are agreed upon this, that openness of soil is in every way desirable; and this not merely to enable the roots of plants to descend into the soil, but also the atmosphere. The advantages of this descent of the air into, and

its mixture, so to say, with the particles of the soil, cannot be overestimated. For it is not merely the disintegrating effect of the atmospheric influences upon the soil, which we have already stated to be so beneficial, but, as is well known, there is a species of manurial agency, so to say, carried on by them—to such an extent, indeed, that some earnest advocates of deep culture, or deep stirring, rather, of the soil, go the length of saying, that with this system nearly the whole of the manuring required by the crops will be effected by them alone. And those who hold this opinion have certainly some experience to fall back upon to support them in it.

Although deep culture and autumn working of the soil have made but comparatively slow progress amongst farmers, still it is gratifying to note that that progress is being gradually quickened, and the practice of both systems becoming daily more and more extended. In working lands in the autumn, advantage should be taken to get as early into the fields as possible after the removal of the grain crops which have been in the land. And here a caution is required; for we cannot sufficiently impress the young and inexperienced farmer—or, may we mildly suggest, the old and experienced one, who may be just a 'leetle' tied to his own opinions and prejudices—with the loss which is sustained by ploughing or working his land in any way when it is not in good condition, and the great gain there is in patiently waiting till it is, and then going at it heartily. It is difficult to overestimate the injury done to succeeding crops by turning over soil which is wet, 'lumpy, and bird-limey;' and there is really no time gained ultimately by this kind of working, independently of the state of the crop, for the seed-bed in such soil is quite unfitted to push on the germination of the seed, and to aid the subsequent growth of the young and tender plants. The attention paid to the mechanical condition of the soil is, as a rule, by far too greatly unheeded; indeed, it is a point rarely thought of by many. Farmers have got or get into a jog-trot, rule-of-thumb way of doing things, and if they look as if they were well done, that seems to satisfy them. Now it is worth knowing, what every one does not know, that each of our crops has got its own seed-root

peculiarities, one seed developing its rootlets in a way quite different from that of another: as the wheat, with its long, vertical, descending roots, which require a firm and compressed soil; or the barley, with its lateral or wide-spreading horizontal rootlets, for which a lighter and more friable soil is required. Then, again, the crop which has preceded that which is now or shortly to be put in, influences greatly the condition of the soil, and also that of the method of working it. Thus the clover is a good crop for bringing the soil into good condition for the wheat, which, as above stated, requires a firmish soil, so that in working it and preparing it for the crop this must be borne in mind. Turnips, again, are a good preparatory crop for the barley, if the land is not in very high condition; mangold-wurzel if it be. And to show that farming is a calling which requires some thought, it may be here noted that the way even in which the turnip has been cleared off will influence the mode of working it this month; for if sheep have been folded on, and the turnips are then wholly eaten off by them, a shallower furrow slice should be taken in than where the roots have been pulled up in the usual way.

Although deep stirring of the soil is so advantageous, it must nevertheless be done with judgment. An eminent authority, who has had perhaps greater experience than most in carrying out the system, states that he would not recommend it to be done thoroughly—that is, to the utmost or greatest depth to which the improved implements can go—oftener than once every four or five years, and then only for green or root crops. And as for the soil for cereals, only a very shallow seed-bed is afterwards required, these requiring, as we have already stated, a firm seed-bed, or rather under-surface soil. Still this must be done with care, for it is possible to err in giving too much solidity to the soil; for it ought to be borne in mind that the root-growths of the cereals vary very much, those of the wheat, as already pointed out, having a vertical growth, and those of the barley a horizontal or lateral one.

The nature of the soil ought also to materially modify the character of the working to which it is subjected, light soils requiring a different treat-

ment from those of a dense, heavy, adhesive kind. It is, indeed, in the working of the latter that the value of the system we have been describing and advocating will be best shown. We have, indeed, no hesitation in avowing our belief, that in its application in conjunction with steam power, lies that future of our heavy clay lands to which our farmers have so long, and apparently so hopelessly, been looking forward,—a future in which the difficulties of working will be overcome, and the full amount of the rich fertility of these clay lands will be obtained. In the heaviest qualities of this kind of soil, our readers, of course, are aware that it was formerly, and is in the old system still necessary to work them upon the bare or summer fallow system,—a system which required the land to be the whole year under the cultivating or preparatory processes, as grubbing, ploughing, harrowing, weeding, and cleaning, so that a large proportion of the working period was, so to say, lost so far as crop-raising was concerned. Now, by the use of the improved steam cultivating apparatus and the implements we have alluded to, these heavy clay lands, if early got on in the autumn as soon as the preceding crop has been removed, can be stirred to such a depth, and so effectually, leaving large interstitial spaces below into which the air can descend, that all the old operations connected with summer fallowing can be dispensed with, and the land so brought into that desirable state of tilth that little else save comparatively light harrowing work, or a turn or two of the grubber or the plough, is required in spring to make it fit for the next crop. Heavy clay soils thus treated can be cultivated at one-half the expense as compared with the old method, and this to say nothing of the large increase of produce obtained from them from the superior style of preparing the soil.

But important as the subject of deep culture of the soil is, and great as are the benefits which correct theory shows to be derived from it, as well as the results of what is now a widely extended practice, our readers will not be surprised to learn that there are some, and these even thoroughly practical men, who take exception to it. Others—and these certainly have far more reason on their side—maintain that, while valuable in some cir-

circumstances, it is not so in others. Thus, while for root crops they believe deep ploughing to be good, they have not found it so for the cereals or leguminous crops, for which, they say, they find shallow ploughing the best, as producing the best crops. Again, under the new system of autumn culture, while the general opinion is that the earlier the land is ploughed the better, even in the case of the heaviest soils, some maintain that they get the best results from deep ploughing, but only if done in the spring. Still further, while deep cultivation would appear, from what we have said in the earlier part of this section, to be valuable for all soils, there are some who maintain, and against extended practice, that while it is good for some, shallow ploughing is the best for other kinds of soils. These facts all point to this, that there are circumstances, peculiarities of soil, climate, and locality, which may materially affect even the soundest theories, so that it behoves the manager of landed property to take all these into consideration before any plan based upon it, and which may have proved in other districts eminently successful, is decided upon in a particular case. Because, as modifications may be found necessary and beneficial where doubt exists, and where such a mode of proceeding can be adopted, it is certainly the safest way to introduce the new system cautiously, giving, of course, the benefits of this to such parts as may apparently be similar to those about which any doubt has been thrown in the history of improvement.

Soils considered in their relation to Drainage Operations.—We have glanced at the various

peculiarities of soils in their chemical and mechanical features, and these connected with crops which they are best calculated to produce; we have now to do the same as briefly as may be for the point named at the head of this paragraph. A well-known authority on agricultural engineering classifies the soils in respect to draining operations under three heads,—*first*, soils through which water percolates or flows according to the laws of gravitation; *second*, soils in which capillary attraction counteracts that of gravitation; and, *third*, where affinity counteracts both the other two, gravitation and capillary attraction. Without entering into the minute details which make up the characteristics of these three classes,—a task beyond the scope of our work, and for which reference must be made to works treating of drainage specially,—we may state roughly that the soils of the first class are those which are known popularly as sandy or gravelly. Much of these soils is dry, and scarcely requires draining; the greater proportion are, however, more or less wet, and imperatively demand it. They are the easiest kinds of soils to drain. The second class are popularly known as sandy clays, or clayey sands, or what are called in some districts ‘dead sands,’ and are more or less mixed with vegetable matter. They comprise many varieties, are of all depths, and possess diverse chemical and mechanical peculiarities. The various soils of this class are, as a rule, difficult to drain, possibly more so than even the soil of the third class, known generally as heavy clay or impervious soils.

CHAPTER II.

LAYING OUT THE FIELDS OF THE FARM —THE POSITION OF ROADS, STREAMS, SHELTER PLANTATIONS, ETC.

THE conclusion would be very readily arrived at, that this department was of little practical importance, if we were to judge from the prominence, or rather, to write more accurately, the lack of it, given to it by some practical authorities, and in works which are either devoted specially to this, or partly to it and partly to farming considered generally. Nor would the conclusion be more definite and decided if the observation were extended to the fields of many farms throughout the country, which are laid out on most erroneous principles, if indeed, in many of them, such a matter as a principle which should guide the practice has been thought of as at all likely to exist; and the contrast between such farms and those on which a principle has been acknowledged and acted upon, is well calculated to show the importance of the department. We are far, however, from concealing the fact that it is by no means easy, if indeed it be possible, to lay down a principle applicable to all circumstances,—and this much may be safely conceded by way of excuse, if excuse be necessary, for those who neglect to trouble themselves about the matter at all,—for here, as in other departments of farming, such a diversity of circumstances exists that it is impossible to define a principle which could be applicable in all circumstances. But still here, as in farming generally, certain broad positions may be stated and conclusions arrived at, the application of which to practice will give fairly valuable results. Before stating these, and giving a few plans which will serve to illustrate their application to varied circumstances of locality, etc., it will not be altogether useless to glance at some of the leading considerations which lend importance to this department of

landed property economics. Thus, the mere waste of time—and time is money—involving in having to go over lengths of roads leading to or bounding fields, which, if better planned, would be shorter, is a serious item in the yearly expenditure, more especially if the roads lead to fields—as pasture fields—in daily or at least frequent use. In this latter case the repetition of the unnecessary going over of the road adds enormously to the labour, and, by consequence, to the cost; for although at first sight it may seem to be but a matter of no great moment to have an extra length of road along which to drive the cows to pasture, when this is multiplied by so many times a day, and this by so many times a week, and so on, and the yearly aggregate summed up and committed to paper, and its pecuniary value estimated, the matter assumes a totally different aspect.

So also with the carting of manure to, and of produce from, the fields under arable culture. The mere passing along a road unnecessarily long, once or twice, is perhaps by some not worth naming as adding to the cost of horse labour and men's time, but comes to be a serious item when repeated very frequently in the year, as it must be. Then, again, as to the mere form or shape of the fields. This comes to be a very serious matter when one considers the cost of fencing originally, and the keeping of it in good repair; and fencing may be reduced to a minimum by proper forms being given to fields, and a due relation of these one to another. And, as we shall presently see, the size as well as the shape of fields under *arable* culture influences to a great extent the cost of their cultivation, the expenditure of horse power being greater in fields of certain size and form than in those where

these are different. This relation, above alluded to, has also an important bearing upon the system of cropping the farm, for when this is attended to the cost of working is greatly reduced; and so also when fields of the same quality of soil are brought if possible near to each other, or within what may be called the same range of operation,—as, for example, heavy lands under fallow, or lighter lands under turnip culture. Further, the position of the fields devoted to pasture, so as to obtain the best shelter for the stock, will obviously have a decided influence for good upon their condition, and in like proportion increase the profits to be derived from them.

The 'water privileges,' moreover, of a farm may be nearly wholly lost, or their value reduced to a minimum, by lack of attention to certain points by which their advantages will be made the most of. The relation of such parts of the farm as are or may be devoted to plantation, to other parts, exercises also a clearly important influence upon its value as a whole; and so also that of such tracts not yet brought into cultivation, but which may in process of time be reclaimed, and made to form part of the cultivated land. All these, and other points which will readily suggest themselves to the thoughtful reader, will show that this department of Landed Property Improvement Economics is not the least important one with which the agent is concerned.

We shall, in as few sentences as possible, endeavour to place before the reader some general principles and diagrams which may serve to illustrate the principal points just alluded to. Thus in figs. 1 to 4, Plate 60, some of the points connected with the laying out of fields for ploughing are illustrated. Experience has shown that the most economical length of furrow which a horse can turn without distressing him is 250 yards, taking the average of soils; this length allowing him, when he reaches the headlands, as at *a* or *b* in fig. 1, a breathing or brief resting time as the plough is turned to go along the headlands, in order to take the next succeeding furrow in the next succeeding 'stretch.' This length, as above stated, will vary as the soil varies,—the lighter that is, the longer may the

furrow be, and *vice versa*; and it may be laid out in a square, as in fig. 1. But for several obvious reasons fields are more conveniently set out in rectangles or parallelograms, as in fig. 2, the shorter length, as *a b*, being that of the line of furrows; and these, if possible, should run in such a direction that the growing crops will receive the largest amount of sunlight. It is obvious that even in a field laid out with such regularity that the furrows are of uniform length, there will still be a large amount of time lost in turning at, and going along, the headlands. The most eminent agricultural authority, Mr. Stephens, the author of *The Book of the Farm*, estimates this at one-fifth of the time of ten hours to the working day. It is evident, therefore, that when fields are laid out as in fig. 3, Plate 60, a very large increase in this otherwise great loss of time will result from the turning at such points as *a a*, and in going along the headland at *b* and *c*. In such a case, perhaps the best way to dispose of the field is shown in fig. 4, by placing, say, a clump of trees at the east side, as at *a*, which will serve as shelter to the crops; and, as we shall see in the chapter on plantations, shelter even to arable fields is a point desirable to be attained in many cases. Or, if shelter of this sort be not desired, on the less exposed side, not to be planted, the corner, as *b*, may be devoted to some permanent crop, useful as forage food for cattle, as say gorse. By some such arrangement as this a well-formed field may be obtained, as shown. Fig. 7 shows the disposition of irregular fields, indicating how much is lost in ploughing, as well as by the form of the road, as *a a*. Thus the field *b c d e* may be improved in form by making the road go from *e* to *d*, as shown by the dotted lines, thus effecting a very considerable saving in going in the direction from *a* to *f*, either north or south. The corner at *b*, if laid out with some permanent crop, will still further improve the form of field. The fields *g* and *h*, if circumstances are otherwise suitable, will best be laid out as pasture fields, affording a change of bite. A good deal of land is often lost by the laying down of roads, leaving such unappropriated parts as at *i* in fig. 7, Plate 60, or as at *j*. By a little thought a better arrangement could be obtained; thus, by adding to the first-named alteration of the road, from *e*

to *f*, another road as from *c* to *k*, it is obvious that the same purpose will be served as by the original road, *a a a*, while the awkward-shaped field, *h*, would be got rid of, and a fairly well proportioned one obtained, *e l m d*. Fig. 5 shows another disposition of badly-formed fields, the buildings being at *a*, and the main road at *b b*.


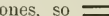
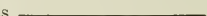
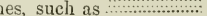



It is a very bad arrangement to have the buildings of a farm divided, so that they will be on two sides of a public road, as shown in fig 5. In this, *a a b b* is the public road, which narrows going south at *e*, part of the buildings being on one side at *d*, and the other at *e*. A worse arrangement than this could scarcely be; only in this case it was made still more faulty by placing the farm-house at *f*, so that no supervision could be had by the farmer over his buildings. The loss with such an arrangement is often very heavy, especially when the farm is a suburban one,—as the particular one here illustrated was,—in the neighbourhood of a manufacturing town, inasmuch as depredations of no small amount are committed, especially during the ‘quiet hours.’ The offices are placed at *g*, the fruit and flower garden at *h h*, the kitchen garden at *i i*; entering from this was a small paddock or pasturing field, *j j*; *k, d*, and *l, m*, and *n*, meadows; while *o, p*, and *q* are the fields devoted to arable culture, which, it will be observed, are the worst formed for this purpose on the farm. Fig. 8, Plate 60, shows a much better, indeed a very fair disposition of the fields of a farm, in which *a a* is the public road, *b* that leading to the main farm or accommodation road, *c c*. This divides the farm into two parts, so that the pasture and arable land can be arranged on either side for the convenience of working. Thus the arable fields are mainly on the left-hand side of *c c*, and so near the buildings, *d*, as that the least time will be taken up in carting out manure and bringing in the produce. Thus, *e, f, g, h, i* are arable fields; *j* and *k*, meadows; while the pasture fields are the farthest from the buildings, as at *l l, m m, o*, and *p*; the four latter being made purposely small in order to secure a change of bite, *o* and *p* being small paddocks near the steading into which to turn calves and young stock; *y* is the farm-house, with flower and fruit garden at front and back;

r the kitchen garden, both being sheltered from the north, and screened by a row of shrubs and trees. It will be observed in this plan that the best formed fields are those allotted to arable culture. Fig. 6 illustrates the disposition of a farm in which there is a hill or rising ground of considerable extent, as at *a a*; a rivulet or large stream, as at *b b*; an extensive plantation, part of which is shown at *c c*, towards which the ground rises from the stream; *d d* the main farm road, which turns round the rising ground *a a* at one point, and crosses the stream, *b b*, by the bridge at *c*; *f* shows the position of steading, *g* that of house and garden. The arable fields are all placed at the lower part of the farm, near the steading, the rising ground being also under arable culture at its lowest point, the highest being devoted to a gorse plantation for forage; the only exception being a small paddock at *h*, opposite the steading, for calves and young stock, and the field *i*, devoted to green forage crops. All the pasture fields, *j, k, l*, and meadow lands, *m, n*, are on the rising ground behind *a a*. As the land slopes from north to south, the part of the stream *b b* is used to irrigate a field laid out on the ridge-and-furrow system (see chapter on ‘Irrigation’).

Figs. 1 and 2, Plate 61, illustrate other dispositions of farm fields, fig. 4 being a modification or rather an improvement of fig. 2, Plate 61, in which the road is altered so as to save time in going to and fro over the farm, while the forms of the fields are also altered. To make the difference between the two observable, the original disposition, as in fig. 6, Plate 60, is given in dotted line in fig. 2, Plate 61. Fig. 1, Plate 61, shows in like manner how part of a farm, in fig. 5, Plate 60, can be altered. The water from the stream, as in fig. 2, Plate 61, should be made available to work the machinery, as shown by the water-lead, *b*. This plan of putting down the lines dotted is recommended in the case of improving badly arranged farms, and in the case of those with rising ground or uneven surfaces, as in fig. 6, Plate 60. It is also recommended as a good method to sketch out the grounds as if flat, and thereafter to plan the proposed improvements. In figs. 4 and 5, Plate 61, we show two plans illustrative of a few points in the laying

out of farms with uneven surfaces. In fig. 4 a broad hill is situated at *a a*, at an angle to which another range, *b b*, stretches along; to avoid going over the hill *a a*, the main road, *e*, of the farm crosses the valley, *b e*, at an angle, and then rises gradually up to the plantation, *f*, crossing by a bridge at *g*. The hill *a a* is laid out as one field, and ploughed with the one-furrow plough. The farm steading is at *h*, the farm-house and gardens at *i*, kitchen garden and orchard at *j*, and main or public road at *k k*. In fig. 5, a ridge, *a a*, extends across the breadth of the farm, nearly parallel to the stretch of the public road, *b b*; the house and offices are placed near the end of the ridge, so as to avoid passing over it. The road *c* enters, therefore, nearly at the side, passing by the house and the steading, *d*, and entering the main farm road, *e*, on either side of which are fields laid out rectangularly, as shown. In fig. 3 we give the plan of a farm badly, and in fig. 6 the same properly laid out. In fig. 3, *a a* is the main public road; *b* the house, steading, and garden; *d*, farm road; *f f* are marsh lands, chiefly of black mud, divided by a ditch, *e e*. In fig. 6, which is the improved arrangement, the farm road entering from the public one is curved, as shown, leading to the steading, *n*, so as to get a meadow, *j*, from the upper part of the marsh. The road from the steading, *n*, goes round the garden, *k*, so as to reach the lower fields, *d, i, b, b, a, c, e*, and *f*, two fields, *g* and *h*, being at the upper side; *i* is the drained mud marsh devoted to haymaking. For these three illustrations we are indebted to an American authority. In fig. 7 we give the plan of a farm, the fields of which when laid out assume a rectangular form. In this, *a a* is the public road, *b* that leading to the farm-house and gardens, with a back road, *c*, joining the main farm road, *d*, leading to the steading and farm-yard, *e*, behind which are paddocks, *c* and *f*, for calves and young stock. The arable part of the farm is on the right-hand side of the central road, *d d*; the heavy soil is at the fields *g g*, the medium soil field being at *h h*; the arable fields are arranged to suit the rotation adopted. The pasture and meadow fields are on the right-hand side, being intersected by a small rivulet, *i i*; *j* shows the kitchen garden, fenced off from the steading; and *k* a large poultry run.

The Planning or Setting out of the Fields, or General Disposition of Hilly Moorlands.—In the chapter on the ‘Reclamation of Waste Lands,’ under the special paragraph headed ‘The Reclamation of Hilly Moorlands,’ some remarks of a general character will be found. What we have to concern ourselves about at present is the laying out or distribution of the lands of this class, designed to be formed into a farm capable of yielding a good return. In place of making a series of remarks of our own on this important subject, we conceive we shall best be serving the interests of the reader by giving those of the late Mr. Robert Smith, as published in the *Journal of the Royal Agricultural Society of England*, vols. xvii. to xxxviii., one of our best authorities, and possessed, possibly, of the largest amount of practical experience in connection with work of this class. The following are Mr. Smith’s remarks on the arrangement of a hill farm:—

‘The foregoing remarks as to the arrangement of a hilly moorland farm are illustrated by the sketch plan given in Plate 62, fig. 2, of which the following explains the principal parts. The public roads are indicated by the broader parallel lines, thus ; the farm roads by the narrower ones, so . The divisions between and the forms of the fields by the single lines . The portion of plantation for shelter, etc., by the black parts, such as *a* or *b*. That of the original bogs, springs, and watercourses by broken, dotted, and parallel lines, such as . The lines of “watercourses” or “gutters” by dark dotted or broken lines, thus ; the direction of the water or stream in these by the arrows pointing thereto. The pools or ponds for collecting surplus water, etc., to be afterwards used for irrigation purposes, are indicated by black circles, thus . The position of shelter-sheds—locally termed “linhays” in the hilly districts of the south-west of England (see par. on “Shelter-sheds”)—is indicated by the dark crosses, thus , the farm-house and offices by the mark at *c*. The head of the brook is indicated in the plan by the letter *A*; and the course of this and of brooks on adjoining farms by meandering thickish lines. *C C D D* indicates the extent of rough hill allotment of 248 acres; the general position

of hilly or rising grounds being shown by light, dotted, waving lines. This rough hill allotment, C C D D, dips to the north-east. The farm lands dip south by east, thus giving the two great essentials for irrigation downwards and onwards, as also the full benefit of the early rays of the sun, as also shelter from the prevailing winds.'




Subdivision of Pasture Fields.—What has been said under the head of steam culture as to the advantages of having the fields, to the working of which the system is applied, as level in surface and of as large an area as possible, does not apply to lands under grass, for pasturing or for meadow. Although, as we have seen, the power of steam has been very recently applied to the reaping of corn, we may yet see it applied to the mowing of meadow grass, so that the same advantages obtainable by having large and level fields under arable culture may be found desirable in the case of meadows under this advanced system of working. At present, however, meadows are of moderate area in extent, although some prefer to have them very large, as being more economically worked during haymaking time, where the mowing and haymaking machines are used. At one time, and, indeed, largely prevalent at the present, the notion was held that pasture fields could scarcely be too large. Many, however, who saw the advantages of the system, cut their pasture fields up into smaller plots; and so marked were those advantages, that the system is being gradually extended, and many now carry out and advocate the subdivision of their pastures who but a short time ago, if not opposed to, were certainly not in favour of the principle. That greater economy in feeding, arising not only from the saving of grass in the manner yet to be noticed, but from the superior value of the grasses, was the result of the system, experience rapidly and conclusively proved. We have elsewhere in the present volume remarked upon the good effect of a change of food, carried out at judicious intervals, upon the health and the feeding capabilities of the cattle, whether they be fattening stock or dairy cows. This had long been observed in regard to artificial foods, and in green or forage crops, but it was some time before any practical men saw that it was equally applicable in the case of pasture grasses. Of

course, so long as the pasture fields were large, this change could not be carried out, and it was only by having smaller fields that it could be adopted. It is well known to practical men that the herbage, both in kind and in feeding quality, varies very much, even on the same farm, and, for the matter of that, even in the same field; so that by cutting off one portion or several, making thus many where before there might be only few fields, perhaps only one or two, the cattle, taken from one after the expiry of a certain period, could at once have the desired change of food by being taken and put up in another.

Nor is this all, for even in cases where the grass in large pasture fields was of good and of fairly uniform quality, by keeping the cattle perpetually in it, it was gradually deteriorated, so that both the quantity and the quality were lessened. This arose in more ways than one. Thus the droppings of the cattle got so multiplied over the surface of a large field even, that a large proportion of its more productive area was lost; for, of course, as our readers will know, where these droppings fall, if they are not removed or broken up, which they not often are, the grass grows rank and strong; and to this the cattle have so great a natural repugnance, as a rule, that they will not eat it unless from dire necessity, so to say. The same repugnance is shown by them to the eating of grass on which their liquid exuviae have been discharged. To those evils, moreover, are to be added this, that in consequence of the continual trampling of the cattle over the land, much of it gets into so parched and 'trashed' a state, that comparatively little growth of grass takes place; while in more favourite spots, such, for example, as near the watering ponds or troughs, or near walls under which they take shelter, the land is so thoroughly broken up and trampled into mud or dust, that no grass at all grows upon such spots. There are other causes of loss which will suggest themselves on consideration to the reader who is at all acquainted with the subject, and which may by some be thought of little value or importance; but granting this to be the case, taking each individual case by itself, the matter becomes a much more serious one when the whole are put together, and

the aggregate loss ascertained. We feel sure that to any one who has fairly and deeply considered the matter, it must have frequently presented itself as one, not of small, but of great importance. For it is not merely the loss sustained of feeding power, so to say, on an individual farm, but that extending over the whole farms of the kingdom,—a loss which thus assumes such dimensions as to make it one of really national concern. It need not, therefore, be matter of surprise to those who have not had their attention as yet much, if to any extent, drawn to it, to be told that the most advanced of our farmers perceive the necessity there is of overcoming these causes of loss by introducing, if not a new system, at least one which will greatly modify the old one. Such a modification we have already indicated as given in the system of subdividing the pasture fields, eating them off in some kind of *successional* order, as may suggest itself to the farmer, or may be rendered advisable by circumstances of locality, soil, climate, nature of the grasses, condition of the pastures, etc. The division may be made by using one or other of the new methods of fencing which possess the advantages of portability, if the term may be applied to them; or at least of being taken up from one, and put down again on a new line, with no great expenditure of time, labour, or money. (See chapter on 'Irrigation,' note on Brown's system of steam ditto.)

Another modification of the old system is not the alteration of the dimensions or area of pasture fields as they are at present laid out, but the way in which the cattle are compelled to pasture in certain allotted spots; when these are eaten off, the cattle being removed to fresh ones, thus perpetually changing the feeding ground, till the whole field is gone over in what may be called a rotation of plots, the process

being repeated as long as the cattle are out at pasture. This modification does away with the necessity of using dividing fences, and saves, therefore, the expense of providing them, as well as of fitting them up and changing them when required, the retention of the animals being provided for in the necessary spots by a simple method named after the introducer of the system, Mr. Dumbreck, which consists simply in *tethering* or tying the animals to stakes driven in at certain parts of the field, so that the cows have only a certain area to feed over, after which the stakes are altered in position to give the animals a fresh bite. A full description of this method will be found in our work, entitled *Outlines of Modern Farming*. Another system, which we have already alluded to as obviating the necessity of using fencing, at least to a large extent, is the soiling or house-feeding one; as the details of this are purely farming, we refer the reader to our volume, entitled *The Complete Grazier*, for a full account of them. Both of these works just named are published by Messrs. Crosby, Lockwood, & Co., of London. Fig. 1, Plate 62, illustrates the sewage farm of Mr. Mechi. In this, the broad parallel lines, thus  indicate the roads; the narrow parallel ones, thus  the open ditches; the dotted lines the subterranean pipes conveying the liquid manure; . . .  . . . the hydrants; stopcocks are provided at various points, to which the hose for distributing the manure over the fields is connected, the supply to the various divisions of the farm being regulated by the hydrants. Figs. 3 and 4 are other examples of sewage farms, in which the dotted lines show the liquid-manure pipes; the black parts at various points the hydrants; the full lines indicating the form of the fields. In fig. 3, *a* is a stream; in fig. 4, *b b* and *c c* are railways.

CHAPTER III.

PLANTATIONS OF VARIOUS KINDS, FOR VARIOUS CIRCUMSTANCES OF SOIL, LOCALITY, AND CLIMATE.

Beneficial Effects of Plantations upon Land and Soil.—To those who are at all acquainted with the subject the title to this paragraph seems unnecessary, begging as it does the question, or involving a doubt as to the truth of the statement; but to those who have heard the freely expressed opinions of many, who from their position ought to know better, on the opposite side, it is essential to say a few words under the heading as we give it. The wonder, indeed, is, that any should doubt the benefit to be derived from judicious planting. Possibly the doubt has arisen from forgetting that there is, as the French would say, planting and planting, or in other words, good and bad planting, just as we have heard of one who objected to all trees on farm land, because he had noticed that nothing grew, or did not grow well, under a wide-spreading heavy tree in a garden. It would be well, however, if the really good effects of planting were more thought of by many connected with the land.

The first of the many beneficial effects of planting is the equalizing of the seasons, lessening the fierce heats of the summer's sun, and mitigating the intense cold of the winter's frost. The second is the effect upon the soil as regards its moisture, not only in drawing supplies from the clouds, but in preventing its too rapid evaporation and the consequent drying up of the soil. The records of remote as well as those of the more recent periods in the history of many countries of the world, have abundantly proved that a country desolate of trees is a country desolate indeed, often to the extent of not being able to produce food in sufficient quantities and of such varied kinds necessary to support the population. The streams and rivulets which, rising from a thousand sources, flow through the

land, permeate the soil, and add to its fertility in happier circumstances, in those unfortunate ones dry up, and in a large number of instances totally disappear, giving rise to a bare and wild sterility along their course. And coming down to more recent times, we see the same influences at work, bringing about the same unfortunate results. Nor is it the least suggestive of the circumstances connected with this question, that some of the most important improvements in modern agriculture have acted as powerfully predisposing causes in bringing the evil about. The desire to extend the area of land under cropping has caused many clumps of trees in plantation belts to be grubbed up and to disappear; and the consequent loss of the power which the trees yielded to retain the rainfall and the exhalations from the clouds falling or being condensed by and dropping from the leafage, has been rendered all the more obvious and its evils increased by the greater rapidity with which the modern system of drainage carries the water thus produced off the surface of the soil to the outfalls, and from thence to the rivers and the sea.

But it is not only in retaining in the soil the water of rainfalls, preventing it from being too quickly dried up by currents of warm air, or by strong winds, or by the action of the sun's rays, but by allowing it to be slowly and gradually shed off from, and percolated through the soil to lower localities; but it also, by attracting clouds, much in the same way as mountain and hill ranges attract them, which deposit their moisture on the leaves, and which, reaching the ground, is retained and slowly distributed as above; in equalizing the temperature of districts; in affording shelter from biting blasts to crops as well as to cattle in pasture fields, —it is not only in these, and in some other ways

which will presently be shown, that plantations are beneficial to lands and soils; there is still another which claims to be and must be noticed. This is their influence in increasing the agricultural value of soils of poor or comparatively poor quality. Where lands of these kinds are planted, even where the results of the planting in the kind and quality of the timber produced are of no great pecuniary value, the other results agriculturally are such as to make it well worth the labour of having such soils covered with timber trees of some kind. The benefits arising from the processes which we have seen to go naturally on where trees are grown, in themselves tend to improve the quality of the soil; but a still greater, at least a more obvious and direct benefit, is obtained by its enrichment, arising from the supply of decayed vegetable matter, leaves, small twigs, etc. And the intelligent reader will observe, that if at first the soil be so poor that but little hope can be entertained that timber grown upon it will be of much value, each succeeding year of growth adds to the soil its supply of this vegetable or organic matter, and in like proportion to its value, so that each year finds it better adapted to produce more luxuriant growth of the trees, and a higher class or quality of their timber, thus completing the links of the chain of cause and effect in a somewhat striking manner. Thus, when the time comes for the removal of the timber, it will be found that from these causes named, from the opening up of the body of the soil by the rain, fractures of the roots of the trees, and—which may in one sense be likened to a species of deep stirring and opening up of the soil—the mere grubbing up and displacing of the trees with their roots and rootlets,—it will be found that a very marked and valuable increase in the quality and value of the beforetime poor soil has been brought about by the system of planting it with trees. We have said enough as to the beneficial results of plantations on lands and soils, and are now prepared to enter somewhat fully into its chief practical details.

Various Kinds or Classes of Plantations.—

Plantations and forests are often considered as one and the same, and the terms used as synonymous. A forest is a collection of trees chiefly, if not wholly, of natural growth and increase,

stretching over wide tracts of land, embracing within its limits hundreds and often thousands of acres, and of which the most striking examples are to be met with, not in this country, but on the Continent, especially in Germany, where the subject of Forestry has been raised to the dignity of a science. A plantation is an artificially formed assemblage of trees, which are supposed to be chosen, as to kind or variety, with a special view to the soil, climate, and locality or position of the plantation. As there are various circumstances connected with property on the large scale, the localities chosen for the placing of plantations, their extent, form, number, and kind of trees selected, will also vary; so that in practice we find plantations ranging from the extensive areas embracing many acres in surface, and running along for perhaps miles, down to the small clumps of but a few trees formed at certain points for the ornamentation of the park or grounds surrounding the mansion, and even to the still more diminutive assemblage of three or four trees placed in a field which may form part of the prospect as viewed from the house. This arrangement naturally classifies plantations under two heads,—first, those put down wholly or chiefly for the purpose of ornament; and second, those for the purposes of direct utility. Of the first of these little need be said, as its treatment comes more, if not altogether, within the domain, so to say, of landscape gardening; the second it is which now concerns us.

This class has numerous subdivisions, of which the principal are—*plantations for the sheltering of exposed lands; plantations for waste lands*, which last have a double object in view,—first, the alteration and amelioration of the soil, fitting it for future and more advanced operations when the trees are removed, if deemed the best, and finally to the formation of land suitable either for arable culture or for pasture or meadow land, which latter may or may not be placed under irrigation; the second object in view in these waste land plantations being the growth of timber for purposes of the farm or for sale. The last sub-class is the *plantation proper*, put down solely with a view to profit from the sale of the timber, although at various points it may obviously act as a plantation shelter

to exposed lands, either arable or pasture. There are other kinds or classes of timber-growing plantations, which, however, are generally considered separately, not coming strictly within the definition of a plantation. These are *small woods* or *woodlands* and *coppice*, although these are sometimes classed together as one under the general term of *coppice*. These it will be necessary to consider, as being often a part, and not seldom if well managed a remunerative part, of property on the large scale. Having now indicated the various kinds of plantations, we shall take them up for consideration in the order in which we have named them; and first, then, as to

Plantations for Sheltering Exposed Lands.—

While treating of the general subject of plantations (see par. 'Beneficial Effects of Plantations'), we have said what was necessary to show the benefits derived from them in various ways, amongst these the important one of yielding shelter to land and crops. We have therefore little need to say more when we come to planting on lands exposed to keen, cold, and strong winds, whether blowing directly from the adjacent sea, or from a land surface stretching far inland. If shelter be good in more favourably situated lands, it must be still better in lands of this exposed character. In point of fact, out of many lands so exposed, a large proportion of them would not bear cropping at all worthy of the name without the benefit of the shelter of a plantation belt. It is, indeed, worthy of special notice how quickly the value of the crops increases after shelter has been obtained; the soil is also greatly altered for the better, being less exposed to sudden changes; the very atmosphere within the plantation belt seems changed, and is quite different both in temperature and 'feel' from that prevailing outside. As regards the latter point, there is something very suggestive in the influence which the air receives, seeming quite to change its character by merely being sifted through the leafage, or passing between the branches of trees. We have yet to learn a good deal in what may be called the physiology of plant life, and this point may be one which will receive attention. That tree leafage has some power, ameliorative and beneficial, there is no doubt, and it is exceedingly probable that the

characteristic action of each species of leafage differs from that of another. These conjectures are by no means devoid of practical value. The advantages of shelter to land under cropping cannot be derived wholly from or in strict proportion to the thickness or depth of the belt; or, as one might put it, the shelter cannot be wholly 'mechanical,' as merely offering a resisting power to the force of the wind, for we often find that remarkably good effect is obtained from a mere strip of plantation. This is exemplified more clearly, perhaps, in a garden, where a thin hornbeam or beechwood, or even a privet fence thinner still, will make a wonderful difference in the value of the crops on its inner or sheltered side. Where a plantation is put down purely for shelter purposes, without any or at least not much reference to its value as timber, this consideration may perhaps lead to an alteration in the mode of planting. Much, of course, depends upon the judgment of the planter in his choice of trees to suit the situation, soil, etc.; for it is obvious that a thin belt formed of trees so well chosen that they grow vigorously, and are able to withstand the severity of the most biting blasts to which they can be exposed, will be of much greater practical value as a shelter than a belt of trees greatly deeper in thickness, but so injudiciously selected that they, not being able to resist the effects of even average winds, never prosper, but decay, and yield little or no produce. In short, to paraphrase the French proverb, 'There are trees *and* trees.'

It is this point, then, upon which the future value of a plantation for shelter chiefly depends,—what are the best trees which we should put down? Now, as each locality has its own peculiarities of climate, position, soil, etc., this question will be quickest and most practically answered by as extensive a series of observations as can be made in the district upon other plantations set down in similar positions. To do this well, not only is a thorough knowledge of trees required, but a quick and ready observation to pick out and detect faults and indications pointing either to the adaptability or otherwise of the trees for the locality and soil; for many will walk over and through a plantation, and, while gaining a fair general knowledge of its

condition, will fail altogether to perceive any of those indications which to the more experienced and reader observer would afford valuable hints from which practical deductions could be made, leading to decisions pointing out clearly the trees fitted and those not fitted for planting in the locality. Such knowledge as this is of immense value to its possessors, and there are comparatively few who have it.

Plantations are rarely composed of one class of tree only, a variety giving variety of tone and colour to the leafage, which adds much to the external beauty when viewed from a distance, as well as variety in form and height, which, again, tells upon the general mass; viewed more closely, or even at a distance, the contour of the belts of trees is more effective. As trees—even those well adapted to stand severe climates—have different habits of growth, and are calculated to yield in varying proportions resisting powers to strong and cold winds, judgment is necessary to decide as to the positions which the various trees are to occupy in the plantation, so that the hardiest will take up that most exposed, and a gradation of shelter be secured, without, at the same time, involving the necessity of laying them down in strictly uniform lines. The outside trees, or those nearest to the exposed edge of the plantation, being of the hardiest, form a sheltering or nursing belt to those behind them; and much, indeed the whole of the success of the plantation, will depend upon the accuracy of knowledge and judgment with which the species of tree best calculated to serve the important object in view is selected.

Inexperienced foresters, or those who take the work of plantation in hand, are often deceived by appearances in deciding upon the hardiest and best trees for this sheltering or nursing belt; for, judging only from look, and often biassed also by certain popular notions which are afloat everywhere and in connection with every subject, he may select a tree which, so far as appearance goes, seems to be the best adapted to the circumstances, but which will prove a decided and disheartening failure. It is only by knowing the 'behaviour,' so to say, of any species during its growth, and under similar circumstances, or at least closely resembling them, of locality and soil, that the choice can be made with the necessary degree of

certainty that it will turn out a good one. Then, again, there are various important points connected with the soil,—whether it will best be thoroughly worked before the trees are planted, or whether it should be left undisturbed; then the best mode of planting out the young trees is also to be considered, their clearing, after management, pruning and thinning, etc.

We have said enough in a general way to show how the plantation of shelter belts is not quite the simple thing some seem to think. It is one which demands on the part of the forester not merely a thorough knowledge of the different varieties of trees,—a knowledge which many, by dint of study, etc., may gain,—but the higher range of faculties to which we have already alluded. As to its importance as bearing on the interests of the property, there can be no doubt. Testimony, as unbroken in its chain of evidence as the facts are strong which support it, is to be had in abundance sufficient to enable any proprietor to decide on the point; for so marked are the advantages arising not merely to the crops and cattle, but to the general atmospheric amenity and climatic characteristics, that, while the letting value of the land will be considerably increased, the selling value of the property, if it came into the market, would also be increased, but in a much higher ratio.

But the work is clearly that which falls under the landlord's department. Other and minor improvements may be undertaken by the tenant, he finding the money, and waiting to be reimbursed by possession of the land for a given number of years. But no tenant would undertake the laying down of plantations on any such terms, as he could have no reasonable hope, under general circumstances, of such an occupancy as would be long enough to reimburse him for his outlay. There is therefore every inducement for the landlord to undertake that which would confer a double benefit on the property. We have, however, supposed that the plantations were laid down with the primary idea that they were to serve the purposes of shelter and improvement of the climate of the district only; and while believing, as already stated, that this would pay alone, there is another source of revenue which ought not to be kept out of sight, namely, the

timber. The value of home-grown timber has advanced, and is still more likely to advance in the future. There are so many uses to which timber of small scantling can be put on the farms of the property,—the thinnings of young plantations and the cuttings of the more matured timber,—that this alone will be found to be of greater value than many would be disposed to admit; while for the larger timber, prices unknown in olden times are to be had readily in the present times. But the work must be judiciously done, and under the care of a thoroughly experienced man. There is ample scope for work throughout the country; for, applicable with singular benefits to exposed lands, which have long been badly cultivated or depastured with results such as could only be obtained from land placed under adverse circumstances, no work of reclamation of waste, or of the renovation of old and utterly neglected land, should be considered completed, nor will they yield the best returns, until proper shelter plantations are put down to ward off cold winds, dashing rains, or driving snow. The subject is one of truly national importance; and seeing this, it is very pitiful to know how little the nation or the nation's Legislature seem to know or care about it. The position is all the more painful when we contrast what is done by other people in the matter of forestry. It were well for us if our Government were to take the subject up, and treat it as heartily and practically as the Governments of other countries, such as Germany, for example. But, failing this help, there are other sources open. Our societies could do much, and it is gratifying to know that they have already done a good deal. Notably, the Highland and Agricultural has done good service in directing attention to the subject by offering prizes for practical essays, many of which, so drawn out, are specially valuable for the large amount of practical information they contain. But it is to individual effort we must mainly look; and if the landlords of property, having lands which could be so improved, were to work upon some such scheme as we have already pointed out, an enormous advance would soon be witnessed in this highly important department of rural economy.

Renovation of Decayed, and Substitution of

injudiciously chosen Trees by good ones in Plantations for sheltering Exposed Lands.—The importance of attending to the proper setting out of shelter plantations, to the examination of the locality and soil, and specially to the nature of the trees to be planted at different parts, is perhaps best illustrated and enforced by examining those instances, not too seldom to be met with, unfortunately, scattered here and there over the face of the country, in which almost the briefest survey will suffice to show how utterly the plantations have failed to perform the duty, and to yield the shelter and all its concomitant advantages, for which they were put down. Nothing, indeed, can be more melancholy than such a sight, especially when it meets one in a district somewhat wild or bare. Some of the trees have utterly died out, their leafless and decaying branches contrasting with those which are still spared to throw out wood and leafage. Some even of these are fast succumbing to the destructive influences under which they are placed, struggling for life; and of the best, so many have given in to these, that gaps are left, giving the whole that weird and rugged look which perhaps only decaying masses of trees present, of which poets have sung, and which painters have depicted with striking effects. All this has had its origin in neglect or ignorance of the proper mode of planting, and of the trees best suited for the locality, soil, and climate; although after the expenditure which has already been made, and with, perhaps, a latent notion that things might change and the trees start forth into new and vigorous life, it seems rather a severe strain upon the landlord to become at once reconciled to the notion that it will, after all, be the better and most economical plan to do away altogether with the wretched plantation, and substitute another laid down by one thoroughly acquainted with the subject. And yet this is the only alternative; and it is better to put up with the first loss, and not to increase it by further delay, but to get recouped by the superior shelter and higher value of yield of properly laid out plantations as quickly as possible. Nor need the doing away with the old plantations be a total loss, for it will be a very bad case indeed in which a goodly quantity of timber cannot be got,—valuable, if not for sale, at least for use on the

property, on which it can be worked up profitably for a variety of purposes. By way of showing how such unfortunate cases as we have alluded to are brought about, and, better still, to illustrate how the failure of the first instance can be made good by the success of the second, and this by the exercise of sound practical knowledge of all the details of planting, aided by skilful observation, and the no less skilful use of this, we believe we cannot do better than give, in a very condensed form, some of the principal points of a very able paper by Mr. Andrew Gilchrist, forester, Urie, Stonehaven, N.B., in which he explains his mode of procedure. The paper is entitled, 'On Successful Planting, Exposed Land,' and had a prize awarded by the Highland and Agricultural Society, in whose *Transactions* it is published, vol. viii. 4th series.

The soil of the plantation referred to in the paper derived its origin from the disintegration of the rocks, chiefly greenstone or whinstone, as it is termed in Scotland, a trappean rock. The depth of this varies considerably, the average being some three inches, this resting upon a bed of decaying rotten whinstone; the soil in quality is light and dry, having the appearance of a brown earth mixed with stones. In some instances it rests upon the whinstone, but this is of a hard, dense character, with few fissures; in others the subsoil is gravel, and some parts are mossy, with a clayey gravel subsoil. The trees planted were principally larch, with a number of Scots and spruce firs, with here and there at irregular distances a few of the common kinds of hardwood trees, the whole in number far below that which should have been planted to form a permanent crop of trees. The plantations, when taken in hand by Mr. Gilchrist for the purpose of renovation or replacement, had been in the ground for forty years, the extent of the various parts running from two to thirty acres. The trees were very unhealthy, many of them stunted in growth, many decayed and decaying, and rapidly dying out. The first cause of this state of matters to be noticed was the fact that the trees put down as nursing, sheltering, or outside trees, on the side exposed to the keen winds, had been selected in ignorance of their unfitness for this important duty. These trees for the most part were of the spruce fir (*Abies excelsa*).

Now this tree, although, to judge from its external indications and apparent habits of growth, it seems well calculated to act as an efficient nursing or shelter tree, as it affords a dense mass of branches and foliage, still, notwithstanding, is an exceedingly delicate and sensitive tree, quite unsuited to withstand strong and cold cutting winds, more especially where the soil is shallow, affording little root-hold. But the tree is not one which, even in deep soils, sends out long and firm holding roots and rootlets, being what is termed a shallow-rooted tree; hence the ease with which it is overturned by strong winds, as was the case in the plantations in question. At a very early stage of their growth, these trees at the outside had quite succumbed to the winds; and even where sheltered, although the lower parts put out branches and leafage, as soon as the shelter had been passed by the growth of the tree, it began to give way and decay. It was only on the least exposed side of the trees that growth was anything like fair; but even here the evil influences at work at other parts affected these, and the branches were open and the leafage poorly developed, and brown and withered in colour and appearance. In some parts the larch had been put down as nursing or sheltering trees on the exposed side of the plantation; but although this is a hardier tree than the spruce fir, it also had been influenced by the keen winds. Many on the most exposed parts were dead, and all were undeniably affected by the rot. Of the best, the appearances were most unsatisfactory, boles or trunks bent before the wind, and covered more or less with mosses and lichens, with no leading shoots, while the branches were short and twisted, covered with spray, and, as a rule, dead at the extremities. Of the 'hardwood' trees planted, the elm, where exposed to the full blast, showed that it was quite unfitted for exposed places; the branches and bole seemed unable to grow in their natural upright position, being contorted and bent in the direction of the wind, while many were dead and rotten. The ash showed a better capability to stand exposure; they had done moderately well, and by judicious treatment it seemed likely to be a fairly profitable tree. The oaks had not thriven, and gave no promise of ever growing to good timber

trees. The beech, although a hardy tree, had not withstood the blast so well as might have been expected; the growth was almost one-sided opposite the wind quarter, while the tendency was to grow into a 'huge, one-sided, wide-spreading bush, its weight of branches making it liable to be uprooted by the wind.' The birch had withstood the blast better than the beech; it had maintained its tree-like appearance, and in places where the soil was more moist, it showed that it was the most suitable of the hardwood trees planted. The alder may be ranked as about equal to the beech, above named, while of all the hardwood trees the sycamore seemed to be the one best likely to withstand the effects of stormy winds and all the evils of exposed situations.

Such was the condition of this unfortunate plantation—a type, we fear, of too many, or portions of many, throughout the country—when the reporter took it in hand. The first step taken was to decide upon the tree best calculated to withstand the effects of the exposure, and to act as outside nursing or shelter trees to the others, and it seemed to be beyond all doubt that the best for this purpose was the native Scots pine. For bleak exposures and thin soils, when planted in the first instance as outside trees, and not sheltered by others, as by spruce or by larch, they thrive well, and are rarely uprooted or overturned by the force of the wind. The great point to be aimed at is to accustom the tree from its earliest stages of growth to be acted upon by the wind; this enables it, or rather, we might say, forces it, to take the necessary firm hold of the soil,—a power which it seems to possess in a remarkable degree, and which it does not put forth so fully when sheltered by other trees. The larch requires to be well sheltered from the wind, and unless it be so it does not prove a profitable tree. The next thing done was the cutting down and clearing of the old plantations, leaving here and there a few hardwood trees and such Scots pines as were growing at suitable distances. The outside belt was of Scots pine, with a few sycamores interspersed here and there to give variety to the foliage—20 yards broad on the most exposed side. The sycamores were placed at distances of 12 feet apart, the Scots pines between at distances of $3\frac{1}{2}$ feet. When the

ground was dry, the remainder of the surface to be planted was filled in with 2500 Scots pines, 800 larches, 200 spruces, with a few silver firs, Austrian pines, and some hardwood trees put in where the ground was suitable. This made the total number of plants per acre 3500, distributed to suit the peculiarities. In places where the soil was thin, and the situation more exposed, the number of Scots pines was increased and few larches planted; and where the soil was of the best quality and the position well sheltered, the Scots pines were reduced and the larches increased in number. The dampish and mossy soils had no larch planted, Scots pines and spruce being the only trees, the pines being double the number of the spruce trees. The plants used were larch—two years seedling, one year transplanted; Scots pines—small two years transplanted; the whole being well rooted, and the height from 9 to 12 inches. The planting was done at once, it not being deemed necessary to adopt the plan, which many consider essential, of leaving the ground unplanted for a number of years after being cleared, and grazed with cattle. This plan, which, if not necessary, is just a waste of so many years, the reporter does not seem to think so essential as some do, and the success which has attended his operations neglecting this plan, and planting immediately after clearing, certainly bears out the supposition. If correct, it is tantamount to being so many years in advance with the growth of the plantation trees. When woods are cleared, there is often a thick, matted, close-growing sward found to cover the ground more or less completely; this injures the soil very much, and if left it prevents the proper planting of the young trees, as they have to be set too deep before they can pass through the thick layer of sward and be put securely in the soil. Although some objected to the plan as subjecting the soil to the chances of drought, the reporter decided upon clearing off this upper thick sward to the extent of 12 inches square at each point where a tree was to be planted, taking care to have the roots well secured in the natural soil. The putting in of the plants was by a double cut, **L** fashion, 8 or 9 inches wide; the first cut is made perpendicular, the other, or horizontal cut, is done in the usual way the soil is turned by depressing and turning

up the side of the spade, this turning the angle formed by the two cuts; the plant is 'driven sharply into its place, with its rootlets below the spade, and the straight part of its root set against the perpendicular cut.' The damper portions of the ground had not been satisfactorily drained for the first plantation, neither as regards the depth nor the straightness of the lines of drains. It was deemed, therefore, more economical and better to cut new rather than to attempt to alter the old drains. The new drains were laid out, as far as possible, so as to be at right angles to the plantation road, this facilitating the removal of timber. The distance between the drains was 25 to 30 feet; the depth of drain, 20 to 24 inches; the width at bottom, 8 inches; at top, 30 inches. The soil taken out was thrown back and spread over the ground before planting was commenced. The success of the plan of renovation now described has been beyond all expectation, and affords an admirable example of what can be done by careful thought and practical knowledge.

Plantations for Timber-growing Purposes.—This is the class which we have distinguished as the plantation proper, the main object in view being the raising of timber as a direct source of revenue, although these plantations perform several other useful functions (see 'Beneficial Effects of Plantations'), often affording direct and immediate shelter to adjacent lands. No doubt all the other kinds of plantations which we have classed separately might, and in the opinion of some should, have come within the present class, inasmuch as they all produce, to a greater or less extent, timber which yields some revenue; still, as will be seen by glancing at the paragraphs devoted to the treatment of their various details, this is not the primary, but rather a secondary object, the direct objects and end aimed at being either shelter for exposed lands, or the bringing in of certain waste or useless lands into a state fit for the higher range of cultural operations, the timber obtained being just so much additional gain or profit. Hence we have deemed it the best arrangement for the purposes of our work to treat them as independent classes; this advantage, if no other, flowing from it, that it admits of the cutting up of what otherwise would have been a long disquisition into comparatively

short sections, easily referred to and quickly read.

Not merely from the extent of land which they cover, but from the varieties of trees grown upon them, either designedly to meet certain industrial requirements or the demand made for particular classes of timber, or from necessity, as where the soil demands certain kinds of trees as the only ones suitable for it, plantations proper are those to which the best efforts of the forester are directed, and in the management of which there is the widest scope for the exercise of his knowledge, skill, and energy. The differences in climate, locality, and soil, and the peculiarities of the positions of plantations in the localities embracing classes of land so widely different in external characteristics as hilly inland ranges and sea-side margins, and soils of every variety, all claim from the forester his most earnest consideration in order to adapt his planting operations so skilfully to each particular case, that the maximum of yield of produce will have been obtained by the minimum outlay of time, labour, and money. All these varying circumstances necessitate so many modifications in position, form or outline, and general characteristics of plantations, that no one rule can be set down as applicable to all circumstances; each case must be decided by its own peculiarities, and these, as we have said, call forth on the part of the forester the exercise of no small degree of far-seeing, thoughtful care, and practical knowledge and skill in working out the various details of the plan of operations decided upon.

Varieties of Soils suitable for Plantations.—It is a happy circumstance connected with plantations proper that they may be established in almost any soil, and, with the exception of high mountainous ranges, may be placed in almost any position; this arising from the fact that the trees offered to the forester are so numerous, and each possessed of its own physical and physiological characteristics, that he has no difficulty in selecting a class or classes of trees suitable for any variety of soil which may turn up to be dealt with. The mutual adaptability of trees to soil, or the converse, is in itself a strong argument in favour of the extension of plantations to localities and positions which would be greatly ameliorated

both as regards climate and soil. The varieties of soils met with in which plantations may be put down may be classed as follows, beginning with the best and ending with the poorest. The numbers given with each refer to the trees most suitable for the soils, and of which a list will be given in a succeeding paragraph:—(1) Rich and comparatively deep and dry loamy soil; (2) ditto, resting upon a subsoil of clay more or less retentive; (3) clayey loam of good quality; (4) clayey loam of poor quality; (5) sandy loam of the best quality; (6) sandy loam poor; (7) sandy soils; (8) rocky or nearly barren soils; (9) sandy silicious; (10) damp or wetish soils of various qualities; (11) damp or moistish loamy soils; (12) soils of all kinds, but varying as regards moisture from the driest to those most encumbered with water.

Varieties of Trees suitable for Different Soils.—The trees grown, or which are capable of being grown in our climate, for timber useful in the industrial arts, may be classed as (1) evergreens, the most important of which are the pines, and of these the best for general purposes is the native or Scots pine, the spruce and silver fir; to which may be added what may be called the shelter or ornamental evergreens, as the yew, the holly, and the box, although this latter is now but seldom grown. (2) The deciduous trees, or those which shed their leaves annually; the sub-classes of which are (a) the softwood, sometimes classed as the aquatic trees, as the poplar, alder, birch, the hazel, the willow. The larch is coniferous, and the only one of this class of deciduous trees which is so. (b) The deciduous hardwood trees, comprising some of the most valuable trees of our plantations, of which the oak stands at the head; the sycamore, often confounded with and called the plane-tree in Scotland; the elm, the ash, the beech, and hornbeam, which is often mistaken, especially in the form of fences, for the birch, which it closely resembles, the leaves of both of them remaining on the branches through the winter and often far on into spring, hence making them specially valuable for shelter-fences or belts, as they afford leafage nearly all the year round; the chestnut, Spanish and horse; the lime, maple, wild cherry tree, the mountain ash, and the hawthorn, the two latter being favourite trees

as ornamental additions to plantations for timber or of belts for shelter, as they give flowers which yield a delicious perfume, and red berries which give colour to the mass of general foliage. The following is a specific detail of the trees suitable for the soils named in preceding paragraph, and numbered (1), (2), etc. For the soil marked (1), walnut is a tree specially adapted; but if the loam be heavy and more or less gravelly, with a subsoil of chalky or calcareous or clayey soil, (2) the oak, the chestnut, the ash, and the linden or lime will grow well upon it; (3) the ash is well adapted for this soil; (4) hornbeam,—if the loam be gravelly, with a gravel, chalk, or clay subsoil, the ash, the willow, and the chestnut may be grown; (5) the beech, the yew, elm, spruce, and Scots pine, and the Weymouth pine; (6) the silver fir and Scots pine, the laburnum and horse chestnut; (7) the pines are best suited for this soil, as also for (8); (9) if soils of this class be in elevated positions, the larch will grow well; it and also the ash will do for a gravelly loam which rests on a subsoil of clay or calcareous earth; (10) the willow is specially suited for this class of soils, as also the alder; the poplar flourishes in most soils; (11) if moderately moist, the lime tree will do well, as also the sycamore, only for this there must be no stagnant water; (12) the birch, the poplar, the lime or linden, the sycamore, willow, alder, mountain ash, plane, maple. The willow and alder will grow in almost the wettest soils; the white poplar and the willow in soils a degree or two drier; and all the others in the different gradations of wet soil up to moist or dampish, but all free from stagnant moisture.

Trees suited for Various Positions or Local Peculiarities of Land.—Land presenting such a varied surface, from the level lowlands up to steep hilly parts and elevated ridges, and with infinite variations of ranges between those extremes, from what we have said in preceding paragraphs in this chapter, and from other considerations which will be obvious on reflection, it will be seen that trees of different kinds have a habitat, locality, or position in which they flourish best,—some doing with the most exposed and bleak positions and the poorest soils, some

requiring the finest soil and the most sheltered positions, and even then succeeding only moderately well and with the greatest care. Some do best on moderate elevations, some on the lowest and most level of all; some flourish well in the driest and apparently the most unfruitful of soils, others demand a soil in which there is an excess of moisture; some do best inland, some give their best development on the shores of the sea, or on the banks or adjacent lands of tidal rivers. All these circumstances demand on the part of the forester the exercise of care to select for certain localities and positions the trees which will be best suited for them. Thus, for low-lying marshy or moorland situations, the willow, the alder, the ash, the birch, and North American pitch pine will be the most suitable; each, again, being grown on the soils most according to their habits, as the willow in the wettest part, for example. For situations of an opposite character,—that is, elevated and exposed to cold and strong winds,—the native Scots fir or pine, the spruce, the birch, the mountain ash, and the larch are the best. For the sea-shore or lands adjacent, the sycamore, the yew, the laburnum, and the alder; and for low-lying, well-sheltered soils of moderately good quality, the oak, the beech, the elm, Spanish chestnut, horse chestnut, walnut, and the lime or linden; while for boggy, swampy, and wet soils in low-lying positions, the willow, the alder, ash, and birch are most suitable; the sycamore and the ash for steep banks on river or hill sides. For trees capable of withstanding cold winds and strong or exposed situations, to act as nursing or sheltering trees to less hardy kinds, the Scots or native fir, the spruce, the mountain ash, the willow, the alder, the black poplar, the birch, and larch will be the most valuable.

Preparation of Plantation Lands for the reception of the Young Trees.—(1) *Laying and Staking out the Form or Outline of the Plantation.* (2) *Fencing.* (3) *Clearing off the Brushwood and Vegetation.* (4) *Draining.* (5) *Digging, Ridging, Trenching, and Ploughing of the Soil.*—The first operation to be gone into is the *best outline to be given to the plantation* (1), or what may be called its general design. If the ground to be occupied by it is very extensive, the probability

is that it will present a considerable amount of variety in local features,—hilly, rolling or undulating, or land nearly level, with breaks and high banks. A skilful forester, in setting out the form or striking off the outline of the plantation, will take advantage of this variety of surface to procure shelter for the more tender trees, and also to economize to the greatest possible extent the cost of fencing. And if there should be arable or pasture lands within the vicinity of the best line for the plantation to take, it may be advisable so to alter or modify it in order that the plantation may afford shelter to those lands. All these and other points, which will be obvious, will be taken into consideration by the careful forester before staking out the line of fence by which the whole plantation must be enclosed and made secure from the inroads of live stock (see a note on this point in paragraph, 'Plantations for Sheltering Exposed Land'). The line or form of outline of the plantation having been decided on, the next work to be done, and it is an important one, is enclosing the whole area by *fencing* (2). As the cost of fencing plantations of even moderate acreage will necessarily be considerable, and in the case of plantations of the first class as regards extent will amount to a very large sum, it behoves the forester to take into very serious consideration the best form or kind of fence to be erected (see chapter on 'Fences'), that which will give the maximum of efficiency at the minimum of cost. Plantation fences require to be not only strong, in order to resist the attacks of heavy cattle and leaping sheep, but also durable; seeing the length of time that the plantation will of necessity occupy the land, till the trees become matured for selling purposes. And even then, in place of wholly cutting down the trees, and converting the land into arable or pasture land, it may be judged the best to replant the area and raise another crop of timber trees; in which case the more durable the fence will have been constructed in the first instance, the more likely will it prove to be the most economical, although the cost may have been large. By far the most durable fence, and in nearly all other respects the best, is the dry-stone wall; if this be well laid out, good and sound foundations secured,

especially on ground much inclined or sloping, and the wall built with great care, so as to secure the best bond between the stones, it will last during a long course of years without requiring much repair, and that only at points which have been injured either by cattle, or, what is often the case, the careless way in which the servants of the farm go over walls. In a line of fence of such great length as that of an extensive plantation must be, different kinds of fences may be eligible or necessary at different points. Thus, where the plantation skirts pasture land, the sunk fence with earth wall, either topped or not with a quickset hedge or with gorse, a wood, or iron-wire and wood, may be used (see 'Park Fence' in paragraph in chapter on 'Fences'). At other points, where flat stones of pretty large dimensions can be had easily, these may be used for fencing, as well as largish boulders from common or moory land. And if there be no other way of disposing of the thinings of other plantations, loppings of large trees cut down, etc., then it may be considered whether it would not be advisable to put down, at least at certain points,—such as those least liable to be injured by cattle, etc.,—timber or wood fences, either wholly of such, or combined with turf or earth, if such can be had in abundance, as the former may be from the paring of common or heathy waste lands. The fencing being decided upon, the next operation is to (3) *get rid of the brushwood and undergrowth of small trees or coppice wood if any, which, if allowed to remain on the ground, would injure the young plants by preventing the access of light, air, and rain to them, and, moreover, would draw uselessly from the soil much of those constituents which would otherwise go to aid the development of the young trees.* In cases where the brushwood is pretty thick and close towards the edges of the proposed plantation most exposed to the cold and strong winds, a belt of it may be preserved to act as a nursing shelter for the young trees. In this case there should be some distance between the trees and the belt of brushwood. When the young plants have got beyond the period at which they are liable to be blown out or twisted by the wind and injured by its low temperature, the belt of brushwood should be cleared off, the

fence having been placed inside the belt. As to the thick, matted grass which sometimes covers plantation land, the brushwood, etc. taken off the land, this should be burnt, and the ashes well mixed with the soil, if this be capable of being ploughed or otherwise worked; or, if not, be used at the 'pits,' if 'pit-planting' be adopted. These ashes add materially to the fertilizing value of the soil. The next operation is the *draining* (4). This often follows immediately upon the fencing, before the grubbing up of the brushwood is done; but it is obvious that not only the course but the cutting of the drains will be greatly easier in cleared land than in that the surface of which is encumbered with a dense growth of vegetable matter and small wood. The drains used in plantations are open or surface drains, the ordinary agricultural tube or tile drains not being admissible, as they are apt to be filled up with the small rootlets of the trees, and even to be displaced and thrown out of line and contact with each other by the roots, the action of which is exceedingly powerful. The drains vary in depth and distance according to the peculiarities of the soil; in wet and marshy places they will require to be deeper and nearer each other than in drier land, and main drains and subsidiary ones will be required (see paragraph on 'Plantations in Boggy Lands,' for remarks on the style of drains required for lands of this description). The drains will all take into outfall or main drains, these being placed according to circumstances of locality. In some cases a rivulet or stream, in others the ditches on the sides of sunk or other fences, may be the outfalls. The drains should be placed in relation to the 'roads' or 'drives,' as they are usually termed, so that the haulage of cut timber will be facilitated, this being best secured by having the drains at right angles to the 'drives,' affording parallel spaces for laying the trees, lopping, and hauling them along to the 'drives.' If the drains are parallel to the 'drives,' the trees would have to be dragged across them, and this would throw down the soil of the sides to the bottom of the drains. The drains will require to be cleared out to their full depth at intervals, as they get rapidly filled up with leaves, small branches, etc., and often overgrown with vegetation; as surface drains

only, they cannot be left too open and free from all obstructions. When draining is completed, the land must next be prepared by (5) *digging, trenching, ridging, ploughing*, etc. The preparation of the soil, or rather the mode of doing this, depends altogether upon circumstances. In wild and waste lands, as commons, heathy or moory lands, or steep banks, and in soils greatly encumbered with fast-set stones, boulders, and small rocks, and where the soil is very thin and poor, and on the surface much broken and irregular, the regular working or preparation of the soil is out of the question, and all that can be done while planting the trees, 'slit-planting' being adopted (see 'Different Modes of Planting Trees'), is to break up at the same time the soil near the place where the tree is to be planted, this being done by the implements used, or by means, where more effectual work is wanted, of the spade, fork, or the mattock or 'pick' in very difficult and obstinate land. It is only in lands of a better quality that thorough digging and trenching, and in regular soil that ploughing or grubbing by horse power, can be done. The most effective, although it is the most costly, is *spade trenching and subsoil stirring by the fork*. This should be done in soils of good quality, especially if the early maturity and healthy development of the trees be desired, or where the trees are very valuable, as the oak. It is, as above said, a costly operation, but the expenses will be reduced considerably by taking a crop from the trenched soil before the trees are planted. The best paying crop, for the majority of good soils, will be root crops, such as mangold-wurzel, carrots, or parsnips, having long tap roots which will open up the soil and prepare it for the reception of the young trees; or if potatoes be preferred, a crop of these may be taken from the land. It is in exceptional cases that the system of preparing the soil by *hand trenching* is adopted, and even in some of these it may be found on examining the soil closely that it will not be required. The wide range of implements at the command of the forester will often enable him to break up and put even some of the worst lands nearly—such as heathy land with a thin, poor, generally sandy soil, with a subsoil of gravel or of pure sand—into something like a good working

condition, better, at all events, than can be effected by the slow process of slit-planting. Of the implements here alluded to, probably one or other of the many forms of the grubber may be found to be the most efficient, and this in conjunction with a paring plough to break up the surface sward, which will probably be found useful on much of the land of this heathy moorland class. Where the soil is anything like what is usually put under arable culture, it may be prepared for planting either by the plough or the grubber, or by both used in conjunction. Land of this sort, so prepared, should have a crop—say of oats—taken from it before the trees are planted. In some cases, two crops may be required to bring the soil into the best condition for the tree planting, especially if it be heavy soil. The first crop may be oats, and the second, after the soil is well worked by the plough and grubber to clear it from weeds, a root crop, as Swedish turnips, mangold, beet, carrots, or parsnips, or potatoes. It is scarcely necessary to say that the manuring which the soil receives for the root crop, if that is desired to be a paying one, will be of great service to the plantation trees. The system of preparing the soil, to which the name of *ridging* is given, is adopted in the case of those soils which may or may not be of good quality, the object being to render them deeper, in order to give the plants a good bed for root-hold and development of rootlets. It is prepared by working the land in breadths, say, of six feet, and taking up the soil of each alternate breadth and throwing it on the top of the breadth which intervenes, thus deepening the soil to the extent of twice its nominal depth; but more, in fact, than this depth is thus obtained, inasmuch as the breadth which receives the soil should, in the first instance, be dug itself before the other soil is thrown on it, and this digging will raise the first soil. Digging always opens up the pores or particles, so that it may be said, in one sense, to expand. This may be proved by trying to get the soil into any hole from which it has been taken. It will be found an impossibility, unless it be tramped or pressed down, there being always a surplus of soil left after the hole is filled. This is one of the great benefits obtained by digging, or otherwise

thoroughly working the soil. In an extensive plantation, such a variety of soils and of land surfaces may be met with, that all or nearly all the different methods of preparing the soil above noticed may have to be used, and considerable judgment will have to be exercised by the forester in deciding which will be the best to adopt under certain circumstances, or whether a modification of more than one may be advisable.

In finally setting out the prepared land, the position or place for the *drives or roads* should be decided on, and the lines staked to show the direction in which they are to go. Where the plantation is on ground much broken up, or in such parts where this is the characteristic of the land, some very picturesque points often occur. A forester possessed of taste will take care so to arrange his drives or roads, that while he does not sacrifice the main object of utility, he will at the same time take in those points, or secure, as he may often do, some extensive and striking view at certain turns or changes in the line of plantation or of breaks in the ground. Plantations are often placed at points not very distant from the mansion, so that healthy and pleasant walks may be obtained at no great personal fatigue. To make the drives all the more attractive to the proprietor and his family, seats with rustic timber work may be put down at the points commanding some extensive view or picturesque point of the land. The drives are generally made in very simple fashion, but little attempt being made at carrying out anything like regular road work. If a covering or rather bottoming be given, it will be small stones or gravel; but in dry soils all that is done generally is to cut out the drive in the soil somewhat like a wide, open, shallow trench, with its surface well rammed or beaten down. In wet, clayey soils, however, a little more care is demanded in finishing the surface. This is generally made higher at the centre than at the sides, to admit of the water draining off on each side to an open drain cut there—the upper side drain communicating with the lower side drain by cross drains or channels, with sides well rounded off to meet the drive surface. If the drive be cut or branched out on the side of a hill or rising bank, in place of making the drive in heavy soils in the above

way to drain to both sides, it is often made to drain from the upper to the lower side by giving the surface a slope in the direction of that of the bank. The drives, at the points where they lead out to the general lands of the farm or estate, should be provided with the usual form of swing gate with curved guard fence, admitting of exit or entrance of passengers, but preventing that of cattle, sheep, or dogs.

Periods for Planting.—Whatever be the period of the year chosen for the planting, one point should if possible be secured, namely, the getting the young plants into the soil as rapidly as possible after being taken up out of the nursery bed, so that they will be got into their final place of deposit as fresh as they can be. Hence the value of the plan which, in a succeeding paragraph (see ‘Plantations for Boggy Lands’), we have recommended, of having on the estate where planting on an extensive scale is contemplated a special ‘nursery,’ in which to raise the plants of the various trees which it is designed to have in the plantation. This, if not the most economical,—but with good management it will be so,—will certainly be a system possessed of many advantages, in addition to the one just noticed of having the plants fresh and free from the damage almost inevitably dependent upon or caused by transportation from a distant nursery. Thus the forester, starting from the very beginning of operations, can select seeds, prepare the soil of the nursery, and watch through all their early stages of growth the various kinds of plants grown. The periods usually chosen for planting out are the autumn months and the early spring ones. But it is often done in mid-winter, care being taken not to plant them out at a time likely to be followed by or during a frost. But, in truth, the time for planting out has rather a wide range, being, according to one authority, ‘all the intervening time’ between that period when the bud at the top has opened or is about to open and when it has closed, care being taken not to touch the plant till this bud has ‘quite closed, and not to move it after it has opened.’ If the autumn months are chosen, October and November are those in which generally the planting is done; but it will be the safer plan to get the planting done in September,

so that they may have got a pretty fair start, and a hold of the soil, before the cold and wintry weather sets in. The hardier the trees, the later may be the period for planting. The oak and ash, for example, may even be planted as late as December. If the spring months be chosen, the planting should not be extended beyond March, certainly not later than the first week of April, beginning, say, with the later days of February. These opening months are the best for planting the deciduous trees of a less hardy species, and for evergreens, which have too much leafage to withstand the heavy winds and gales of the late autumn and winter months.

Condition of the Plants for Planting.—We have said in last paragraph that the first essential in the condition of the plants is, that they be as fresh as possible, the least interval between the taking up out of the nursery and putting them in the plantation bed being secured. The next condition is that the plants be not injured or damaged, either in root or stem or leafage, by transportation. But it is right to state that while these essentials will be best secured by having a nursery near the plantation, damage, if not given by transportation and all its rough usages, may be so by the careless way in which the plants may be taken out of the nursery and handled between that and their final planting, and also, indeed, during the actual planting itself. In those operations the utmost care and delicacy in handling the plants are essential. The best condition for the plant to be in, after being lifted from the nursery bed, is that in which a plant grown in a pot or tub would be when this was inverted carefully to release the plant. This, under these circumstances, would leave a large mass of soil surrounding, adhering to, and mixed up with the roots and rootlets of the young plant. This should be the condition aimed at; and every care should be taken to remove the plants thus possessed of root-soil to the plantation without disturbing or destroying this, and also keeping the stem and branches whole and unbruised. In removing plants from the nursery bed, the larger they are, the greater the care demanded for the operation. The forester will see that this work, as well as that of planting (see par., ‘Different Kinds and Modes of Plant-

ing’), be entrusted only to experienced hands: it will be money ‘ill held in,’ as the phrase is, to exercise economy in this department.

Order, Disposition, Number of, and Distance between the Trees in the Plantation.—While some authorities insist upon the trees being planted out in a certain unvarying order or disposition, and with fixed distances between them, it is obvious that, advantageous as this regularity is, there will be circumstances which will prevent its being carried out. As regards the disposition or order in which the plants are placed in the soil, that which is very generally followed is the square, this being obtained by the intersection of lines, as $a a$, drawn parallel to and equidistant from each other (see figs. 1 and 5, Plate 63), with other lines drawn at right angles to them, as $b b$; the intersecting points are c, d, e, f , and at those points the trees are planted. All the lines, it is scarcely necessary to say, are equidistant from and parallel to each other, the distance in both sets of lines being the same. But while this is the case as to dispositions most easily set out in the ground, it does not admit of the greatest possible number of trees being planted upon equal spaces or superficies of ground. This can only be done by adopting the system of planting in hexagons, as shown in figs. 2 and 6, Plate 63, the trees being planted at the points of the hexagon $a b c d e f$, and one in the centre at g , fig. 6, where a central point is obtained by drawing the diagonals $b c, a d$, or $b e, a d$, these intersecting as shown. No matter how numerous the hexagons are, they all fit into or dovetail with each other, so to say, so accurately, that no space is lost, while the distances are equal throughout, and the margins or outer borders round the fences work up to these, and finish off in a perfectly straight line, as shown in fig. 7, where the fences are indicated by the lines $h i, j k$, the terminating points of the hexagons making with these lines a series of triangles, as $f c l, l m n, a c o, o p q$, these being the points at which the trees are planted, giving the disposition as in fig. 9, showing upper and lower fences. Some have recommended the pentagonal system of planting out, as in fig. 8; but while the lines of these are even more difficult to lay down than those of the hexagon, figs. 2, 6, and 7, and infinitely more

so than those of the square, fig. 1, they do not fit in as do the hexagons. The choice for *regular* disposition, then, must lie between the 'square' and the 'hexagon,' often, but erroneously, called the 'quincunx,' which is, in fact, but a number of squares disposed in diagonal order, as in fig. 10, Plate 63; but in a plantation of large area there will be kinds and conditions of soil in which no regular disposition can even be attempted to be carried out, the plants being put down wherever they can best be placed, all that can be done being to keep the required distances between the plants as regular as possible. As regards the *distance between the plants*, this also varies according to circumstances, but the average distance adopted is 4 feet. The *number of plants to the acre* is obviously dependent upon the distance between them. Thus, in regular planting in squares or parallel lines, a distance of 4 feet gives 2722 to the acre. At a distance of 3 feet, which is exactly a square yard occupied, the number of plants to the acre is the same as that of square yards, or 4840; at a distance of 3 feet 3 inches, 4124; 3 feet 6 inches, 3555; 3 feet 9 inches, 3097; 4 feet, 2722; 4 feet 3 inches, 2411; 4 feet 6 inches, 2151; 4 feet 9 inches, 1970; 5 feet, 1662; 5 feet 6 inches, 1440; 6 feet, 1210; 6 feet 6 inches, 1031; 7 feet, 889; 8 feet, 680; 9 feet 6 inches, 482; 10 feet, 435; 11 feet, 340; 12 feet, 302. Of distances under 3 feet—2 feet 9 inches, 5760; 2 feet 6 inches, 6669; 2 feet 3 inches, 8604; 2 feet, 10,890. These distances and numbers are calculated for the method of setting out in squares with parallel lines. The following shows the increased number of plants per acre which can be put down on the hexagonal plan, fig. 7, Plate 63, taking the above measurements in the order as given. With a distance of 3 feet apart, in place of 4840 as given above, for the square plan of setting out, the number on the hexagonal plan will be 5588; 3 feet 3 inches, 4765; $3\frac{1}{2}$ feet, 4112; 3 feet 9 inches, 3585; 4 feet, 3148; 4 feet 3 inches, 2787; 4 feet 6 inches, 2491; 4 feet 9 inches, 2234; 5 feet, 2015; 5 feet 6 inches, 1667; 6 feet, 1399; 6 feet 6 inches, 1193; 7 feet, 1028; 8 feet, 787; 9 feet 6 inches, 558; 10 feet, 503; 11 feet, 416; 12 feet, 350. Of distances under 3 feet, the fol-

lowing:—2 feet 9 inches, 6669; 2 feet 6 inches, 8042; 2 feet 3 inches, 9992; 2 feet, 12,592.

The table, of which we have given several figures suitable for certain distances, generally in use for calculating the *number of trees per acre at given distances*, is often found to give erroneous results in cases where the trees are placed or desired to be placed at equal distances from each other, inasmuch as the table is calculated on the supposition that the trees are planted so as to form squares, as in the diagram, fig. 3, Plate 63. Now it will be observed that while the distances along the sides of the squares in any direction, as in that of the line *c f*, or the line *f g* at right angles to it, are all equal, as *b d*, *d c*, the distances, when measured in the direction of the diagonals, or parallel to *g 2*, *a*, or as in the small square at the left-hand corner of the diagram, fig. 3, Plate 63, are not equal to the distance of a length of one of the sides, as *a b* or *a c*. The land so planted is therefore 'not equally taxed,' to quote the words of a writer on this subject. Hence the proposal to plant trees, as already described, in the form of hexagons. This was first done, and the principle explained and illustrated, and contrasted with the square method, in a paper from which we have taken the illustrations in figs. 3 and 4, Plate 63, by Mr. James Craig, land surveyor, Lochwinnoch, given in the *Transactions of the Highland Society of Scotland* in July 1855. By adopting the hexagonal plan of planting (fig. 4, Plate 63), a given space of ground will contain a greater number of trees than the same space would admit of if planted on the square system, figs. 1 and 3; and all the distances will be equal, all the angles being equal, as shown by the lines *a b*, *a c*, *a d*, etc., in fig. 1, trees being supposed to be put down at the points *b*, *c*, *d*, *j*, *f*, and *e*, and also in the centre of the hexagon at *a*. Thus, as Mr. Craig points out, supposing the distance between the plants is to be 3 feet in the square system of setting out, the distance between the rows will also be 3 feet, giving six rows in a certain space; while by the hexagonal method, as in fig. 4, the distance between the rows will be 2 feet 7 inches, less fractions, and seven rows in place of six will be

got in the same space,—a clear gain of one-sixth. Again, if at 3 feet apart on the square system, 4840 plants will be used, on the hexagonal, 5588; thus showing to how much greater an extent the land is utilized by the hexagonal than by the square system. The following is part of a table given by Mr. Craig, so far as 'imperial' acreage is concerned, showing the exact geometrical distribution of trees per acre on the hexagonal system in fig. 4, Plate 63:—

Distance in Feet.	Number per Imp. Acre.	Distance in Feet.	Number per Imp. Acre.
1	50,800	12	349
1½	22,355	12½	321
2	12,575	13	297
2½	8,047	13½	275
3	5,588	14	256
3½	4,016	14½	239
4	3,143	15	223
4½	2,483	15½	209
5	2,011	16	196
5½	1,662	16½	184
6	1,397	17	174
6½	1,190	17½	164
7	1,026	18	155
7½	894	18½	146
8	785	19	139
8½	696	19½	132
9	620	20	120
9½	557	22½	103
10	502	24	87
10½	456	26	74
11	415	28	64
11½	380	30	55

Different Kinds of Planting.—Properly speaking, the operation ought to be designated transplanting, this being in fact what it actually is. In gardens, one kind or method of transplanting is almost universally adopted, that is, by the well-known process of dibbling; but in tree planting, as the soils are not uniform either in quality or in surface peculiarity, like what garden soil generally is, and which, therefore, admits of a uniform plan of transplanting being carried out, the methods of transplanting are somewhat numerous. The first, and what may be called the rudest or most elementary, is in its general features like the garden dibbling process, and is known as 'slit-planting.'

There are different kinds of 'slit-planting,' and each has its own particular implement. For heathy or moory land, the simplest, most easily performed,—one man only being required,—cheapest, and what may be called the rudest

method, is that done by the aid of an implement or tool in form and principle of working almost identical with the garden dibble. The moor or heath slit-planter is, of course, much larger than the garden dibble, being some 15 inches long in the dibble part or prong, which tapers from a diameter of some 3 inches nearly to a point. The dibble is not straight, but slightly curved along its whole length, and is fixed in a shaft or stem some 3 feet long, the upper end of which has a cross handle or bar to give the workman sufficient leverage. The tool is driven forcibly into the soil, the handle being at the same time depressed, so as to loosen it and allow of an opening being made, into which the root of the plant is inserted, the plant being fastened by a stamp of the heel of the man. A man can plant some 3000 plants a day, or an average nearly of an acre; but this depends upon the soil, which regulates the distance between and the consequent number of plants in an acre. For sandy and light soils, where the surface is nearly free, or has only a thin covering of herbage, a different form of dibble is used, known as the 'diamond,' from the shape or section, which is triangular, some 4 to 5 inches in the side at its upper part, and tapering to a point. The mode of using it is very similar to the last-described tool. The spade, old or partially worn out, so as to have a very sharp edge, is used for different kinds of 'slit,' or, as it is often called, 'cross-cut' planting, chiefly on grass lands, or those covered with a sward more or less deep, or thick and close and tough in texture. One method very commonly used is to make two cuts like the form of the letter T, inserting the spade, and by depressing its handle so to open up the cuts in the soil sufficiently to admit of the roots of the plant being inserted, which when done by an assistant,—a sharp, intelligent boy may often with advantage take the place of a man,—the spade is withdrawn, and the elasticity of the cut surfaces enables the rootlets to be grasped more or less firmly, and the operation is finished by the workman pressing the cuts down with his foot. These methods, especially where the soil is covered by a grassy sward, have the great defect that a firm hold of the soil by the roots of the plant is not always

secured; indeed, in some cases it is difficult to know whether this has been so or not. The consequence is that the plants may either die for lack of proper nourishment, and from not being root-fast,—an essential point in planting of all kinds,—or if they live, they do not develop healthily or quickly, many of them getting moved, and some, being so loosely set in, are blown out by high strong winds. In all cases where at all possible, the soil itself should be reached by the tool or implements employed, and all the better if this be moved or stirred at the same time, even if this be carried out only to a limited extent. To secure the advantages here referred to, a modification of slit-planting as follows may be adopted. The sward is cut clean out to a diameter, say, of a foot or so; this is to be laid aside with the grass surface downwards, and while in this position divided by the spade into two equal parts. The workman with the spade then loosens the soil within the circle exposed by the removal of the grass sward and turf, so as to give as great a depth as possible, in the limited time at his disposal, of broken up or pulverized soil, in which the plant rootlets are extended as nearly in their natural position as can be attained. The turf is then taken up, one half being placed at one side of the hole, the other at the other side, their two edges embracing the stem of the plant. The turf may be pressed down with the foot, so as to give the plant a firm root-hold. Where the plants are on the outside of the plantation, and therefore exposed to the winds, it is considered a good plan to insert them in the soil with a bias or inclination towards the wind or quarter from which it blows. This position will enable the plants to resist better the force of the winds than if placed vertically in the soil; and by the end of the second season they will have been blown, as it were, back into their vertical position, and in such a condition of strength and firmness of root-hold that no fear need be entertained as to their being blown out from or loosened in the soil, or blown back the reverse way. There is another method of slit-planting, which may be called the L method; this the reader will find described in the paragraph, ‘Plantations for Exposed Lands.’ The method of slit-planting last described has a close resem-

blance to the next method, known as ‘pit-planting,’ which is the best and most certain of all methods of planting in ordinary ground not specially prepared by digging, trenching, ploughing, or grubbing. The method is very simply and easily carried out, involving, however, more labour than the modes of slit-planting just described. The pits are dug at distances from centre to centre corresponding to the distance at which the trees are to be planted; they may be either square or circular in plan; generally they are dug square, the sides varying from 18 inches to 2 feet, and depth from 15 to 18 inches. The pits are dug either in the late spring months, as April or May, if the planting is to be done in December or January. If planting is to be performed in the spring, the pits are dug at the end of the summer or the beginning of autumn preceding. This is done in order that the soil taken out of the pits, and which is laid by the side of the pits, and the soil at sides and bottom of the pit itself, be weathered and pulverized by being exposed to the frost, etc., during the winter. When the pits are opened, the turf and grassy sward are cut up into small pieces by the spade, and thrown into the bottom of the pit, to be weathered throughout the autumn and winter months. When the period of planting arrives, a man and a boy are set to work. The first thing the man does is to break up and loosen the decomposed turf and weathered soil at the bottom of the pit, and then work it about till it becomes loose and friable. Wet weather, or if there has been much rain previously, will obviously be a bad time to prepare the pits for planting. A portion is then taken out in order to make a seat for the plant. This the boy inserts in the pit, holding it vertically and firmly, while the man covers the rootlets gently with the pulverized mould at the side of the pit, the boy moving the plant vertically up and down, so that the soil gets worked in between the rootlets. The soil is then filled wholly in, and the man then leaves the boy to fix the plant firmly in by treading with his feet, while he proceeds to prepare another pit.

Although ‘pit-planting’ possesses many advantages over the other systems described, it requires to be carried out with judgment. For example, the plan almost universally adopted of digging

the pits, and allowing them to be 'weathered' by exposure to the atmospheric influences during a large proportion of the year, may be, and is under certain circumstances, a plan which will likely in its results defeat the object in view. Thus, if it is deemed better for one class of soil than another, that soil is a heavy, adhesive clay; and at first sight it is perfectly correct, for weathering does more effectually than any other known means reduce the heavy, cloddy soil to what is known as a good 'tilth' or pulverized state. But there is weathering and weathering; and whether that is the best plan which makes a pit or hole to allow the soil taken out and laid aside, as well as the sides and bottom of the pit itself, to be weathered, is at least open to doubt. True, it is good for the weathering of the soil taken out and laid aside; but what of the pit itself? A good authority, and an able as well as a prolific writer on agricultural subjects, puts the matter very pointedly when he says that the result to the pits and from the pits is what certainly is not wanted,—namely, in consequence of the rain and snow getting access to it for so many months, the bottom gets into the condition of a regular puddle of moist clay, often, indeed, forming small stagnant pools of water, or a semi-fluid of weathered clay and water. And although he says that they may appear dry when the planting is carried out, they may not be, and often are not, really so; while, after the soil is put in, it is at the best so loose that the pit, to a certain extent, may be said to exist for some time, thus giving access to rain, which cannot pass through the retentive clay of the bottom, but remains there, to act most deleteriously upon the young plant, struggling to 'establish itself in life,' which in many cases it does not succeed in doing, dying out soon and rapidly. This authority, therefore, recommends what certainly appears to us to be the better plan of preparing such soil for planting, and that is to turn over the soil with the spade or grub it up with the fork to a good depth at the points, and for some distance round where the trees are to be planted. This, being done in early autumn, will allow of the soil itself being weathered in its natural position and condition, and be fitted to receive the plants in spring. Where the land has been put under what may be called ordinary modes of preparation,

as ploughing or digging and trenching, the planting is done by opening up the ridges—in the case of land so surface finished—with a double mould-board plough, or by opening a furrow on flat land with a trenching plough, the spade being used to finish the planting with, or it may be used alone to make the holes for the reception of the plants; but in all cases the greatest care should be taken to give ample space for the rootlets, and to see that the soil be well pressed in, so as to give the plants a firm root-hold. As to the work which may be done by the different methods now described, it may be reckoned that in ordinary 'slit-planting,' where only one man is required, he will be able to put in on an average from 3000 to 3200 plants a day. In the T and L methods, or what is otherwise called 'cross-cut planting,' the man and boy, or the two men required for this method, will put in between 2000 and 2500 up to 3000 plants a day, according to the nature of the soil and its grassy covering. In 'pit-planting,' the man and boy should, on an average, plant from 300 to 400 a day, according to the condition of the soil, plants, etc. The number of pits which a man can dig to receive the plants may be set down at 100 a day, more or less, according to circumstances.

After Treatment of Plantations—(1) *Weeding and Clearing of the Ground*; (2) *Keeping of Drains in Good Order*; (3) *Pruning of the Trees to aid the Formation of Selling Timber*; (4) *Thinning of Plantations.*—(1) However carefully all the points which have occupied our attention, as discussed in preceding paragraphs, have been carried out, it is obvious that upon the after treatment of the plantations depends the ultimate profit which ought to be realized from them. For if the details of these be so far neglected as to be partially and inefficiently done, or altogether overlooked, as in some instances has been the case, the result will be the partial or nearly total loss of all the preceding work. There is such a thing as navigating a vessel with the utmost degree of care on the open sea, or through tortuous, difficult, and dangerous channels, and bringing her up to within actual sight of port, yet, by carelessness at the last moment, wrecking her on some rock near to, or driving her up against the very stonework or piles of the harbour. And just so with planta-

tions, and, indeed, many other departments of farm work. Work should not be praised till absolutely completed. These remarks are not unequalled for, in view of the fact that in a few—or shall we say not a few?—instances the preliminary work is done excellently well, but the later stages wofully and wastefully neglected, or considered, apparently, to be a matter of such trivial moment that it may be safely overlooked altogether. Where this turns out to be the ultimate result of the preliminary costly and laborious work, it requires no elaborate statements to prove that the wiser course would have been to have refrained altogether from entering upon the work of forming the plantation. If, then, the most satisfactory results are desired to be obtained from the formation of plantations, it will be essential to see that the details of after management are as carefully gone into and executed as were the preliminary details already described, and which we have supposed to have been thoroughly and honestly attended to and carried out. The first of the details of after treatment of the plantation is the *weeding and clearing of the soil between the plants*. If the reader will consider the subject of 'Weeds,' and the way they act injuriously upon the soil, and by consequence upon the plants or crops which grow upon and derive their nourishment chiefly from it, he will see that they not only take from the soil—and that in many cases in a much greater proportion than the regular crops or plants—the constituents which nourish the plants, but, by overcrowding the space between them, deprive them of the air and light, and, in fact, of nearly all the atmospheric influences which go far to develop the plants and maintain them in full, vigorous, and healthy growth. There is thus a double reason for getting rid of the weeds which infest plantations; and the same remark applies in like manner to all kinds of undergrowth, no matter what they may be. The only plants which ought to occupy the soil are those of the trees, for which, indeed, the plantation was put down,—a very commonplace way of putting the point, but one, with all its important consequences, very often forgotten. In going over the land for the purpose of clearing it from weeds and undergrowths, another important work should be attended to,—*seeing*

to the condition of the young plants or trees. Those which have failed to take root must be taken up and replaced by strong and vigorous plants from the nursery. Those which have not failed wholly, but have not taken kindly to the soil, and are dwindling away, or likely to make but poor progress, should also be taken out; they will never be worth the soil they occupy. Those which have been blown out by winds should also be replaced. In brief, the whole should be carefully looked over, and all defects and deficiencies made good. But while attention must be paid to the keeping of the young tree plants free from the inroads of weeds and all foreign or extraneous growth, no less important is it, although in another direction, to keep (2) *the drains in good working order*. The very form of these, or way in which they are made, together with the conditions under which they are placed, require and demand a more than usual degree of care in keeping them in order; for, open as they are, and liable to have their sides, etc. destroyed or injured by vermin burrowing in or near them, and exposed, moreover, to the fall of the leaves,—a source of filling up which increases yearly with the increase of the growth of the trees,—they very rapidly get filled up. There is perhaps no department of the after management of plantations so neglected as this; the drains are allowed to remain for years without the slightest attention being paid to them, and so completely does this neglect fulfil its work, that many, especially of the smaller or subsidiary drains, are quite filled up, and their very course or position obliterated. If drains are worth putting down,—and they are a necessity,—they are surely worth being attended to, all the more that, as open drains are, as a rule, only admissible in plantations, the full effect of drainage proper cannot be obtained; the greater the need, therefore, to keep up to the highest point such lesser efficiency as they are possessed of. We come now to the important department of the after treatment of plantations, namely, the (3) *pruning of the trees*. While we have shown that other departments are apt to be greatly and sometimes wholly neglected, of this it may be said that danger too often arises, and much mischief is done to the trees, from the overdoing of it. And in view of the evils arising from excessive pruning,

some writers have rushed into the opposite extreme, and counsel foresters not to prune at all, or prune so sparingly that, compared with the old and still generally adopted plan, it may be said that pruning scarcely holds a place in the work to be done connected with the after treatment of plantations. Certainly some very striking examples have been brought forward of late to prove that where trees are let alone,—care only being taken by judicious *thinning* to give them ample space to grow in,—or at the most receive but an exceedingly small amount of pruning, they do remarkably well, and yield abundance of timber. If, however, we closely examine some of the physiological points of trees, and their habits of growth, it seems scarcely possible that the requirements or results looked for in trees, the timber of which is to be sold for industrial purposes, can be obtained without pruning. But there are two kinds of pruning, the good and the bad, under which latter category may be classed over or excessive pruning, as well as careless or bad pruning, by which a tree may be greatly injured, or perhaps totally ruined for the purposes of a timber tree. Pruning should have for its primary aim the encouraging of the tree to throw all its productive powers into steady additions to the bulk of the stem, all top shoots which do not minister directly to this, or, what is worse, are antagonistic to it, being pruned or cut away. Those shoots or leading branches appear at the top of the tree, as just hinted at in the name we have given to them, 'top shoots;' and the object is to preserve that one which decidedly and clearly will form the most direct and natural continuation of the main stem or 'bole' of the tree (the latter term being that which is applied to a tree stem when it attains to and goes beyond a diameter of eight inches; before this it is not reckoned a timber tree or timber, but is known as a 'sapling' or a 'young tree,' the latter being more generally used, a sapling having a diameter of six inches at a height from the ground of four feet). Two shoots often occupy the top part of the tree, and are so nicely balanced as regards condition and vigour, that it is difficult to choose between them as to which is to be cut off and which is to be left. But if these two be tied together, and allowed to remain thus for some time, the 'weakest will have gone by the wall' so decidedly, that choice

will be by no means difficult. As regards the other lower and subsidiary branches not 'leaders' or 'top' ones, there is only a general rule to be followed, which is a safe one, but which requires the exercise of some judgment to carry properly out, and that is, so to prune or cut away that they will grow, forming what may be called a well trimmed or balanced, not a lop-sided tree, having more branches on one side than there are on the other. This is done best by commencing at the top or with the leaders, and gradually pruning downwards, leaving a branch on one side as nearly opposite as possible to a branch on the other side. These form what may be called the successive grades or tiers of branches, and gradually increase in length as they approach the root. The intermediate spaces should be cleared of all branches, as they only draw off the sap which otherwise would go to the nourishment of the bole or main stem. The same should be done with the smaller branches on the leading side grades or tiers. These are the leading points to be observed in tree-pruning; but the best way in which to do them will depend upon circumstances, and upon the skill, judgment, and quick, ready glance of the forester. As regards the best period for pruning the trees, this also is greatly influenced by circumstances, the period which suits one class or kind of tree, and, indeed, the sub-varieties of the class as well, not being suitable for another class; but generally the best period of the year for pruning is when the tree is in its dormant state, that is, when the sap is not flowing, or has nearly ceased to flow, in the stem and branches. Hardwood trees, as a rule, may indeed be pruned almost at any period of the year, although the above rule holds good with them as with the others. The time in the age of the tree at which pruning is best begun varies also with circumstances, but a general rule is from the fourth to the sixth year of their being in the ground.

We now come to the *thinning* or the '*weeding out*' of the trees of the plantation. Just as we have seen that as weeds and undergrowths, crushing and crowding in upon plants, tend to stop or injure their development, so in like manner do trees act upon one another, when, after gaining a certain size or bulk of development, they crowd upon one another. Hence the necessity there is for thin-

ning out trees at certain intervals, so that those which are left standing will be in the best condition as regards space in which to grow and increase steadily and healthily. To thin properly requires the exercise of no small knowledge and judgment, and much also depends upon the disposition of the trees, especially in the relation which the nursing or shelter trees bear, both as regards their number and disposition, to the hardwood and more valuable trees. The kinds or classes of trees forming plantations depend, as we have stated more fully in preceding paragraphs, upon a variety of circumstances; but stated here broadly, they are made up of hardwood trees, varying in class, which are to form the timber-producing part of the plantation, and coniferous trees or pines, which are chiefly, if not wholly, planted to serve as nursing or shelter trees to the above. These nursing trees are disposed in two ways: where parts of the plantation are exposed to high and cold winds, the nursing trees are made to form a belt, of greater or less depth, outside of all, while other nursing trees are disposed throughout the mass of the plantation generally. To deal with the outside belt as regards thinning, this is comparatively easy; but those in the interior ought to bear that relation to the hardwood trees above alluded to, and this so that the valuable trees, being placed at wide intervals apart, have the inter-spaces filled up with the nursing trees, or in some similar disposition, but so that the thinning or weeding out is confined solely to the nursing or coniferous trees. This arrangement (see paragraph on the 'Disposition of the Trees in Plantations') will enable the valuable hardwood trees to be retained on the land for such a period that they will have so far advanced to maturity, and thus be useful for selling purposes when the time arrives at which thinning them out is necessary. If trees other than coniferous be used as nursing trees, in thinning out, care should be taken to cut down or 'weed out' the least valuable first, so that the most valuable will have a longer period to grow, and thus produce a larger yield of useful timber. As regards the time at which and the extent to which the thinning should be carried out, much will obviously depend upon circumstances; but a rule, easily remembered, will be found applicable to cases generally, and

this is, that it ought to be begun so soon as the trees begin to press upon each other, crowding their branches and interlacing them more or less with one another, and to that extent that may interfere with the growth of one another.

Plantations on Peat or Boggy Land.—In the section treating of reclaiming waste lands, we have explained the methods generally employed in bringing under cultivation tracts of those wide ranges of peat or boggy soil which are met with in all parts of the country, but especially in Ireland. But while there are portions of these tracts of peat or bog, and large ones too, which are capable, under proper management, of yielding profitable crops, there are other parts—and in some districts forming, unfortunately, if not the whole, certainly a large proportion of the peat, bog, or moss—wholly unfitted to become agriculturally useful, except at an outlay far beyond that which can be reasonably hoped to pay as an investment. Still, in view of the large, indeed we may say enormous, acreage of lands of this kind—if such they can be called—here and there met with, it seems little better than a national reproach to us to say that nothing whatever can be made of them. There is one use to which portions of them may be put, and usefully so, namely, planting trees upon such portions as can be made solid enough by draining, etc. The trees, even if they do not attain full growth, yield so much timber and smaller pieces in the thinnings, that the amount received will form no inconsiderable item. At all events, it will be got for a very trifling expenditure. There is, however, another advantage obtained from planting trees in those wet mosses, namely, the gradual improvement of the soil itself. This arises from more than one way in which the trees act; in the first place, they draw no inconsiderable amount of water from the peat or bog, and by their branches and leafage distribute it to the surrounding atmosphere; in cases of rain, the same leafage takes up no small quantity, and tends to distribute it slowly and equally for some distance round their boles. The leafage, also, in the case of deciduous trees, dropping to the ground gradually, forms a species of mould, and even in the case of pines there is no inconsiderable amount of vegetable matter shed from

them on to the soil. Further, this soil, as it is gradually formed, is ameliorated and improved by the shelter which the trees afford. Thus, in course of time, when the trees begin to be removed, the peat will be found to be of a character very considerably changed for the better, to such an extent that by the processes elsewhere described, part at least, if not the whole, which has been under plantation may be prepared to bear cropping in the usual way.

In preparing the land for the plants, the first process through which the peat, bog, or moss is to be put is drainage, which is the first essential in the preparation of land of this kind, no matter what may be the ultimate objects in view, cropping or otherwise. The great arterial drain or outfall will be large, its dimensions depending upon the circumstances of the soil, locality, etc. There may also be great difficulty in cutting it, on account of the watery, semi-fluid stuff through which it passes. The water may collect so rapidly that it cannot be carried away with sufficient quickness to enable the proper depth to be obtained, and to form the sides, which should slope outwards very considerably. These, under the action of the water in the outfall drain, may slip down in lengths, or gradually subside into the trench. These and other difficulties inherent in the situation may be, and generally are, overcome by hard work and ingenious expedients; but in some few cases the first step rendered necessary will be to get rid of the superfluous water settled round the edges of the moss, or spread out in pools over its surface. Some districts are so bog-infested, that the patches and masses are so numerous that it is difficult to get land sufficiently firm to form a road, or rather path, by which the bog may be traversed. In some cases the peat or bog may be comparatively isolated, being surrounded with ground more or less solid. In this case an outfall drain may be cut from the margin of the peat to the point of final outfall, some rivulet, river, or the sea. If this length be too great, it may happen that another bog lying at a lower level may be so hopelessly bad that the addition of the drainage water of the higher bog to its contents cannot make it worse. Suppose, however, that the main arterial drain or ditch—which is to traverse the

whole breadth or length of the bog, or which, if circumstances compel it, may run along the side of the bog—has been cut; although it is expedient to lose no time in cutting throughout its whole length, it may be expedient to cut but a comparatively shallow trench in the first instance—of course the full width it is to be when finished. This will enable the surface water to be carried off, and tend to consolidate the land somewhat. Subsidiary drains are then to be cut at right angles to the main drain, these being placed at distances from each other varying according to circumstances, condition of the bog, etc. The plan of cutting the full depth of the sub-mains by degrees only will be found a good one, for the reasons stated above in reference to the arterial drains, as the surface water will then be led off, and the bog considerably consolidated. Next to be cut are the smaller or cross drains falling into the sub-mains. These are of still smaller dimensions than the sub-mains. We have now the bog provided in various directions with drains or channels of varying depth, into which the surface and under-soil waters drain and percolate. But it must not be supposed, although there is thus a sequence in the operation, that as regards time they are all to be pushed on and finished at once, preparatory to planting; on the contrary, long intervals may elapse between the cutting of the larger drains and the smaller, these varying according to the wetness of the peat, and the rapidity with which it is drained and dried. The great object is to have this done as effectively as is possible under the circumstances, so that an upper crust of what must be called soil, but which, at the best, will be little worthy of the name, be formed. This will, by having its pores opened more and more as it dries, allow the atmospheric influences—as sun, light, air, frost, etc.—to work upon it, than which there are few better agencies for ameliorating any soil, no matter what its nature may be. It is not easy, if indeed it be safe, to set down dimensions under circumstances which are perpetually changing, or rather in which those of one case are very different from those of another. But the following, if they do not give the actual sizes of drains, etc., to be cut in the bogs, will give—what is of some value—the relative pro-

portions. Thus, if the main drains or outfalls are 6 feet wide at top, 2 at bottom, and depth 5 feet, the sub-drains will be 3 feet wide at top, half this at bottom, and 3 feet deep. The smaller drains may, if necessary, be about a third less. If to these a larger outfall is added, this may be from 7 to 8 feet at top, 3 feet or 2 feet 6 at bottom, and 5 to 6 feet deep. All the drains having been completed, and the boggy surface brought into something like a solid surface, quaking and treacherous at the best as it will be, the peat taken out in cutting the drains should be wheeled on the bog to be planted,—planks as broad as possible will be required to support the barrow, and prevent its wheel from sinking into the yielding bog,—and spread uniformly over the surface, yet as lumpy as possible; this being done in autumn, so that the winter's frost, etc. may act upon it, and sweeten and ameliorate it. As the bog in the case we are supposing will be of the poorest, crudest, sourest quality, containing little or nothing at all calculated to promote and keep up the growth of the trees which are to be planted in it, it will be a good thing to take advantage of the time during which the drainage, and gradual and often, as before said, very slow drying of the bog, to make an abundant supply of compost, to serve as a soil, or species of soil, in which the trees are to grow. As a basis for this, bog soil will form a good one, especially if it has been well weathered by exposure to the air on dry land; or bog soil from a bog of better quality, or from bog land which has been under cropping for some time, may be used. If clay can be had, it should form part of the heap, and lime and salt; everything which can decay, as weeds, sea-weeds if at hand, and the thousand and one things which lie about a farm—rendering it too often untidy and disorderly in look—may be added to the compost heap. The more varied its contents the better, the great object aimed at in its formation being to secure a manure as nearly approaching to farm-yard dung as possible—the ‘universal manure’—and therefore containing all the constituents of plant life. According to the nature of the bog, the special substances added to the compost heap will vary. Lime is scarcely ever present in bog soil, especially of the

poorest quality, and this when added to it tends to reduce its acidity; and so also are the other constituents wanting, as the analysis of the bog soil will show, and which ought always to be taken, and which will, or should if possible, be supplied to it by adding special substances to the compost heap, such as clay or marl, salt, etc.

The kind of trees to be planted is a matter for most important consideration, considering further the very peculiar character of the soil which has to bear them, a soil in itself so destitute of the elements of plant life, that even when these are partially supplied—which, at the best, can only be hoped for—by the addition of compost (see paragraph on ‘Compost Heaps’), or of some substance such as clay, the trees will be carrying out for a long time a ‘struggle for mere existence.’ In selecting trees, several things have to be considered; if the object be to make the bog available for growing crops by preceding these by trees, which alone seem to possess the advantage of producing something from the soil,—which otherwise, as stated at the commencement of this section, would be utterly useless,—then the object should be aided by selecting trees which come to maturity in a comparatively short time, such as the poplar, the black Italian being the best. The next point to be considered in selecting the trees is their capability of resisting or overcoming the cold tendency of the superabundance of water at the roots and rootlets, by themselves being of such habit of growth as necessitates and enables them to take up a large portion of the moisture in the soil, and thus tending to improve its condition materially. Amongst the suitable trees of this class is the willow and the native Scots fir (*Pinus sylvestris*). The former is specially adapted for wet, over-moist soils, and when a proper kind is selected—such as the White or Huntingdon—to be grown for timber, not for basket-making purposes, it forms a handsome addition to the look of the plantation, and affords, like the poplar, a timber for which there is such a growing demand that it may be considered a remunerative tree to plant. The larch has been so long and extensively grown, owing to the great demand for its timber for railway purposes,—a demand, however, lessening rather than increasing,—that it forms a

large proportion of nearly every modern plantation; but the tree has such a liability to be attacked by disease—acres many a one having been destroyed—that in many cases, even in soils and localities well adapted for their growth, proprietors are now becoming chary in planting it, substituting others,—such, for example, as the poplar, already referred to. It is a tree certainly not adapted for over-wet, cold, and poor soils, such as the bogs we are now considering, as its habit of growth does not admit of its drawing up from the wet soil large supplies of its moisture; and when planted in such places, it is necessary to start the plants in a good rich soil, a small portion of which is put into small pits dug in the bog at the regular intervals required to fill the land with so many to the acre. This soil affords nourishment to the young trees when they require to make a good start, and brings them up to that point when they can make the best of such soil as the bog affords, which by this time will be considerably improved by the agencies at work, after plant life begins to appear upon it, and which we have already noticed. One great advantage to be obtained from the presence of larch trees in bog soils is that the droppings from the tree of leaves, etc., change the soil on which they fall into a very rich decayed vegetable mould or humus. All trees do this more or less, but the larch yields, perhaps, the richest products in this way. Whatever be the kind of trees, then, selected for planting, regard must be had to the various points we have now indicated. Another favourable thing for the plantations will be shelter; bogs, unfortunately, are so placed that shelter from some rising ground near them is but seldom obtained, so that the winds have an unbroken sweep across them. The trees selected should be so disposed that the hardiest ought to occupy the position of 'nursing trees' to the more tender varieties in the interior; and if the prevailing wind be accurately noted, a good deal of shelter will be obtained by judicious selection and planting of such nursing trees. It would pay in many instances to put down an outer belt of quick-growing, well-leaved trees, not so much with a view to obtain timber from them, as to serve as shelter to the timber trees inside. In bog lands, a belt of willows might be the

best to use in such cases; it is of rapid growth, does well in over-wet soils, and if allowed to occupy the ground only till the inner trees are well developed, if much solid timber be not got from them, they will have yielded a fair supply of 'wands' for industrial purposes.

We now come to the planting of such trees as have been selected. And here we would remark that, as a rule, the art of transplanting is little understood by a great many who undertake it. Many of the failures in plants not 'coming forward' may be set down, not to the many causes which are named, but to the bad way in which transplanting has been done; we should be inclined to say, in the proportion of three instances out of every five. This stricture applies to all transplanting, including that of trees. To ensure successful transplanting, more than one point has to be considered. The first, if not the most important of these, is to have the plants as fresh and full of sap as possible. To secure this, where bog planting is contemplated, there will be ample time afforded by the preparation of the land to form a special nursery on some adjacent part of the property, in which to grow plants from seed. When seedlings are sent from a distance, however carefully packed and quickly transmitted by rail,—the first may be got, but the speedy 'delivery' will *not*,—the plants cannot possibly arrive at the ground where they are to be planted out in anything like that condition necessary to give them all the chances of taking to the ground kindly and quickly; at all events, their condition cannot be compared to that of plants brought from a nursery near at hand. One cannot ensure the best weather for transplanting, and the result often is that plants, put into the ground in a condition already half deprived of their natural juices, have for the first periods to struggle for life; whereas a fresh, vigorous plant, not crushed, bent, and distorted, taken from a nursery near at hand, being placed in the ground properly, is in a condition at once to strike its tender rootlets into the soil; and should that be deficient in moisture, the plant has a good store of its own sap to aid its taking root. Many other advantages will be found to arise from having a nursery to rear plants from; these are so obvious that they need

not be named here. The trees or young plants selected for transplanting should be the best and shapeliest in the nursery, care being taken not to have them too high, as they are apt to catch the wind too readily and to be loosened in their hold on the ground, and thus to derive a twist or set which must be retained to the end, and will greatly deteriorate the value of the timber. Some limit the height in case of larch to 20 inches, but if the bog be exposed to very high winds this is too great; and plants lower, but thicker in the stem, should be preferred, the height being from 15 to 17 inches. The height of Scots fir (*Pinus sylvestris*) about 10 inches, which will not admit of being much lower than this. Willows are propagated by cuttings taken from two- or three-year-old trees; they should be cut about two feet in length, and have rather less than half their height out of the ground. In point of fact, so readily does the willow take to soils, especially moist ones, that cuttings or slips from much older trees may be set, and they will rapidly begin to shoot out branchlets and leaves. They would thus very soon form nurses for the slower-growing inner rows. But a great deal of the resisting power of a young plant to the force of the wind depends, perhaps, as much upon the way in which they are transplanted as on anything to be gained by a mere change in the height of a few inches. Again, due regard should be had to the direction of the prevailing and strongest winds, and that the rows of plants be so placed in relation to this that they will be in the best possible position to resist the wind; and when placed near the margin of the smaller drains, as they must necessarily be in many instances, this position should be such that the plants will not be blown against with a force calculated to blow them into it or towards it.

The age of the plants must also be considered, this not exceeding three years as a rule. Some prefer to allow the seedlings to remain in the nursery soil till they are wanted; others, again, prefer plants which, after two years as seedlings, are taken up and allowed to grow for one year, making up the three years. Transplanted seedlings are found to yield plants with a good ball of rootlets and a vigorous stem—two great desiderata. By far the best time to plant is in

early spring, about the beginning of March, so that it will be finished in the same month if enough of hands be put to the work. To plant in autumn in such waterlogged stuff as an unclaimed bog is simply throwing away time, labour, and plants,—it is impossible under such circumstances that the latter can take hold of the ground, and make some growth before winter sets in, and thereafter struggle through the cold and wet successfully. If autumn be bad, winter, we need scarcely say, will be worse. As there is no soil worthy of the name in bogs such as we are now considering, in which some of the usual modes of setting the plants in the ground can be adopted, the only one available is the hole or pit-planting system. The pits, at intervals varying from 3 to 4 feet apart, according to the plants and their number to the acre, should be dug in the autumn, so as to allow the sides and bottom to get well weathered by the frost, as well as the bog soil taken out in forming them. The size of the pit will depend upon circumstances, but as a rule, 12 to 16 or 18 inches on the side of square will do. If soil is to be put in in spring, they will require to be a little larger than if this were not used; if so, this soil or clay or rich loam of the first class should be laid at the side of the pit, to get weathered during the winter. For further details as to the modes of setting in the plants, see the paragraph 'Planting and Transplanting of Seedlings for Plantations.' The thinning and pruning should be done with judgment, and not therefore left to be performed by any labourer or other person who is ignorant of the subject (see paragraph on 'Thinning and Pruning Trees in Plantations'). The trees which are left standing should have sufficient room and but little more in which to grow freely in their further development. All these details, but merely glanced at here, as their nature admits of nothing more definite being given, evidently point to this,—that the forester in this, as in other departments of his labours, will have to exercise no small amount of careful forethought, skill, and judgment before full justice can be done to it, and the most valuable results will be obtained only with the most economical management and outlay of labour and money.

Small Woods—Coppices.—On many properties there are here and there considerable stretches of

plantation, or woodlands as they are sometimes termed, of small trees, underwood, or brushwood. These are useful, not only as affording shelter in exposed situations to adjoining arable or pasture lands, but as yielding a supply of small pieces of timber, which 'come in handy,' as the phrase is, for many farm purposes—fencing, making of hurdles, gateways, etc.; and at the same time also affording a small but ready-money source of revenue from the demand there is for small wood of the varieties generally grown for various trade purposes, such as bobbin-making for the cotton trade, clog-making, etc. Much more might be made of these small woods than is generally the case by attention to sundry points, which in the majority of cases are almost wholly, if not quite neglected. Amongst these may be named the general lack of proper enclosure, so that the woodlands are quite open not merely to the depredations of tramps, vagrants, etc., but to what is worse, the damage done by cattle, etc. straying from the pasture fields. The cattle not merely crush and break the young and rising plants and the smaller brushwood, which is useful for many purposes of the farm, but they greatly injure the trees which are more advanced in growth; indeed it may be said nearly the whole of the trees, as these are generally of low growth, and are nearly, if not wholly, within the reach of cattle, who in feeding upon the leafage do more damage than merely stripping this, although this is bad enough, by breaking off branches and otherwise injuring the tree more or less. Trees subjected to this treatment cannot, and never do, thrive; and any gain, the value of which at the best is doubtful, which may be supposed to flow from the food the cattle get there, is greatly overbalanced by the heavier loss sustained by preventing the trees from gaining their full and most luxuriant growth, and in destroying much of the undergrowth. To obviate those evils, fences should be put up (see 'Fences'). Another great source of loss arises from the custom in some districts of mixing large timber trees with the smaller ones constituting the woods. The evil done is manifest on slight consideration, and it acts in a twofold way, to the injury alike of the large timber trees and of the smaller ones; for as the small trees and the brushwood and underwood act upon the

growth of the large timber trees, causing them to produce more branches and leafage at a comparatively short distance from the ground, the bole or trunk of the tree is stunted, and rarely arrives at its full height and healthy maturity; while, on the other hand, the leafage and wide-spreading branches of the large timber trees thus produced react upon the brushwood and smaller trees below, preventing them from gaining their full and healthy development. The two systems are thus seen to be quite antagonistic, and ought never to be on the same ground; the large timber trees ought always to be outside the belt or stretch of small woods, and if judiciously placed and disposed, they will add to the appearance of the woods as a whole, while they will also act as shelter to the young plants of the woodlands. Another evil connected with the general management of woodlands is neglect in cutting the timber at the proper periods. As a rule, the trees are allowed to remain too long before they are cut, the result of which is that the old branches kill the new ones, and if the process be not stopped, will eventually destroy, or at least greatly injure, the whole tree. Attention, moreover, is but seldom paid to the condition of the young seedlings or other plants which may be put in to replace the old ones cut down; these are frequently smothered and crushed out of existence by the rank undergrowth. This should be removed from about the young saplings and plants, so as to give the light and air free access to them. The last point we here notice is the want of proper drainage. This keeps the land too frequently in a perpetual state of over-moisture, in which it is impossible for the trees to grow healthily. On this point we need say no more here, as the necessity for drainage will be obvious, and we have already gone somewhat fully into the subject.

Should a Change in the Kind of Trees grown in Plantations be not now adopted?—The question here put is worthy of the most earnest consideration of the landed proprietor. At present plantations are made up wholly of forest timber trees, but in view of the enormous demand for fruit of every kind,—a demand which has increased, and is daily increasing, to an astonishing degree,—the question above put has been mooted with reference to the putting down of a

certain proportion of plantation ground with *fruit trees*. This may appear to some to be what, indeed, in many respects is a startling innovation in plantation practice; but this arises chiefly from the novelty of the proposition, taken in conjunction with the idea that a plantation must of necessity be composed wholly of timber forest trees, and cannot well be anything else. But a very slight consideration will suffice to show that there is really nothing to be brought forward of any moment against, but very much in favour of, the plan. The main object in view in putting down a plantation on landed property is to derive from it a source of revenue, and hitherto this has been supposed to be best if not only got through the medium of trees, for the timber of which there is the largest demand for industrial purposes. Now, this being the main object of plantation work, it matters not to the proprietor from what kind of tree the revenue is derived. If otherwise, then he might as reasonably object to the planting of any particular kind of timber forest tree in favour of some other kind, and this apart altogether from the relative value or demand—which regulates the value—of the different trees,—prejudice, or the mere expression of ‘I wish it’ principle, being the chief if not the only motive in the matter. Now it is a fact that prejudice does affect the question of fruit as against timber forest trees. This is seen very markedly in the case of ornamental gardens, or in landscape gardening, so far as the trees therein employed are concerned, it being apparently an axiom with those who have the laying down of such work, that no fruit trees are admissible; or, as a landscape gardener more forcibly than accurately put it on the occasion of the propriety or otherwise of cutting down a very fine fruit tree which happened to be growing on a piece of land which was about to be arranged as an *ornamental* garden plot, ‘Oh, a fruit tree is out of place in ornamental garden work.’ Why it should have been so there, any more than it was in a clump of trees put down in landscape gardening on an extensive scale, as in the grounds surrounding the mansion-house of the property, or even as forming one of the rows of trees in a plantation proper for timber growing, is, we confess, somewhat hard to see. If beauty *per se* is a

point of any value,—and it is equally hard to see why it should not be of some,—then one would think that the whole argument, or rather the points of the question involved, would be in favour of fruit and against the pure timber forest tree. Not only beauty of form does a fruit tree possess, but there is the beauty of flower and fruit, each at different periods of the year, giving the rare charm in the variety of shades and tones of colour, which is ever a delight to the cultivated taste. Those only who have travelled much abroad—with ‘the observing eye which sees,’ and the mind which takes note of all—at different periods of the year, and who have gone into the fruit-growing districts, can form any idea of the really strikingly beautiful effects produced by fruit trees in mass. We have travelled along a district of this kind for miles, and through acres upon acres of fruit trees in full bloom in the spring-time, and in full fruitage at later periods of the year, and have in it been peculiarly struck with this, that our forest trees would have an additional source of beauty given to them by the interspersing here and there of fruit trees, either singly or in clumps, this being done with judgment, so that the full effect of variety in form, tone, and colour would be secured. We say additional beauty would thus be given to forest-tree masses, for assuredly we are not of those who, because they advocate an improvement which is so great an innovation upon established practice as this might be, therefore feel bound to admit of no merit on the other side of the question. Far otherwise; for only those who have studied trees in detail and in the mass, as in the latter case presented in our plantations, can have any idea of their beauty and the contrasts in colour, light and shade, which the different varieties of trees give rise to. But while forest trees, as a rule, yield only one source of revenue, namely, the timber,—the exceptions being those few forest trees which grow bark useful and valuable for various industrial processes,—fruit trees, as a rule, yield a double source of revenue, their fruit and their timber. As to the revenue which a judicious planting of fruit trees would yield, or the chances, we should perhaps rather say, of a market being obtained for the fruit, some idea may be formed from the

simple statement that the value of fresh fruits imported last year from the Continent was over the large sum of £6,000,000 sterling. But while the supply of fruit abroad may be said to be unlimited, its importation here is limited by the distance of many of the fruit-growing districts there from the markets here, the result of which is that the importations, great as they are, by no means supply the demand here; and as this demand has greatly increased of late years, and is rapidly increasing, the time is all the more favourable to the chances of a greatly increased revenue being obtained from fruit trees planted in this country on a much more extensive scale, and over the widest possible range of country, than has yet been witnessed. So much for the fruit as a source of revenue. As to the timber, it is well known that that of many fruit trees is valuable for industrial purposes. And as regards the labour connected with the planting and after management of fruit trees, as a writer in the *Garden* has recently and well remarked, 'it is no more trouble to grow an apple tree than it is to grow an ash or a lime tree; and the apple tree, when in fruit (and we may add in bloom), is certainly far more attractive than either of these.' Some may think that the pruning of fruit trees will be an almost insuperable difficulty in making up at least large portions of ordinary plantation with them; but this difficulty is one chiefly of imagination, for it is but little more, if indeed any more, difficult to prune fruit trees than to prune forest trees;—no doubt knowledge, skill, and judgment are requisite, so that the future fruit-buds be not ruthlessly cut away, but so also are those essentials requisite in regard to the pruning of forest trees. Further, some recent experience seems to point to this, that fruit trees *seem to do best when simply let alone*,—that, for example, of the now somewhat celebrated fruit farm, as it may be called, of Mr. Webb of Calcot, near Reading. This gentleman has been remarkably successful as a general fruit grower,—chiefly apples, pears, nectarines, plums, cherries, and peaches, including a vine much larger than the celebrated one at Hampton Court. The soil in which the trees grow has not once been dressed since 1854 with any manure, the only thing done in this way being to allow the

leaves of the trees to lie on the ground as they fall. The trees never receive any pruning, but grow quite like a thicket, care, however, being taken that they do not crush or crowd one another too much. Nothing is grown under them but flowers for the market, as primroses and polyanthes. The hazel-nut trees are remarkable for their size and for their extraordinary yield; they are grown in rows, and allowed to attain a height of from 12 to 15 feet. When they become too overcrowded, one row is cut half-way down, and two years afterwards the next row is cut down, the first cut down row having by this time grown up again.

Should fruit-tree cultivation not be extended to plantations of forest trees in the way here pointed out, although, in addition to what we have said, much more might still be said in favour of the system, there cannot, we conceive, be any remarkable objection to its extension to the clumps and belts of trees, or 'jottings here and there' on fields of two or more trees in the neighbourhood of the mansion, and seen therefrom, as forming part of what may be called the ornamental or landscape gardening part of the property. There is everything in their favour for such situations, and their well-known beauty, to which we have specially referred, will have a fine field for its best display, while it will add in turn to the beauty of the landscape. For apple trees, says the writer in the *Garden* already quoted from, to be planted in such situations and in shrubberies, the best varieties are 'the Hawthornden, the Emperor Alexander, the Lord Suffield, and the Beauty of Kent. These are all trees of vigorous habit and fine foliage, and produce large clusters of bloom, and bear abundant crops of large, handsomely coloured fruit, which is unsurpassed for culinary purposes.' Another good situation for fruit trees will be the hedgerows, in which trees here and there are already permissible or existent. They will look very much better than pollard trees of ash or elm, with their ugly, gnarled, and stunted stems. In the chapter on 'Waste Lands' will be found a few remarks as to the cultivation of fruit trees in small plots of waste or unproductive land. Taking the whole of our remarks together, we trust we have shown that this system—not by any means new or a

'whim of the present day,' for the first known publication advocating it was published nearly two hundred years ago—is one which, if not in all respects applicable to all cases, is so to a large majority of them, and is at least worthy of having that consideration given to it which every system has a right to demand which promises to open up new sources of wealth, and to extend into new areas the great advantage of a variety of trees capable of being grown in the same soil, thus obviating such risks as are always attendant upon the cultivation of one species or but a few varieties, or, to use the homely phrase, avoiding 'the putting of all one's eggs into one basket.'

Application of Manures to Trees.—Amongst the varied operations of plantation work, even in those distinguished by the highest class of management, that of manuring the trees has seldom, if ever, a place. It is not that this operation is not performed because it is not always, or rather, as a rule, easy to carry out,—and in some cases the difficulties in the way are such as to make it almost practically impossible to do so,—but because it does not seem to be considered necessary to the healthy development of the trees. How this has come about it is not very easy to say, but possibly it has originated from the point just alluded to, namely, the difficulty, even in the most favourable circumstances, of applying manure as readily as it is done to the general or ordinary crops of the farm. But seeing that the same laws which influence and regulate vegetable growth in the case of those farm crops must also influence and regulate —although with modifying circumstances, according to position, soil, and climate—that of trees, it is difficult to see how they should not have the benefit of them. Like ordinary crops, they no doubt draw somewhat of their manurial sustenance from the atmosphere, through the agency or medium of their leaves ; but, like farm crops, they also derive much of it—the greatest proportion, in all probability, of the manurial constituents which they require—from the soil in which they grow. And just as in the case of farm crops, so in that of trees, if the constituents they require are not present in the soil naturally, or by long and continuous cropping become exhausted, and are not supplied to it, then the crops and trees alike languish more or less,

make small development, and ultimately fail— if they do not previously altogether die out—to yield the produce which under more favourable circumstances they would have yielded. It is not easy to controvert these statements, for they are founded upon scientific truths, which, in the case of crops at least, are daily confronted by striking and palpable facts. And if this be not the case with trees, it arises not from the truth that they are suffering from want of manurial constituents, but rather that while it is acknowledged that they are suffering from some cause or another,—this being so patent that it cannot well be denied or overlooked,—this cause is said to be something or other, but certainly not the true one. No doubt trees, as ordinary plants do likewise, do suffer and languish from causes other than want of manure; but if investigation were instituted, and trials made, it would be found that the mischief was often caused by want of manure, and that to an extent which would surprise many. A few instances are on record of the truth of this. Some trees which showed symptoms of decided decay, or of loss of vital power, recovered their energy, put forth fresh and healthy leaves, and began rapidly to develop sound branches, and this very shortly after liquid manure had been applied to the soil immediately surrounding them. In another case, where the trees gave still more decided evidence of going back, solid manure was applied, and the beneficial results were not long of being realized. The difficulty of applying manure to the large number of trees which make up an extensive plantation is no doubt great, but some means could surely be hit upon by which the difficulty would be so decreased as to make the manurial application more easy than it is now. The difficulties will obviously be greater or less according to circumstances, and where these are of the easiest kind, there, at least, manure might be applied. In cases where the trees were languishing for the want of something, the application would soon show whether it was for the want of that. Failing direct application of manure to trees, there are indirect ways, so far as human agency is concerned, but very direct so far as the trees themselves are so ; for, under favourable circumstances of growth, they manure themselves through the

agency of their own leafage. This has long been known to be a powerful source of healthy life and development in trees. We could cite one case where, in an orchard famed for its enormous yearly produce, nothing whatever has been done to the trees for many years, but simply allowing the leaves to lie as they fall.

But in order to gain the full advantage of this self-manuring, as it may be called, it is necessary to give the trees ample space to grow in; for the more they have, the fuller and freer is the development of the leafage, thus affording another example of the mutual dependence of one operation upon another. But while, independent of human agency, trees manure themselves, there is another way in which they are manured,—by an extraneous agency, but which still is not human. In another paragraph we have said that it is beneficial to the young trees for all undergrowth on the soil to be taken away, so that the trees alone should have the benefit of the manurial constituents in the soil, and not be robbed of them by the undergrowth. This may be taken with a reservation, at least in some instances; for while tall and strong undergrowth would be hurtful, as a rule, to the young trees, excepting in so far as they might act as shelter, the mere herbage or coarse undergrowth of grass in its decay provides a supply of manure to the trees. The whole subject here opened up is worthy of special study. *Trees* which are evidently *decaying*—and of this the most obvious and perhaps the best sign is the change in the colour of the leafage, which changes from the bright fresh to a sickly green, the difference between which is detected at once, almost, even by an inexperienced eye—may have quite a new and a long lease of life given to them by simply taking up all the old mould or soil for some distance around the tree, and to some depth below the surface, and replacing it by fresh mould, well manured either with dung, compost-heap matter, or good peat soil.

Many trees which are beginning to decay owe their decadence, in many cases, simply to having the atmospheric influences shut out from the soil in which they grow by a dense undergrowth of vegetation, and also by the clinging to the bole and branches of parasitical plants, of which ivy is the worst. All these should be

thoroughly and ruthlessly removed, and the soil round the tree dug up to some depth, and it will be all the better if manured. However picturesque, in the case of pleasure-ground or park trees, parasitics as ivy may look, their presence there is ultimate and certain death to the trees to which they cling. A very old plan of reviving decaying trees, but said to be an exceedingly effective one, is to cut a trench all round the tree root not less than three feet out from its circumference,—the depth to be such as to go quite down to the subsoil, which should be stirred and opened up, but not brought to the surface. All the soil near the surface, and that which seems worn out and exhausted,—and an experienced eye can soon distinguish this,—must be taken away. It need not be lost, for it can be added to the compost heap, the good soil being put aside to be relaid in the trench along with fresh soil, compost, manure, dung, and peat soil. In cutting the trench, the roots and rootlets must be cut fearlessly, though taking care that of the strongest roots those will be left which will serve as ‘anchors’ or supports to the tree chiefly against the prevailing winds. When the trench is filled up with the prepared soil, as above stated, and the whole finished off, the dead wood of the tree must be sawn off, all moss, lichens, parasites, removed from bole and branches at spring-time, and the lower part of the bole or stem washed twice or thrice during the summer with soap and water laid on with a brush. The end of the month of February or beginning of March is the best time to cut the trench. Within two or three months from the cutting of the trench and the severing of the old roots, etc., an extraordinary development of roots and rootlets takes place, the roots in this short space often reaching to a length of twelve to fifteen inches. These throw out an infinite number of rootlets, which penetrate the fresh-laid soil and manure, and some give a new start to the vigour of the tree, which enters upon a second life. In the planting of trees in the ornamental department, or those situated near the house, a great deal of their effect as trees is lost, as one able authority well remarks, by planting them too deeply, so that they appear when planted as if they were ‘so many poles with no base to stand upon;’—

an effect which gives a remarkably poor appearance to trees, which are better seen than those in a plantation, and which many of our readers must have taken notice of.

In a plantation where natural growth is allowed to go on, this pole or 'Venetian mast'-like appearance does not exist, or if it does, it is only in exceptional cases. There the 'collar' of the tree allowed to grow above ground is, of course, seen; and the 'root limbs' spread out, or develop from the bole or stem all round, dying away imperceptibly into the surrounding turf or soil. This form of natural growth always adds to the look of a tree, being natural; and in lawn plantings, or in parks near the mansion, where the trees are observed, this effect should be aimed at. It is best obtained by planting the trees in the first instance very shallow—so shallow, indeed, that a mound of soil may be required to be put round the tree at first, in order to cover the roots, which would otherwise be exposed. And an advantage is gained by adopting this plan other than that of beauty, half of which, in lawn and park plantations, is lost by the old and general method in which the stem rises abruptly from the soil. And this advantage is one of utility, as, when the collar is allowed to rise above the soil and show its finely developed and sometimes most singularly-shaped root limbs, the tree is so much more firmly fixed in the soil that it is able to withstand strong winds,—an advantage of no mean order, especially in isolated positions, which are more exposed than trees in plantations, where a mass of trees in one position shelters another in a different one.

In the selection of trees for ornamental clumps within the near vicinity of the mansion or farmhouse, where the latter is of such a class as to demand 'grounds' of its own, due regard should be had to the securing of as much variety as possible, not only in the form of the tree, but in the colour or tint of the leaves, and that, moreover, in some cases, of the bole and branches, as the beautiful silvery sheen of the silver beech. Some prefer the clumps, where there are several to be formed, each of one kind or class of tree only, giving variety by having each clump of a different class, the variety desired by having different trees in the same mass being confined to belts of wood

or small plantations. It is, after all, a matter of taste; but we incline to think that the claims of a higher standard of taste will be met more decidedly and effectively by having the variety as named in the first sentence above given in each clump, no matter how many the clumps are. If these are near each other, both clumps should not have the variety secured by the same but by another class of trees; when the clumps are wide apart, they may be mere repetitions of any one. The variety here recommended is fortunately easily obtained, as each class of tree has its own peculiarities of shape, conformation, and altitude. A recent writer on the subject of ornamental grounds classifies the forms thus:—(1) 'Columnar,' this being exemplified in the ordinary or common cypress, the Irish yew, and the pyramidal oak; (2) 'Rigid,' this having its exemplars in *Araucaria imbricata* and *Corvus mas.*; (3) 'Free,' the common beech and the *Abies Douglassii* illustrating this class; (4) 'Pendulous,'—the weeping birch and the *Abies decodara* exemplify this class; while the ivy, the carpet-juniper, the honeysuckle, and vines are exemplars of the fifth and last class, (5) the 'Prostrate.' As regards the form of the leaves, the needle-shaped leaves of the pines and firs exemplify the characteristic described as 'linear;' those of the oak, elm, etc., are characteristic of the 'simple' leaf, or that which is in one piece; while the 'compound' leaf, that is, one composed of several leaflets, is seen in the ash, walnut, etc. As regards colour, the 'purple' is seen in the leaves of the purple beech and the purple nut; the 'dark green' in the yew and in the common holly; the 'light green' in the lime or linden tree and the arbor vitæ; 'gold' in the golden holly, golden yew, and in the variegated Spanish chestnut; 'silver,' *Abele poplar*, Lavender cotton, and some of the varieties of the *Abies decodara*. As regards colour, 'green' should in all cases be the predominant colour; the silver, gold, and purple figuring sparingly, the two former (silver and gold) contrasting with the dark, the latter (the purple) with the light green.' By judicious distribution and interspersing of the trees in the clumps, so that while each tree has abundance of room not only to develop itself fully and freely, but to display the peculiarities of its characteristics, form, etc., at the

same time the whole mass will be one which conveys a sense of repose and thorough aptness for the position, very striking and beautiful effects may be produced, which will add much to the charms of the objects surrounding, and put down to aid in the adornment of, the house and its grounds.

Finish or Form of Stone Walls or Turf Banks as Fencing and Shelter to Plantations.—Where, for the double purpose of serving as fencing and shelter, on the side exposed to the coldest and strongest winds, to the young trees of a plantation, stone walls or turf banks are erected, much of their efficiency, if not indeed the whole of it, depends upon the way in which the upper part or coping is made. Mr. Bain, who may be said to have made the subject of shelter his own, so complete and systematic have been his remarks upon it, was the first to draw attention to this important point,—a point so obvious after being stated, that it resembles somewhat the case of Columbus and the egg. If the coping of the wall or last layer of the bank be made flat, this is the worst; or if made with an angle, or ‘weathered on both sides,’ as the technical term is, this is the best form which can be given to it; and how, we shall at once see. Let us consider the wind, as it comes sweeping along, being placed in a series of layers, so to say, all of them parallel to the horizon; when they meet and come in contact with a wall, those below the coping or top are bent back, creating an eddy more or less strong, which may take a variety of directions, according to the nature of the wall. Those at or above the level of the tops of the trees sweep over them with little or no damage to or influence upon them; but those layers, so to call them, which are at the level of the coping are the mischief-makers—that is, if the coping of the wall or upper surface of the turf bank be not properly finished. It was to the remarkable influence of this part that Mr. Bain directed attention. If, where the angle of the wall coping or bank is sharp or much inclined, the blast is deflected sharply upwards, it is only one or two of the outer rows of trees which are affected by it; where it is less acute or lower, the deflection upwards of the blast is much less, and the number of trees exposed to its influence is in-

creased, the blast going farther in towards the interior, cutting down a greater proportion of tree-top at the level; while, if there be no coping to the stone wall or sloping top to the turf bank, then the blast is not deflected upwards at all, but goes right in a direction parallel to the horizon, cutting off the tree-tops ‘as with a knife, so that hardly anything of value rises higher than the wall.’ We have, of course, made use of a somewhat fanciful illustration as regards the wind sweeping along in layers; but still it is to a large extent true, and it affords perhaps as easy a mode of understanding its action as any other which might have been used. And certainly varying depths of wind action are observable, one being arrested as by a wall, another at a higher altitude passing over this and going forward. We see the influence of angular surfaces in deflecting currents of air in a great many ways, and they are made sensible to the sight if smoky particles be mixed with the air. And the value of attending to this influence may be gathered from observation of their action. Thus we believe that down-draughts in chimney-flues would be, if not wholly, at least in great measure prevented if the flue top was furnished with angularly deflecting surfaces. But as regards plantations, there can be no doubt whatever that where shelter-walls or banks are put up, if they are finished flat, ‘the entire value,’ to quote an authority, ‘of the shelter is lost by inattention to the mere form of the top of the wall.’

‘Some magnificent timber flourished,’ says Mr. Mechie, in an admirable paper in the *Transactions of the Highland Society* on the ‘Plantation of Exposed or Barren Tracts’ (No. 5, 1870), ‘in bygone days, through the advantageous effects of shelter; and similar results may be expected still by obedience to the same laws. A hill of high altitude and much exposed may be clothed with timber from base to summit by planting it in zones, encircling the hill at such distant intervals as to allow each zone to rise sufficiently high to shelter the succeeding one before it is planted. An exposed hill planted all at once does not succeed, because the plants most exposed assume a form of habit of growth dwarfed, stunted, and so crooked, that when shelter is afforded they cannot afterwards recover. Soft-

wooded and fast-growing trees are those best adapted for maritime planting, of which are elder, poplar, briar, etc. Such plants are certain in course of time to make headway, when favourable influences combine; whereas those plants of stiff and sluggish growth, having assumed a stunted habit, are little influenced or excited to growth by one or two good seasons. In planting moss, especially when the surface is flat, hillock planting, the plan previously described, should be employed. Stone walls have a bad effect in producing a good margin row behind them, from the circumstance that the plants are too much sheltered and tender for the sudden exposure which they meet with on protruding their heads above them. All bare, smooth, bleak surfaces should be rendered rough and broken, as with the plough, spade, or mattock, that the plants (which are presumed to be small) should have shelter till fairly rooted.

'Extreme exposures should be planted by using very small, hardy, well-rooted plants, planting them closely together, and thinning early. Boggy ground or deep sand is best planted with old wood, cuttings of willow, poplar, and elder. The difference of hardiness among trees and shrubs of one species, as the thorn, beech, etc., is so great as to render one plant sufficiently hardy, and the other not so. The silver fir and Scots pine are the hardiest amongst coniferæ; while the sycamore, ash, black Italian and aspen poplar are the hardiest of deciduous trees.'

Selection of Trees to be grown on the Property, and their Distribution thereon.—Although very desirable, for obvious reasons it is not always—indeed, we might say it is not often—that the trees which it is most desirable for business reasons to grow upon the property can be grown; or if the attempt be made, greater or less loss will be the likely result, and this, as we have seen, arising from the peculiar circumstances connected with the land, such as locality or position, climate, and the characteristics of the soil. But while selecting the trees which will, under the circumstances, yield the greatest ultimate profit, and while determining upon their distribution upon the soil, care should be taken to see that that distribution aids most effectually the realization of that profit. The relation of the distribution—that is, the position

and consequent number of trees per acre—to the class of trees which are to remain longest in the ground, and form the ultimate or last stage of the plantation's growth, and also the relation which those bear to the nursing or shelter trees, must be carefully considered. These points are not always so, as may be conjectured from what we have said, and from what will be gathered more specifically from the paragraph under the head of 'Plantations as Shelter for Exposed Land.' This neglect or overlooking of such an essential point brings about no small loss, and sometimes the total failure, or nearly so, of the trees planted.

Where the plantation is made up—as plantations are generally made up—of certain proportions of hardwood to nursing trees, the space given to the hardwood trees is frequently too limited. This applies more particularly to those trees which, from their habit of growth, are to form the ultimate trees of the plantation, that is, those which are to remain longest growing. When these are placed too near each other, thinning out, even at a pretty advanced period of their growth, is necessitated, in order to get rid of the evils of overcrowding. Now this in the case of valuable trees, such as the oak, is a loss, for, by allowing them to remain on the ground till they arrive at maturity, they produce the highest quality of timber; the converse, of course, also holding true, that those, through the distance between the trees being too limited in the first instance, which have consequently to be thinned out are cut down before they arrive at that age at which they produce the most valuable timber. And the same remark applies to the nursing trees placed in the intervals between the hardwood trees, for if these be planted too closely, some of them will have to be thinned out at an earlier period of their growth than would have been the case had they been less overcrowded; and thus those thinned out will be much less valuable for timber purposes than if they could have been allowed to remain till they had approached nearer to the period of their maturity. These points are obviously of great importance, and should not be overlooked. No rule suitable for all circumstances can, however, be given for the guidance of the forester as to how best to secure them; he will have carefully

to investigate what the special circumstances are of the plantation with which he has for the time to deal, and thereafter decide upon the plan of operation to be followed up. We may, for example, point out, however, one instance; thus, if oak is to be the ultimate class of tree for the plantation, the soil, etc., being suitable for this, the distance of 12 feet or a little more advocated by some will not yield the same ultimate profit as the distribution which gives a distance of at least double this, up to, say, 30 feet, with corresponding positions for the nursing trees of larch and Scots native fir between them. Whatever be the distances decided on, it is essential that these should be regular or uniform. Some, to suit certain better spots of soil which may be met with, or for no reason at all, certainly not so good as this one *prima facie* appears to be, put down the trees at irregular distances without any fixed rule or plan. This may be allowable, and in some qualities of land, as rough common or moorland, is indeed forced upon one, but should not be so in lands of better quality and finer surface. For if the distances be irregular, and the side of a tree be nearer to the next contiguous tree than the opposite side to its next tree, it is clear that the tree will be lop-sided in its development of branches, having a more luxuriant growth on one side than another, thus giving rise to serious evils in its after growth, if not attended to in time as regards pruning; but which operation, after all, is but a lesser evil, or a choice of evils. The more uniform on all sides the growth of a tree is the better, but that uniformity ought to be the result of natural growth in a proper position, in which it is at liberty to develop on all sides equally. In thinning out this is a point amongst others to be attended to, but it is right to state that this cannot be always so certainly, or at least so easily, secured on the square as on the hexagonal system of planting,—this last system compelling, so to say, a uniformity of position, whatever be the extent to which thinning out is performed; and this, perhaps, constitutes an advantage greater than the others which this system possesses, and to which we have elsewhere in this section alluded.

Estimating the Cubic Contents of Timber Trees when felled and topped.—In estimating the value of

rough timber as it is cut down and the branches cut off, it is usual to make an allowance for the bark. As this varies with the kind of tree, the allowance varies also; but a mean is generally decided on, as, for example, in thick-barked trees, such as the elm, one inch per foot of the fourth of the mean circumference; for thin or smooth-barked trees, such as the ash, the allowance is half the above. Another system, which is perhaps more simple, is to allow 2 inches for all pieces the mean circumference of which begins at 12 and ends at 24 inches, 3 inches being the allowance for from 24 to 36 inches of circumference; 4 inches for 36 to 48; 5 for 48 to 72; and 6 inches for all above the latter.

In estimating the cubic contents of rough timber which tapers pretty uniformly from the thick to the small end, a usual rule is to ascertain the mean girth or circumference between the two diameters, divide this mean by 4, multiply the product by the length of the piece, and from the quotient deduct the allowance for bark as above. For hewn or dressed timber, find the area of the base or thick end, that of the top or small end of the piece, as also of a section taken at a point equidistant from the two ends. This third area is to be multiplied by 4, to which are to be added the areas of top and base; then multiply the product of these by a distance equal to one-sixth of the length of the piece.

In cases where the contents or cubic bulk of *standing trees* is required, the rule adopted is first to ascertain the 'quarter girt,' which is done by measuring the height of six feet from the ground up the vertical bole or trunk of the tree, allowing for the taper between this height and the middle of the bole, and then find in the usual way the sizes of the girt in square inches, square the result, and multiply the product of the square by the length of the tree in feet, and divide the product by 144, which will give the number of cubic feet. It is usual to deduct from the quarter girt an allowance for the bark; this allowance we have given in another sentence in this paragraph. It may be remarked, however, that this for elm and ash, and the chief of the white-coloured woods, is too much, some authorities giving only for these one-half of the usual or standard allowance.

CHAPTER IV.

THE RECLAMATION OF WASTE LANDS.

OF the numerous subjects at present engaging the attention of those interested in the present position and future prospects of landed property, considered as a source of agricultural wealth, there is perhaps none which possesses so varied an interest, and occupies such an important position, as that which forms the subject of the present chapter; and very marked, as our practical readers know, is the diversity of opinion which characterises all subjects in which agriculture is concerned. This, perhaps, is one of them in which this diversity is even more decided. This, however, need scarcely be wondered at, when one considers that the discussions connected with it have been carried on by no means from a purely agricultural view, nor by parties having much of agricultural knowledge, but have had imported into them elements which may or may not be rightly connected with the subject, but which, nevertheless, have tended to complicate very materially its various details. Need we say that these elements have been almost purely political, and have been brought into existence by those who at least may, without any breach of charity, be presumably conceived, if they have had any farming knowledge, to have had it only of the most limited character, and that acquired within as limited a period. What we have said, therefore, at the commencement of our remarks may by some of our readers be taken with a reservation, inasmuch as they may conceive that those who have introduced these political elements into the discussion of the subject have, perhaps, had more of an interest in the furtherance of their own peculiar views than in that of the improvement of landed property, for which they professed at least so great a regard. Be this as it may,—and we are far from saying

that the subject has not, or should not have, its political as well as its agricultural aspects,—it is unquestionably unfortunate that so marked a prominence has been given to points which, from the very character of our work, we are compelled to consider, if not in some respects altogether foreign to the subject, at least comparatively unimportant; and attention has been withdrawn very much from those which are, on the contrary, of the highest value. Where opinions so diverse have been promulgated, and where the true facts of the case have not been closely kept in view, it is exceedingly difficult, within what is of necessity at the utmost but a limited space, to place before our readers a full and fair view even of the leading details of the subject. What we can give, however, we shall endeavour to give in a fair, dispassionate way, holding the balance between the divided parties and their opinions as evenly as we can; and the reader will probably find, as we have found in nearly all discussions, that the middle course is the safest to be followed, for it would be hard to suppose that vital elements tending towards its practical settlement would not be found on both sides.

From what we have said, the reader not thoroughly practically acquainted with its details will by this time have arrived at the conclusion, which is the true one, that its discussion has been and is carried on by two great parties. One of these—and its members are those who have certainly taken the greatest pains to give publicity to their views—brings forward a wide array of statistics, showing the enormous acreage of land existing throughout all parts of the United Kingdom, and which, it is maintained, can all be cultivated so as to yield, if not the very highest, at least a

very large amount of agricultural produce. Again, many members of this party maintain that these wide tracts of unproductive are prevented from being changed into productive land in consequence of certain obstacles thrown in the way, by legal enactments and personal prohibitions and hindrances, which are persistently upheld by the aristocracy and landed proprietors of the kingdom. We have little desire, as we have as little space, to discuss this latter point. But we will not surely, by either party, be charged with taking aught but a common-sense view of the subject, when we say that in this, as in all similar cases, the landed proprietors would only be too glad to see their rent-roll enlarged, and their incomes increased, by the cultivation of lands which are at present producing them nothing, or at the best but a trifle, scarcely worth taking into account. Leaving this point, therefore, as one of no great practical importance, we proceed to state that the party we are now considering have another point in what may be called their creed, which is, that if not in every sense only just, certainly the best way by which these waste lands can be brought into cultivation is to allot them, or portions of them, out amongst a number of individuals possessing a practical knowledge of farming, the allotments in each case being recommended or suggested to be of small extent. This point is urged for two reasons,—first, that the lands would give employment to a large number at present out of work; second, that they would by these be more quickly brought into a condition of productive utility; nay, further, that this would be higher than if the lands were cultivated on the system now generally carried out by farmers. We do not care to inquire whether there be other motives for this proposal.

We have now to turn our attention to the other great party concerned in this question; and at the outset we have to note that between it and the one whose opinions we have just described, there is one point on which they agree. This second party, which is mainly composed of landed proprietors and practical farmers, does not object to the accuracy of such statistics or statements which are brought forward by the other party with reference to the existence of large

tracts of uncultivated lands in the kingdom. The term uncultivated here, however, is not the accurate one, for a large proportion—some good authorities estimate it at as much as one-half—of the land or so-called land brought forward and named as waste is truly enough named so, inasmuch as consisting of waterlogged spaces, barren mountains, rocky surfaces, and soils which by no process known at present to agriculture can by any possible means be made fertile, so that the term cultivable can in no practical sense be applied to such tracts.

While agreeing, therefore, so far, it will be seen that the two parties differ, but differ on a very practical point; but we put it to any reader, however strong his predilections may be in favour of what we may call the popular view of this subject, whether it is not a common-sense view to take, that men who have been all their lives engaged in the work of farming, or who are specially interested in its true progress, are not much more likely to know the practical part of the subject, than others who have come to it so very recently, and who certainly cannot lay claim to the possession of thorough knowledge of its details. We shall see as we proceed that the reclamation even of the best class of waste lands is by no means so easy a matter when conducted on the small scale, while the profits are long in coming, and by no means great when they arrive; but we have above given expression in another way to the simple fact which we here explicitly state, that there are large tracts of land which, as far as we see at present, cannot possibly be reclaimed. The commonplace phrase, that 'we may buy gold too dear,' conveys a practical lesson, even in such an important question as this; and when we are told further that even the worst land can be reclaimed, because there are abundant evidences around us throughout the country that large tracts of land have been reclaimed in times before us, it should be remembered that the circumstances of these times, as regards the social condition of labour, etc., were vastly different from those under which we now live; and the element of time, or the period required to do a certain work, which exercises great influence on the paying point, held a very different position in the economics of labour then from

what it does now. But we shall see, however, presently, that it cannot even be ignored now, and that it makes 'rather queer work' with the calculations of those sanguine people who seem to think that all our reclaimed lands have only to be handed over to what is called our surplus or underpaid population of labourers, for comfortable livings and money to be made out of them. As already said, and what must be in itself very evident, the opinion of practical men is the only safe guide by which one can arrive at a right conclusion on a point such as this,—that of one of this class outweighing the dicta of scores of other authorities, no matter how confidently they may be, as indeed they generally are, put forward.

It is not possible, in the space at our command, to bring forward practical evidence in anything like the abundance which we could otherwise easily do; we must content ourselves, although with great regret, by placing before our readers one or two examples only. The first we deal with is that of one who knew the subject intimately in all its departments; and dealing with the statements of one who may be looked upon as the leading authority of the other or popular view of the question, as opposed to the practical, he met them in the following fashion. After pointing out, by way of clearing the ground of one of the leading fallacies of the subject, that the acreage of waste land which could be reclaimed was very far below the estimates put forward by the popular party, our practical authority proceeded to show that fallacies also existed as markedly in the minor details. The plan proposed by the popular exponent or advocate was to appropriate to each labourer an extent of 20 acres, of which he was to make the best he could. Obviously, dealing with land which from its very nature would be placed in a locality calculated in anything but a practical way to minister to the comfort of parties living on it, a comfortable cottage was the first necessity, all the more that it would not have been consistent with the views of these philanthropists to start their 'improvers' with a hovel to live in. Taking the very lowest estimate, then, of a cottage, we shall say, but a degree or two above the style of the hovel, the cost could not be placed at a lower figure than £50; and as prices

rule now, 50 per cent. might be added with safety to this. Here, then, on a farm or allotment of 20 acres, we meet with an expenditure of £50 at the very first. Taking the expense of reclaiming the land, the estimate giving the highest quality of work capable of producing arable crops was £18 an acre, and the lowest £6, which latter would alone admit of the growth of grass,—taking this latter estimate, which of course gives the poorest chance to make the most of the land, we find the expenditure with cost of cottage to amount to £170 on the 20 acres. This expenditure does not include the cost of tools, which, even of the simplest possible character, would bring the outlay close upon £200, which, indeed, would be made up, and more, if we add the cost of purchase of seed; and if to these items we add what certainly would in some fashion be required—furniture for the cottage—we make the sum total above the amount named.

We have, however, to consider the fact to which we have but recently alluded, that agricultural operations demand time for their performance, and during that time, before the land can be productive so as to yield an income, the labourer must be provided with a fund on which to live; and it has been calculated that on the average of waste land, this time would amount to a minimum of four and a maximum of six years, before it would yield a rent of 15s. per acre for pasture land, while it would not yield a single quarter of wheat or barley. To deal, then, with even the vastly reduced acreage of land shown by our authority to be capable of reclamation, the enormous sum of £200,000,000 of hard cash would be required; but if the acreage estimated by the popular party was to be taken, a very much larger one. Some idea may be formed of the enormous capital required to give to our surplus population—although where *that* is we have somewhat of a difficulty in seeing—the allotments of waste land which is said to be their right, and of which it is further said our laws or our aristocratic legislators deprive them, or debar them from having. Nor is the difficulty, which most business men would say is likely to be an insuperable one, made the less so when we consider, as our practical authority well puts it, that there would be, in

view of the high wages which now rule in every trade, and the abundance of work which it has long possessed, some difficulty in getting men who had been accustomed to this condition of living to take in hand the cultivation of land which, after four or six years of incessant labour, and even with the pecuniary assistance we have named, would only produce an estate worth £20 or £22 an acre. And as to the kind of 'incessant labour' required to produce this result, those only who know what small farming is can form any conception of it; and sure are we, that if those who have formed opinions as to farm life of this class or character were to enter practically into it, even but for a month or two, they would find that they had been very much misled by the pictures which well-meaning, but unfortunately all too unpractical, philanthropists had drawn for them.

And, as if not satisfied with these, they have gone to the Continent to find the materials for still brighter portraiture of peasant life. We venture to say—and on this point we have some of the advantages of a practical acquaintance with this department—that it would be exceedingly difficult to find almost the very lowest class of our labouring men, accustomed to English hours of work and to English styles of living, to change their trade or calling for such labour as a Continental peasant willingly undertakes. Well, then, may another authority say, that to attempt to bring waste land into cultivation through any system in which our mechanics or farm labourers are to be the agents is a perfect fallacy. When treating in another chapter on the subject of small farms as against large, and their relative influence upon the agricultural progress of the country, we shall take occasion to explain this point more fully, and to show that even in the case of those who have a practical knowledge of farming in some at least of its details, that is, the class known as small farmers, even they can have but a miserably poor chance of making well out of the reclamation of waste land. What chance, therefore, remains for the mechanics and labourers of our towns in this much-talked-of department of national economics, we leave our readers to say. Indeed, although our ablest tenant farmers are in every way

capable of knowing how best to reclaim land, it is the opinion of our highest practical authorities that the work of reclamation should be that of the landlord and not of the tenant; and that the reclamation of waste land would tend largely to increase the value of their property is obviously beyond all doubt. Innumerable instances might here be quoted in proof of this, but we here satisfy ourselves with the mere statement of the fact. Cases in point, and striking enough, will come duly up as we proceed to describe the details of our subject. Although what we have as yet given has had reference to the question as to whether the reclamation of waste lands can be undertaken by the particular class of the community for whom a certain school seems to be of opinion that they are specially designed as an outlet for their labour, and although we have endeavoured to show that there are such difficulties in the way of this hope being realized, and, further, while we have stated decidedly that there are large tracts which cannot under any known system of treatment ever be reclaimed so as to pay, the reader must not suppose that we are of opinion that there are not tracts, and large tracts, moreover, of land in the various parts of the kingdom which can be reclaimed. On the contrary, there are but few districts, and, indeed, it might be said comparatively few properties, in and on which tracts of land of greater or less extent and of different qualities may not be found which are capable of being greatly improved. It is to the leading classes of these that we now direct attention.

The subject is so wide, and the various details so very numerous, the practice of one district varying so much, according to circumstances of locality, climate, etc., that to do justice to it space would be demanded far exceeding that we have at command. We can only, therefore, take up the leading points; and these must obviously be treated of rather in a way which will be suggestive than in that which can lay any claim to being considered exhaustive. A point of very considerable importance bearing upon the reclamation of waste lands is the relationship subsisting, or which ought to subsist, between the landlord and the tenant as to the relative share of the work which they ought to

perform. This divides itself into three classes,—1st, Work which may be done mutually, or with the two in combination; 2d, Work which ought to be done wholly by the landlord; and, 3d, Other work wholly by the tenant. It must be admitted that the points involved are of a somewhat delicate character, or have been made and are continued to be so by a series of circumstances perhaps peculiar to this country, which have been in operation during a long period of years. It is thus that what appear at first sight to be very simple matters to be settled, have become environed by such a train of circumstances, social and legal, that this settlement is by no means in many cases the simple matter it appears to be. This point will be further alluded to in the chapter in which what may be called the legislative department of landed property is taken up; meanwhile we may briefly note that in the work of reclamation of waste lands, especially those parts surrounded with special difficulties, and requiring long periods to elapse before pecuniary returns can be expected, the landlord, in addition to doing certain parts of the work at his expense, should grant liberal agreements, under which the tenant will be encouraged to do his part thoroughly and well. It need scarcely be said that the landlord will erect all necessary buildings, lay out and construct roads, and fit up the necessary fences, etc., to which will be added any drainage work which may be required; the tenant on his side paying a percentage in the shape of an increased rental. But there are some parts of the work which it seems only fair and reasonable that the landlord ought to perform, as those now named. Thus, for example, where poor soils, deficient in certain constituents, require to have these added in order to make them productive, as, for instance, claying or marling,—this appears to be a work which should be done by the landlord as much as drainage, for it is one which might be called a permanent improvement; as a practical man puts it, this would appear to be ‘an equitable course.’ Then, again, it is a point open to fair discussion between landlord and tenant, whether the cartage of materials, which is usually thrown wholly upon the tenant, should not be done by the landlord, at least in part, considering the heavy work, where, in the rough

and rugged districts of some kinds of land undergoing reclamation, the tenant has quite enough to do with his horses in the work of improvement. As regards agreements, these, as we have said, should be of the most liberal character. Mr. Smith suggests, for example, that the plan of a scale, or, as we should call it, a sliding scale, of rents should be adopted, commencing at the *lowest possible* in the outset, at which point in the work all is outlay or nearly so, the amount of rent increasing every four years to the end of the term, the farm improving—or at least it ought by the tenant’s skill and labour to improve.—in value. The term should be a long one, and have breaks in it, allowing the tenant to quit at these should he desire it. He also claims a tenant-right for unexhausted improvements at the end of each break in the lease, in order to prevent the farm from being ‘run out.’ Thus in the term of twenty years two breaks would be allowed in the lease, one at the end of the eighth, the other at that of the sixteenth year. Then, as regards the sliding scales of rent, it is suggested that, taking the average value for the whole farm at 10s. per acre, and the rise in rent being every fourth year, the scale would run thus:—the first four years, 6s.; the second term, 8s.; the third, 10s.; the fourth, 12s.; the fifth, 14s.;—thus, should the tenant quit, say, at the end of the first term of his lease, he will only have paid the lowest rents during the period while he has been laying out the largest amount in capital and labour. It does not fall within the province of our work to enter into the full details of the cultivation of reclaimed lands of different classes, save in an exceptional instance or two of special importance, nor, indeed, to take into consideration all the classes met with; the principal object we have in view is to notice, as briefly as may be, those which may be said to come under the head of leading classes, and which, if taken in hand, promise to pay well, and add the most largely to the exchequer of the property.

Reclamation of Hilly Moorland.—What are called waste lands situated at elevations or altitudes of greater or less height above the sea-level are composed as a rule of two classes. *First*, those which are situated at the highest level are of

necessity more or less exposed to heavy, keen, and cutting winds, and are usually more or less diversified in surface, rocky, and for the most part barren, so far as a capability to grow any of the higher class of plants is concerned. Such lands are, although unfitted for what is generally termed cultivation, well or moderately well adapted for the formation of plantations; and if a due regard be had not only to the general improvement of the appearance of the property, —a point which all men of taste will never fail to appreciate at its true worth and endeavour in the best way to secure,—but to what is of chief importance as regards the economic value of the land, this planting should never be neglected. For, as has been shown in another paragraph, planting, if judiciously done,—and the reader will find in the chapter on plantations all the points on this fully detailed,—pays as a good investment, yielding a fair return even under ordinary, and a good return under favourable circumstances. But it improves, as we have also shown in the above-named chapter, the climate generally, and affords shelter specially to the lands which, lying on a lower level, are generally of such a character as to be put under cultivation of some kind or another; and to all, shelter is of the highest value in largely adding to their productive capabilities. The *second* class of elevated waste lands, often known as hilly moorlands, is made up of marshes, peaty moss land, bogs, and other diversities of moorland, the peculiarities of which are so considerable in number, and so run into each other, that it is difficult to name them all here, if indeed it be necessary to do so. This class of hilly or elevated waste land is not as a rule likely to repay the cost of reclamation and improvement if covered with stones, benty or rough grasses, although they may serve more or less satisfactorily, in a degree, as feeding-grounds for the hardiest of our live stock. Where, however, the fern, the broom, or the heather grows, cultivation of a certain class can be carried out with greater or less success, even, indeed, in some of the more favoured spots at a lower level, to the growth of turnips.

But all the waste moorlands of the class now named are capable of being so improved that

they will yield an extensive acreage of grass land, the chief agent in forming and improving this being irrigation, of which the 'catchwater' system is obviously the one adapted for the peculiar local features of such land. In determining to improve such lands, attention must be paid to the natural or indigenous plants which they produce, the general climate, the position of the various points which are influenced by exposure, the prevailing winds, their vicinity to marshy parts not easily or cheaply capable of being cleared, and, indeed, all the climatic and local peculiarities which affect or are likely to affect the improvements contemplated. As stated in the title to this section, we shall confine our remarks to the reclamation of elevated moorlands. Of these there are what may be called enormous tracts in various parts of the kingdom, which, while a considerable proportion is, as we have already stated, fit for nothing else but the pasturage ground of rough, hardy stock, possess still a very wide acreage capable of such improvement as will convert them from the 'useless wastes,' which so many of them now are, into lands which, if they are not highly productive, will be so to such an extent as to make them yield a fair return for the outlay expended on their reclamation. It is scarcely necessary to say that this return will be yielded, not in the form of the produce of arable farms in more favoured regions, but in the live stock which they will maintain. From this point of view it is impossible not to look upon the improvement of such lands as a point of the highest importance to us as a nation; for while we are now in no sense dependent upon ourselves alone for the produce of cereals, we still take the position, and are likely long to keep it, of being not only the best breeders and feeders of live stock in the world, but are mainly dependent upon our own herds and flocks, what we receive from other countries forming but a miserably small percentage of the total consumption of the United Kingdom. And while our best lands, under the able management of our first-class graziers, produce largely, and may yet by further improvements be made to produce more, still it is to the reclamation and improvement of our poor lands that the hopes of the grazier for wider and still

wider areas on which he can rear increased herds and flocks must look to be realized; and although some consider this reclamation and improvement as affording, if not quite a hopeless, yet not a very hopeful prospect of increased wealth in the live stock of the country, and while we have pointed out in the introduction to this chapter the difficulties which lie in the way, the fact nevertheless remains that in the large tracts of now valuable land, which not long ago were in truth dreary wastes, there is ample ground for encouragement and hope.

The late Mr. Smith of Emmett's Grange, Molton, Devon, who may be looked upon as one of the great if not the greatest authority on this department of farming, divided hilly moorlands into three classes, which we cannot do better than adopt. First, the hill-top and other rough land, useful for the summering of young cattle, store sheep, colts, ponies, etc.; second, the middle division, lying immediately below the rough wet ground, or having a southern aspect, and which, being usually dry, is suitable for arable culture; the third class is made up of the marshes in the valleys with some portion of the hill-sides, which is capable of being laid out for pasture lands and meadows. This division constituted, in fact, the arrangement of a moorland farm as recommended by Mr. Smith, and keeping in view the point we have just alluded to as regards our live stock. Mr. Smith stated that 'the practical bearing of such an occupation is that of stock producing returns, consequently an eye must ever be had to this particular class of farming.' After thus dividing the moorland into what may be called blocks comprised in three classes of land, Mr. Smith, in an admirable paper on the 'Cultivation of Moorland,' in the *Journal of the Royal Agricultural Society of England*, proceeds to describe his system of treatment. This he arranges under separate heads, as follows:—First, the detailed arrangements of the three blocks or classes of land; second, the buildings of the farm; third, the fencing; fourth, the drainage; and last, the general cultivation of the whole, with special details of treatment to suit different localities. Under the special chapters on the subjects of the first five divisions, the reader will find a brief note or two, with illustrations of the leading features of Mr. Smith's system under those heads.

What we have now to deal with is the general review of the cultivation.

As Mr. Smith observes, the land put under operation first will be that situated near the house and buildings; and from the character of it, the first thing to be done will be paring the surface and burning the herbage, weeds, etc., which will be turned into the soil in the after operations. The usual workings of the land for a root crop then follow. The addition of lime to the ashes which are the produce of the thick, matted coating of indigenous plants, powerful as these are as manures, is essential; and in order to have this and the soil well incorporated, the former should be thoroughly worked in order to pulverize it. Part of the land thus prepared for turnips must be devoted to oats, the sowing of which should not be done later than March; and on farms in which a considerable portion of reclamation work has been done, the oats should be sown on the turnip land the crop of which was first cleared in the preceding autumn, those turnip lands cleared at a later period being devoted to the sowing down of artificial grasses without a corn crop. This omission of the usual corn crop is done in order to enable the new-turned-up fibrous soil to get consolidated sufficiently for the growth of cereals. In sowing down the grass seeds, another dressing of lime, at the rate of one and a half tons to the acre, will be found well to repay its cost and that of the labour, at a time when so much work is waiting to be performed. The turnips preceding the grass crop are generally folded, that is, ate off by sheep hurdled on the land, after which the land is carefully ploughed and cleaned. The artificial grasses and rape seed being sown the first week in April, they will be ready for stock by the end of June, and if well taken to the land they will fatten fully ten sheep to the acre; and if cleared occasionally from stock so as to allow the grasses to recover, they will 'prove of infinite value up to Christmas. If they remain clear from the end of September for the ewes and lambs, which is a still better plan, they give a help over the inclemency of the months of March and April, after which they become first-rate pastures, and maintain their comparative goodness for several years.' And as time goes on they may be safely

and profitably cropped with corn, especially oats; and by taking after these a turn of the turnip crop, the lands will be renewed for a fresh sowing of grasses and succeeding years of pasture. We have said that these pastures will remain comparatively good for several years, but they should be broken up at the end of the fourth year, which may be said to be the termination of their real goodness. On breaking up, the oats are sown, which completes the rotation. This rotation is a seven years' one, the second year being grass seeds with rape; the third, fourth, fifth, and sixth years being pasture; the seventh year, corn, which finishes the rotation. The grasses to be sown should be such as grow quickly and yield heavily. Mr. Smith adopted the following mixture:—3 pecks of Pacey rye grass, 1 peck Italian do., 4 lbs. Timothy grass, 2 lbs. cow grass, 4 lbs. white clover, 3 lbs. rib grass, and a small quantity of parsley seed. In subsequently improving grass lands, there is no manure so simple and effective as a compost formed of vegetable mould mixed about six months previously to use with lime or salt. 'This plan of farming in an elevated country goes very far to conquer the climate, and to enable the farmer to keep a large and healthy flock of sheep; in fact, it may be said to form the keystone to the whole structure.' Mr. Smith was so convinced of the plan of seeding out those newly reclaimed lands without a corn crop, that he adopted it even in the case of old land, reserving the corn crop till the end of the course; and when it was absolutely required, he preferred taking two white crops after breaking up the grass land, just previously to the subsequent fallow, to sowing the usual corn crop in rich land in a moist climate.

There is another class of hilly moorland which, when broken up, affords first-class soil for after culture under a liberal lease, to which we now briefly direct attention. This class of land is tolerably dry, but from producing strong heather, furze (gorse, or whins), and other coarse, hard-rooted plants, is too powerful for the paring plough or spade. This class of land requires patient dealing with; it will never pay to be forced into cultivation; it should be taken in hand, therefore, one year, previous to the turnip crop. The land is thoroughly grubbed up, so as to relieve the roots

and set free all plants and herbage, which are collected into heaps and allowed to remain until sufficiently dry to be burned. Ploughing to the depth of 6 inches is then done, and as the turning up of the soil proceeds, the ashes are thrown over the land and allowed to remain for months, until the soil gets so weathered that other processes of ordinary cultivation, such as grubbing, harrowing, cross ploughing, etc., can be carried out for the production of a fine tilth, these being begun about the beginning of March. Turnips are sown the next summer, care being had to avoid taking a corn crop, as oats,—a plan which, while apparently profitably followed by some, will in fact ultimately kill the 'goose which would otherwise have produced them golden eggs.' There is another class of moorland, of which there are extensive ranges in the country, growing stunted heather, and about the same class of dry land weeds and plants as in the class last named, which are lying waste from other causes, namely, want of depth and an excess of large stones. This class of soils possesses the advantage of not requiring drainage, but the difficulty is how to deepen them with the best effect. But even this deepening sometimes is not necessary, as some lands are found to yield the best crops with what may be called the shallowest of ploughing. Waste lands which have a preponderance of stones on their surface are not generally adapted for tillage purposes, as the stones attract the solar heat. But by deepening the soils, thus exposing them to atmospheric influences, by changing the kinds of plants grown upon them, and ploughing under green crops as manures, and by compressing after pulverizing by heavy rolling, or by the application of heavier soils or of marl, or by folding sheep upon them, these dry sandy lands 'may be infinitely improved at a not very large outlay.'

Following the laying out and erection of the fences (for which see the chapter on 'Roads and Fences'), comes the subject of drainage. This is of necessity a very important department; but as much depends upon the geological character of the land, each district naturally having its own peculiar geological features, we cannot here, for obvious reasons, enter into a detail of the methods to be employed. Some remarks will be found bearing upon the particular class of land now

under consideration, in the chapter on 'Drainage.' In connection with the cultivation of this class of land, Mr. Smith draws attention to what he calls a very nice point in subsoiling on some kinds of moorland, even with porous subsoils. These have a fixed bed of thin clay or iron sedimentary deposit lying between the subsoil and the surface of the land, and which have been allowed to remain so long unimproved from the fact that although drainage may have been carried out, as the only thing necessary to be done, this drainage will not effect the purpose without a proper breaking up of these strata; this alone can be done by deep subsoiling or trenching. When within a reasonable distance from the surface, say 15 inches, Mr. Smith's plan has been to pare and burn the upper grasses as the first operation, the paring being done as deeply as possible; the rough herbage, etc., thus removed from it is allowed to lie all the summer on the surface, and then burned as it lies. This slightly chars the soil below, and no further cost is incurred in spreading the ashes. The land is then ploughed to a depth of $4\frac{1}{2}$ or 5 inches, the ridges being thrown over on the uncut land, thus forming a number of them throughout the field, and effectually covering up the ashes. The land is next subsoiled to a depth sufficient to reach the bottom of the stratum already named, breaking up and disturbing this without mixing it with the upper soil. This work is done after that of the ordinary turnip crop is got rid of, thus releasing the horses for this heavy work. The narrow ridges of the first ploughing which are left undisturbed by the subsoiler are allowed to remain till spring, when the land is ready to be prepared in the usual way for ordinary cropping, the best crop being turnips. This subsoiling naturally produces a quick change in the under-current of such passing waters as may be at or beneath the under strata, and these show themselves by the water breaking out at some new point of obstruction, and which must be carried away by appropriate drains. This subsoiling effects quite a revolution in the state of the soil. When the moorland is too deep for subsoiling, and yet of too good a character to be allowed to remain as waste, trenching is adopted. The first operation is to skim the surface with a paring plough; weeds,

heather, etc., are removed by hand, in order to admit of the working of the common plough, which takes as deep and yet as narrow a furrow as possible, after which the trenching is proceeded with. This is begun at the lowest range of the field, and when well opened and started the furrows are chopped across and turned downwards, after which the trench is opened to its desired depth, so as to break up the pan or stratum of clay or iron deposit already alluded to. The paring furrow, composed of rough grasses, heather, etc., is carefully thrown under, each man having a stipulated portion of the work to do, following each other and completing it as he proceeds. The operation of trenching is done and finished before Christmas, or earlier if possible, so that the land may have a long weathering during winter, after which it will be in sufficiently good heart to have a crop of roots taken from it, and the culture of which will prepare it by breaking up and mixing the different soils.

It is, of course, impossible to give a detailed description of all the varieties of hilly moorland within the limits to which the scope of our work naturally confines us; but we believe the reader will coincide in our opinion, that, making allowances for differences in soil, locality, and climate, the plans recommended by Mr. Smith, to which we have given marked prominence in our pages, comprehend nearly all the points which have to be attended to in the reclamation of this waste land, or, if not so thoroughly comprehensive as this, it is assuredly suggestive of what should and can be done.

We might quote example after example of lands of this class treated with marked success; but for the reason named above, we can only refer to one as evidence of what can be effected by very simple means in raising land from the lowest condition of useful fertility up to a fair paying point. This example is afforded in the case of the prize offered by the South Tyne Agricultural Society for the greatest improvement in unreclaimed mountain or hilly land, and which was awarded to Mr. T. Little, Watch Cross, Carlisle. The land is at an elevation of 1000 feet, having an exposure sloping to the north-west. The quality of the soil is a peaty hazel, with a clayey subsoil of good quality resting on freestone and

limestone. In its original condition it was very wet, its chief products being heather, wire bent, and rushes, and its probable value ranging from 1s. 6d. to 5s. 6d. per acre. The operations were very simple, being draining and liming. The drains were 4 feet deep and 27 feet apart. The lime was applied in the proportion of 120 bushels, Carlisle measure, to the acre; and in the spring a portion of this was well salted, in order to quicken the lime. The proportions of costs were—draining, £5, 5s.; liming, £4. After draining, the lime was spread on the surface, without burning the heather. The lime was laid in heaps on the land, and allowed to slack before being applied to those portions where the land was hard and heathery; but where soft and grassy it was spread at once. The result of the operations was the springing up of a close-set sward of natural grasses. We refer specially to this last point, inasmuch as some reclaimers go to considerable expense and trouble in sowing down the land with grasses, whereas in the majority of instances, the superabundant wet being removed, and lime or lime and salt alone used, the natural grasses at once spring up. Indeed, we should suggest that it would be well for those who doubt what nature is so ready to do when helped, to try by way of experiment a limited surface of land on the two plans here alluded to.

Flow Mosses and Peat Land in Hilly Moorland Districts.—The treatment of this land, if land it can be called, where water is the principal element, in hilly moorland districts, is, as may be supposed, a matter of no small difficulty; the boggy land or flow mosses being, of course, the worst to deal with. The peat land, or that from which fuel is ordinarily cut, is generally met with on the summit of the hill lands. This class of soil may be much improved by the cutting of open surface-gutters, in conjunction with a proper adjustment of the levels and outfalls. These gutters may even be made available, as they pass down to the lower level, for the taking in of occasional hill springs, and the united stream carried down and along some convenient slope for the purposes of irrigation. These tributary streams empty into others of larger dimensions, and these, again, into a

‘floating gutter,’ which latter spreads the accumulated water over the mossy dry hill-sides; and if care has been taken to exclude the black or dark peat water from the irrigatory channels, in process of time the weeds and poor herbage of these are destroyed, and their place taken by grasses of a richer and more nutritious character. Such is the system, briefly described, adopted by Mr. Smith in his treatment of hilly moorland, for which see the appropriate paragraphs in this chapter.

The mosses or morasses at the foot of hill land, where clay deposits abound, involve work of a more tedious and difficult character than in cases in which there is greater regularity in the upper and lower strata; thus, for example, where sandy deposits and clay formations having no communication with each other are met with, and ordinary drainage used, each bed requires its own separate drain, so that the system becomes very complicated. The reader desirous to enter into the details of the system of treatment of such cases pursued by Mr. Smith, is referred to his paper given in another part of this chapter. We proceed, therefore, to describe his method of cultivating these morasses. A main feature in this is the adoption of his plan, elsewhere in this work described, of using the power of water for carrying to and distributing over the surface of land, soil and manure of any desired class. The deposit of soil of any kind procurable in the neighbourhood of the bog, carried down and made by this ‘water-carrier’ system, is placed thickly upon the mossy peat, and by the addition of lime the growth of a superior class of grasses is promoted, while the inferior herbage and the sedgy moss decay, and thus add to or form a manure which promotes the growth of better herbage. Of course, drainage of a simple character—that is, open drains leading up the centre of the bog to the head of the spring, with subordinate, upright, and side springs leading into the central one—is at the same time carried out. On the land, when it is moderately consolidated, a crop of rape seed is taken, which is fed off by sheep, which tend still further to consolidate the surface. The land is then winter ploughed to the depth of the settled part, and cleaned in the spring,

previous to being sown down with grasses, which form the ultimate water or irrigated meadow. In cases where the superior advantages of the water-carrier system for the transportation of soil cannot be carried out, it will even pay to cart it on to those uncultivated bog lands.

Treatment of the Soils of Hilly and Stony Moorlands by 'Claying' and Depositing a Good Soil by Irrigation.—Poor soils on land of this class have been wonderfully improved, where irrigation has been part of the plan of laying out, by conveying by means of the water, silt and earthy deposits of good quality, or by using water in which these naturally are, and which, by settling, deposit their contained matter on the surface. The washing down of earthy matter in this way from the high lands—a process which is always going on—to those lands lying at a lower level, can be made available in improving land to a surprising extent. Mr. Smith, the great authority on lands of this class, has done great things in this way. He also notes that where soils of hilly moorlands have been brought into moderately good condition, they have been wonderfully improved by the use of compost matter of vegetable mould mixed with lime and salt, the vegetable mould being obtained from bogs, which, as Mr. Smith observes, thus become sources of manurial wealth rather than altogether objectionable swamps, looked upon as unhealthy morasses. By the use of this vegetable mould, Mr. Smith has wrought most surprising and beneficial changes in grass lands on hilly moorlands without the use of any artificial manure whatever.

Another method of improving these moorlands, which grow indigenously in England, such as furze, poor stunted heather, and other dry land weeds, when situated in good climates, is by deep culture and the removal of the large boulders and stones. Ferny and marshy land has been much improved by the operation of claying, which is thus described:—'Perpendicular pits (in line) are sunk at a distance of say 14 to 15 yards apart between the rows, and on reaching the clay (which varies in depth from 3 to 6 or 10 feet) the workman "casts out" some two to four draws in length, part on each side of him; and in sinking the succeeding pit,

the upper black earth is thrown into the last one, to fill it up, and so on. The object in sinking pits for this purpose is to prevent the sides of an open long cut coming together, as they were accustomed to do before the plan of "pits" was adopted. Still there are many lands that are advanced in cultivation so far as to be free from "bear's muck," and these are found to stand the work of open trenches, and the clay (from the settled state of the peats) is found to be much nearer the surface; the greatest obstacle being that of old roots and trees, which have to be removed from the surface of the clay bed.'

Those farmers who have unreclaimed waste land on hilly moorlands, within reach of their cultivated land, would do well to take in hand the *gradual improvement of the waste*, treating it in such a way that the minimum of expenditure would yield the maximum of results. From what has been said on the subject of reclamation of waste land, it will be seen that to carry it out on an extended scale requires a large expenditure. Any plan, therefore, by which a farmer can gradually take in adjoining land of this character, and while doing so receive an immediate return, even though that be of small extent, is worthy of special notice. The system proposed by Mr. Smith in this direction is, perhaps, the best which could be adopted, and to a brief description of this we shall devote a sentence or two. To this system Mr. Smith gives the name of 'summering farms;' these farms being set out so as to afford facilities for a stock farm, little or no corn being grown. The following is the course to be adopted so as to make the most of the summer, and to lighten the difficulties incident to a long and profitless winter. The breeding and the feeding of sheep is the feature of the farm, the summering of cattle and colts forming merely an adjunct, which might pay something. A goodly number of working oxen should be kept, these requiring no extra or but little attention during the summer, which would be the only period when cultivation would be going on. The fences being put down, the plan of intended fields laid out, the first enclosure made, the native turf is then pared and burned; meanwhile, the oxen having been collected, the first crop of roots is

well in by the end of June. On this land, two and a half tons of lime per acre should be spread. Such of the rougher lands as cannot be pared may in July be ploughed and well drag-harrowed for burning, ploughed up, and allowed to lie for tillage in the spring for Swedish turnips. During the winter months the oxen are rested and fed cheaply, or some of them only may be retained, the others being sold, and their places refilled in the following spring. By March the turnip lands will be ready for the first ploughing, coincident with which will be the paring and burning of new tracts taken in; and by the first of April, the turnip lands are to be sown with grass seeds and rape, without corn, which will be ready to be fed off by fattening sheep in July. The operations of the preceding summer are again to be repeated thus as the farming proceeds, with a coincident extension of grazing lands; and it may be well, after a time, to place upon these a few young cattle during the summer months, while on the yet unreclaimed land, summering cattle, ponies, and store sheep are kept. By this plan of farming, a provision of roots is made for the winter and spring use; young grass, one or more years old, will follow for the early grazing, and the rape and young seeds for the fattening of all sheep required to be sold, or the growing of such sheep as are to be removed to an inland farm for wintering. This principle of gradual extension of reclamation works is obviously applicable to classes of land other than that we have now been considering, and is one well worthy of attention. The great mistake too often made, and it is one made also in connection with old cultivated lands, is to undertake too much at once; it is infinitely better to take in a small extent only at first, and do the best possible with that, gradually adding to it as means are provided by the profits arising from the first portions reclaimed.

Reclaiming Moss Pits.—We are compelled to use this novel and therefore little known name for lack of a better to designate those depressions in the surface of cultivated land which are often met with in certain districts. These are of varying forms, often very nearly circular; but of whatever shape, are formed by the upper land

coming in on all sides, and meeting at certain points, stopping there, thus making the cup or pit-like depression alluded to. The bottoms of these being so far below the drainage level of the surrounding land, and having as a rule no outlet, retain the water, which becoming mixed with vegetable matter blown in or carried from above, a species of moss or bog is formed, which well repays the cost of draining off the superfluous water and preparing the soil to bear crops. The margins of these hollow mosses being the nearest to the land coming down from the higher and better land, and being comparatively dry, are generally brought under cultivation first; indeed, reclamation stops here as a rule, as the operations necessary to be done are more costly than can be repaid by such crops as the 'drained margins' yield, and for which the tenants pay, or should pay, no rent during their tenancy—the heavier cost of the whole moss running over precisely the same period.

In reclaiming the whole of those deep moss pits, the first step to be taken is the same as done with reclaiming all land of this class, namely, to thoroughly drain the whole area from its contained water. Circumstances render this work in some cases comparatively very easy; in others so difficult, that it sometimes taxes the knowledge and practical skill of the most experienced. In some cases there is great difficulty in securing a proper outfall for the drains without tunnelling or building a concealed culvert, so as to reach the lower level from the edge of the moss. Then, again, although in many cases the upper surface of moss herbage is sufficiently compacted to bear the load of carts conveying soil, gravel, etc. to form a good bottom, still, on opening up this herbage surface for the drains, the water will be found in great quantities, and the moss for a great depth is simply boggy water and boggy silt, in which it is difficult to cut drains.

This was the case in a work of reclaiming a hollow moss pit, described in a very able paper in the *Transactions of the Highland and Agricultural Society*, on the 'Agriculture of Kirkcudbrightshire and Galloway,' from the pen of Mr. Thomas McClelland. Here the moss pit was deep and with a top of light flow, the

whole extent of the bog being about an acre and a half. The moss was surrounded by ridges of gravel, the lowest point being 14 feet above the level of the surface of the bog. The outlet being determined on, the first step taken was to dig out all along its course the soil and gravel, this being carted off to and laid over the surface of the moss pit. This tended not only to give a firm bottom, but also to keep the level of the surface as high as possible; with this latter object in view, the herbage was not cut, pared, and burned, but allowed to remain, which also aided the consolidation of the bottom. Notwithstanding all this, when the operation of cutting the lateral or open drains was begun, the bottom soil was found to be of such a treacherous boggy character, that when a 12-foot pole was pushed down it failed to find bottom. It was obviously absurd to attempt to lay drain-tiles on a bottom soil—if such it could be called—like this. To secure, therefore, a firm bottom which would keep the levels and inclines of the drains with as little change as possible, timber boarding was used, on which the drain-tiles were laid. This operation proved so thoroughly successful, that the following winter the soil was so dry and consolidated as to enable the ploughing to be done for the first crop, which was oats, and which brought in the sum of £10. As the cost of the whole work of reclaiming was only £15, this instance will suffice to show how well such work pays. In view of this encouraging fact, it does seem a pity to allow thousands of acres of moss-pit land to remain waste and profitless, or, at the best, here and there only done partially by reclaiming the margins. But the more thoroughly the history of reclaiming work of this kind is gone into, the more completely is this lesson taught us.

Reclamation of Peat or Bog Land formerly an Estuary of the Sea and traversed by a River.—A case of this kind in the county of Galway, described by Mr. Mitchell Henry, M.P., possesses some features of practical interest, inasmuch as the successful reclamation has been effected by much humbler and consequently less expensive methods than those carried out by the Duke of Sutherland, hereafter to be described, although the classes of soil are very similar. At one period the bog was covered with trees, which have now

wholly disappeared, but the trunks and roots of which are still existing in the soil. The case is worth recording here, if for no other purpose than to serve as a contrast, and it is a suggestive and practically useful one—with which purpose, indeed, Mr. Henry cites it—to the extensive but much more expensive operations of the Duke of Sutherland. The cost of the works of reclamation of these come to something like a rent-charge of 39s. an acre, a charge which, Mr. Henry justly remarks, would be strictly prohibitory in the majority of districts; but when the works, as in those of Mr. Henry, can be done so as to keep the rent-charge—*plus* the ordinary rent of the farm—down so low as 15s. to 18s. per acre, excellent profits may be realized for the expenditure. The works, however, cited by Mr. Henry were lower even than 15s., being done for 13s. per acre, this including the cost of farm buildings and roads, and all the necessary works connected with the reclamation. In the case cited, the bog rested on a bed of gravel, as bogs often do, or upon beds of clay. The first thing done, then, was to cut the main and the secondary or subsidiary drains right down to this gravel, this being done by the implements much used in Scotland, by which a triangular or wedge-shaped piece of the bog or peat is cut out,—two men cutting the drain, while a third replaces the peats taken out in such a way that a vacant part is left below, this forming the drain, the wedge-shaped peat being well pressed into its place. The smaller or cross drains (see another paragraph on 'Planting on Peat or Boggy Soils' for some remarks on the formation of drains) were, of course, not nearly so deep as the main and subsidiary or secondary drains. These drains last a long time; some made on the same principle in Chat Moss, between Manchester and Liverpool, over twenty-five years ago, are as good now as the day they were first made. The great point to be aimed at in draining the bog or peat is to free it from all *excess* of moisture, but not to render it absolutely dry, for in this case it would become mere dry turf. After the drains have been made for a time the bog sinks considerably—this from the quantity of water taken from it—hence allowance must always be made for this subsidence in making the smaller or cross drains

deeper at first than they are required. With the depression of the bog there comes about a very considerable degree of consolidation in the mass, a very important and valuable point, for it admits of the after processes being carried on, the first of which is digging or ploughing. If the latter operation be done, oxen are better to be employed than horses; if the latter be used, their feet must be shod with broad superficial pattens, to prevent them sinking into the soft bog. When the bog is broken up, the first and most important operation in the reclamation of bog land is gone through. After the lime has performed its work so far as to neutralize the acids in the bog—which is its most important agency in such soils—and reduce it to a condition somewhat like a good soil, it is chain-harrowed. At this point, if designed for grass, this will be found to grow excellently, but in the case under notice it was deemed the better plan to put as much as possible of the land under roots, with farm-yard manure for turnips and potatoes. If lime be unsparingly given, the crop, even the first year, will be a paying one. But the land in this case was put under a proper rotation as follows:—Roots, followed by oats, which were seeded down with clover, the clover occupying the land for two years after the oat crop was taken off, this making a five years' course. By breaking up the soil a second time after a judicious interval of cropping as above named, it is materially improved. It is right, however, to state that Mr. Henry does not think that the reclamation of bogs more than four feet deep will repay the cost of reclamation. Some very striking and successful examples of the reclamation of peat lands are to be met with on the Continent, where large tracts of this abound, as, for example, in Holland. A journal gives recently an account of some very extensive work of this kind in the province of North Brabant, carried out by a wealthy Amsterdam merchant. Some idea of the task this enterprising gentleman undertook may be conceived from the statement of the fact that the area he undertook to reclaim, of some 1400 to 1500 acres, was chiefly under water, and bore by way of produce a single miserable birch tree. This area was a thoroughly peat one, this being in some places as deep as two yards, but principally only a sixth of this.

The land, if the term could be applied to such a watery domain, was bought simply at its fuel-producing value, costing some £10,000. Extensive peat lands in Germany having been cultivated with striking success, the proprietor determined to follow the method there adopted to bring into cultivation the unpromising place he had purchased. The German method consists in the first place in cutting across the peaty surface, ditches 15 feet wide, and at intervals of 25 yards; underlying the peat is sand, and this is taken out in digging the ditches and laid on the surface in heaps. As the surface of peat between the ditches is levelled, this sand is taken and spread over it to the depth of 4 and 5 inches. This so consolidates the peat that horses can walk over the surface, so that ploughing can be done with a subsoil plough, so as to move the under layer of peat, but without mixing the upper layer and the sand which lies upon it. The land is next dressed with manures, of which only three are used, namely, nitrate of soda, dissolved bones, and the now well-known manure kainit. In the use of this has lain the whole secret of the successful reclamation. Of this, the following quantities per acre:—176 lbs. of dissolved bones, the same of kainit, and about a half of this weight of nitrate of soda. This dressing must be applied to the land previous to the sowing of the seed, the first crop best fitted to be taken being oats and rye, but in the course of a year it will grow almost every kind of produce. Thus the gentleman who visited the farm found as farm crops, wheat, barley, beans, pease, oats, rye, Indian corn, clover, and grass land, with turnips, mangolds or field beet, and sugar beet. It should be noted, that while the kainit and the dissolved bones require to be used in the same quantity season after season, the nitrate of soda is diminished as the peat becomes weathered and broken up. The crops, which we have shown to be numerous as grown upon the land thus treated, are exceedingly heavy; moreover, farmers claim for the system another great merit, namely, greater regularity of crops than on other systems.

Reclaiming Land encumbered with Boulders and Rocks.—In many districts there are fields, or what is, perhaps, the more correct designation, tracts or expanses of land—these not yet being

divided off into fields—the surface of which is more or less thickly strewn over with large rocks and stones. These are not, as is supposed by many, indications of poor or sterile land in all cases where they occur, being, in fact, often deposited over the surface of what is soil of excellent quality by one or other of the geological agencies which were at work in remote ages, as, for example, that of the glacier. It is a mistake, therefore, to come to the conclusion that land is poor because its surface is more or less rock-covered,—a mistake probably arising from the fact that such rocky soil is met with in moorland hilly districts. They were dropped in all districts and on all qualities of land, sometimes numerously, sometimes sparsely, just as the glacier process—for that we presume to be the operative one—was placed in situations and climatic conditions favourable or otherwise. Nor does the absence of boulders in good fields now prove that they never had an existence there. By the exertions of our ancestors, in times now long gone by, they may have been removed by labour of which, with our improved appliances, we can form no conception; while even here and there, in fields of the first quality of soil, large boulders are still to be met with in the line of fences, proving that these were either removed to form part of the fence, or allowed to remain in their original position, the fence being arranged to suit their position. That much can be done in improving land by removing boulders and large stones, not only in hilly moorlands, but in lower and more favoured districts, there can be no doubt; and for, perhaps, the most remarkable and successful examples of what can be done, we have to go to other countries, as the Continent and the Colonies, and the United States probably, more especially where rocky land is met with, which, like everything else there, is on the grand scale, in wider expanses and in more wild confusion. As there, so here, the difficulty in the way of getting rid of large boulders is perhaps the reason why the land which they encumber has not been as yet even attempted to be improved; and as there, so here, in many cases this difficulty has not been overcome, because the question has never been asked, Is it possible to do it? In such cases, as in America,

for example, where it has been gone about in the right way, success decided and satisfactory ‘has crowned the work.’ To attempt to loosen—for the large boulders have, in the lapse of ages, got more or less deeply imbedded in the soil—the boulders, to lift and remove them to their new position by the mere power of manual labour or brute force, is neither more nor less than what the *savage* would do; and to continue doing it in this, the age of mechanical improvement, is, if not going backward, at least standing still. There are now various forms of apparatus—indeed, it is no difficult matter to design one, with very simple appliances—by which large stones can be raised with great ease, removed, and deposited where required.

The most obvious primary work to be done is forming the fences with the large rocks. We illustrate in figs. 10, 11, and 12, Plate 37, three forms or methods of erecting fences of this kind. Where the boulders are large and very numerous, it will be a good plan so to take the position of these that they will be in the line of proposed fence, or rather, that line should be arranged to suit the lying position of the boulders. Where these have to be specially removed, it will require some discretion on the part of the foreman in the selection of the boulders. The largest in the wall (fig. 10, Plate 37) go into the bottom tier, and are laid with their longest diameters across the wall. The next tier is made with smaller boulders, laid upon the top of the first so as to break the joints. In this style of wall no trench is necessary to make the wall substantial. But upon most farms the surface earth is valuable as an absorbent in the yards; and if the field is within a moderate distance of the barn, it will pay to skin the surface with the plough wherever a wall is to be placed. Indeed, in clearing such a field, so much subsoil is disturbed, and so many holes need filling, that it will generally pay to take the surface soil from the bed of the wall. The third and last tier of stone is still smaller than the second. A section of the wall is completed by the laying of three stones; and the stones are to be laid in the order indicated, according to their size. In laying each stone, the forward and hind wheels of the machine—if one is to be used—are to be

placed on opposite sides of the wall. The interstices, where they occur, are filled with smaller stones. Plate 37, fig. 11, shows another style of wall, which is desirable where the smaller boulders are more numerous than the larger ones. Stones, weighing from 1 to 2 tons, are laid in double tier for the bottom. These are made firm by filling in with cobbles; and upon this bottom one or more tiers of boulders are laid, to make the wall of the requisite height. Plate 37, fig. 12, shows a wall made of single boulders set on end; and where the rocks are of suitable size, this style of wall is the cheapest and best. The above is an American method of building boulder walls.

Reclamation of Land by Steam Power.—Much as has been done in the reclamation of land by the power ordinarily at the command of the farmer, and much as will yet be done by it, there is no doubt that the future of this, not the least important department of the improvement of landed property, lies in the application to it of that power which has wrought such wonders on the soils of more favoured districts than those which we have been in this chapter considering. In another part of this work, while treating of the general treatment of soils, and in alluding specially to that of the heavy lands, we have endeavoured to show that much as has been done by submitting them to the operation of the system of deep culture, aided by that of autumn working, a vast deal more yet remains to be done before the treasures of these lands can be made available to raise the splendid crops which they alone almost of all our soils are capable of producing; and this we also pointed out could only be done when, to the two systems above named, is added that of steam cultivation; and, as stated at the commencement of this paragraph, so also the case rests with the reclamation of waste lands. It seems invidious, in tracing the history of what has been done in any of the departments of agriculture, where the doing has been on an extensive scale, to single out from the necessarily large body of workers one or two for special note, or perhaps for special praise. But in the case of the subject of the present paragraph, we are spared the awkwardness of this position, inasmuch as there has been but one instance, at least

on the large scale, where steam power has been applied to the reclaiming of waste lands in this country. This example is met with on the estate of the Duke of Sutherland, in the county from which his Grace takes his title. On the estate of the Duke there has been an enormous tract, amounting nearly to 200,000 acres of peat, moss, and other waste lands, which were at one period deemed to be wholly incapable of improvement. They were therefore left for a long series of years literally to themselves. But of late years the Duke, than whom no one is more impressed with the necessity of utilizing the waste places of the land, impressed, doubtless, also with the improvements which had been made on the estate by his predecessors, provided only with the facilities—all too limited—which were then at the command of agriculture, and possessing in himself mechanical abilities of a high order, and knowing well, therefore, what steam had done in the fields of the modern farmer, determined to take in hand the attempt to make it applicable to the reclamation of at least some portion of the vast area of 200,000 acres (correctly, 176,000), of which what might be called the old-fashioned appliances and modes of working had not been able, as we have seen, to utilize any appreciable amount. The quality of the land, moreover—at least a large portion of it—made the power of steam all the more essential, so to say; for it consisted of heavy clay, underlying, as a rule, moss land of a peculiarly difficult character to deal with. This moss varied in depth, but in some places it was exceptionally deep, and therefore added to the difficulties to be encountered. It is scarcely necessary to say that the first process undertaken was that of draining—one, as we have elsewhere stated, which is preliminary to nearly every class of land-reclaiming work. Then followed trenching, after which the ordinary processes were carried out. At the first, horse power was used; and although the results were satisfactory, it was only when that of steam was employed that it became evident the new power was to bring about new results, and these so astonishing that a new era in the practice of land reclamation, even of a most difficult character, was about to be introduced. For it was not only the fact that steam could be used with great precision and amazing rapidity,

but that it was applicable to circumstances so difficult that horse power, however skilfully adapted, could not be made at all available. Nor was the economy of the new power a less satisfactory feature; for, while comparing it with the work done by horses in cases where this was available, the cost of preparing the land by the old system was never under £5 an acre, that of the new was as low as 33s., while experience showed that even under most difficult circumstances that would not exceed £2. But while the land under reclamation presented the cultural difficulties of a mossy surface and a clayey subsoil, a third difficulty of a very formidable character presented itself in the twofold form of heavy stones and massive boulders, and tangled and huge tree roots, the remains of the forest which in olden times had covered the surface of the land. These obstructions, as might be supposed, not only greatly hindered the full power of the steam plough being developed, great as that power showed itself to be, but it caused breakages of a most harassing and costly character—so costly that it soon became evident that, unless some means were discovered and adopted of overcoming the difficulties thus presented, they would greatly retard the work of reclamation, if not, indeed, prevent the scheme proposed from being realized. But at this important point in the history of this remarkable national undertaking—for in its results and their lessons it was truly worthy of the designation—the mechanical abilities of the Messrs. Fowler,—or to put it perhaps more accurately, their talented manager, Mr. David Greig,—joined with those of the Duke himself, succeeded in introducing a form of plough or machine which, in its great success, completely mastered the difficulty. This was the now celebrated ‘marsh-land plough. Were this the place, we might, to the great interest of many of our readers, describe this remarkable invention. Suffice it to say, that by its mechanical arrangements massive stones and boulders present no obstacle to its onward progress; it glides smoothly and easily over them as it meets them, while, by an ingenious application of the common anchor, it does not leave them still to encumber the soil, but moves them, tears them up, throws them aside on the surface of the

land, ready to be removed therefrom; while, at the same time, it leaves the land thrown over in rough furrows, admirably adapted for the carrying out of the succeeding operations of cultivation. Scarcely anything is left for manual or horse labour to perform; the very stones and boulders, which we have above stated as being left by the marsh-land plough on the surface land, are, by an ingenious application of a tilting sledge, lifted from it and hauled along from off the land, and tipped on to that which is not under reclamation. The very trees, indeed, growing on land which is to be reclaimed, are grubbed up or torn out of the soil by steam power, and removed to any part required. To record all that has been done by his Grace during this work would be simply the writing of the history, which would be somewhat voluminous. When the results are more numerous, although those which have already been attained are eminently satisfactory, we trust that this history may be written, so that it will not only record facts, give details, and illustrate points in agricultural practice of the highest value, but will show a right-spirited landed proprietor, with abundant means at his disposal, and a disposition to use them nobly, what he can do in inaugurating an efficient system of working and of overcoming difficulties of no ordinary kind, in realizing a scheme calculated to be of the highest service to agriculture generally, and therefore to the people at large who are dependent upon its products.

The Reclamation of Land at the Margin of the Sea.—We have in a special chapter taken up the consideration of embankments at the margin of the sea, and on the banks of tidal rivers. Of course, the object of these works is the keeping out of the water from the lands which have been reclaimed from the margin. The way in which such lands, after being thus enclosed, are formed, constitutes a very interesting chapter in agricultural economics; and if the scope of our work permitted of it, we should very gladly devote some pages to its details.

Suffice it to say that, so far as the lands or soil on the sea margin is concerned, it is chiefly, if not wholly, formed by the action of the drainage waters of the uplands on their passage to the sea. These bring down varying quantities of soil, which in a variety of ways is arrested before it reaches the

sea, and is spread out, so to say, in layers or deposits of varying thickness, which are intersected by streams running in almost every conceivable direction, causing the formation of islets and deltas of soil. These in process of time become covered with rough, rank, and scanty herbage, the roots and leaves of which, by processes obvious to our readers, add to the depth and consistency of the soil.

Where these operations are continuous, the formation of land which could be put under cultivation would be one of comparatively rapid growth. But another element comes into operation, which retards the formation of solid land, as well as materially deteriorates its value. This, we need scarcely say, is the action of the tides. These, as they flow inwards, bring up with them various materials, some of which, as weeds, are fertilizing; others, in time of storm, such as sand, of the opposite character. On the other hand, at their recession at the ebb, they carry with them frequently, in the form of silt, greater or less portions of the finer particles of the better qualities of the soil brought down from the uplands. But another evil arises from the action of the tides, namely, adding largely to the salt qualities of the soil. To get rid of the saline substances in various forms of chemical combination thus brought upon the land, is the first operation in its agricultural treatment. Land on the sea margin is also formed by the well-known tendency which the sea has, at certain parts of the coast, to recede from the land; and where this is flat, in combination with the land drainage already alluded to, the formation of soil goes steadily on. It is, however, naturally a slow process, even at the quickest, and during it the action of the tides causes various changes in the surfaces and parts of land which have been formed, which, when the land is taken under reclamation, cause the cultivator considerable trouble in dealing with them. Deriving its origin from various sources, it may be conceived that the soil thus formed at sea margins varies very much in its chemical constituents as well as its mechanical characteristics. In some cases it may be sandy, light, and poor; in others, enriched by soils of the first quality brought down from the uplands, it may be such as will ultimately form a loamy soil of the first class; and in other

cases it may be of a heavy, close, and retentive character. All these varying peculiarities bring about the necessity of various modes of treatment, and it rests with the manager of the property to decide which of them will be most applicable to the circumstances. In some instances the soil will be of that doubtful character, and present such mechanical and cultural difficulties, that it will be a question with him whether it will be worth while to take the land under reclamation; but, as a rule, it will be found that land at sea margins will amply repay the cost of their enclosure and cultivation. Many circumstances, however, will have to be taken into consideration before this can be finally decided upon.

An important element, so far as the cultural points are concerned, is the character of the lands, taking them at their average, through which the drainage waters pass in the land bordering the sea, and, so far as the structural ones are concerned, the nature of the soil on which the embankment is to be formed. Nor must the character of the coast itself be kept out of view; on the contrary, it is of vital importance, for, if exposed to violent storms, for example, it is obvious that considerable difficulties will be thrown in the way, not only of erecting the embankment, but of keeping it in good order afterwards. Nor must the character of the soil, and the materials which are at hand useful in the construction of embankments, be lost sight of; for if these be poor or deficient in quantity, and so necessitating their being brought from a distance, the cost of the works may be such as, taken along with other circumstances, to render the general work of reclamation such a costly one that it would not pay to undertake it, or, at the best, involve such expenses as not to repay the labour, trouble, and cost involved. The legal rights, also, of neighbouring proprietors is an element to be taken into consideration; for not only may these involve the cost of compensation, but they may afterwards raise awkward questions in case of accidents happening to the embankment, causing floodings not only of the land reclaimed on the estate, but on adjacent properties. All these are points which show that the decision as to whether land at sea margins should be reclaimed is one involving considerations of great importance, and which, if

neglected by the agent, may involve the proprietor in heavy loss.

In bringing land of this class under cultivation, the first work to be done is to enclose the area intended to be reclaimed by a broad and deep drain or ditch, which may be said to be a continuation of the 'delph' (see chapter on 'Sea Margin Embankments'), and about the same dimensions. The depth allows of about $3\frac{1}{2}$ feet of water to stand on an average in the ditch, which will thus give a depth of 18 inches below the level of the soil or general surface, the object being to drain or freshen the soil to this depth; less may of course be done. With a fall of a foot and a half to the mile, with a width of 10 feet at the level of the water, and a depth of this of 2 feet, the drain or ditch will discharge about 1193 cubic feet per minute. To bring the soil of the enclosed area within the influence of the drainage, it is cut up, so to say, into a series of compartments, these being arranged, with the ultimate cropping or cultivation kept generally in view, by small drains. The distance between these is also regulated according to the nature of the soil, heavy soils requiring closer, lighter ones less frequent drains. As in the case of the drainage of peaty soils, bogs, etc., these drains should be deepened gradually, the period varying according to circumstances before they reach the depth of 18 inches, or that named above to which the enclosing ditches go. In process of time the different areas or compartments of enclosed land become consolidated, and, by the continued passage of fresh drainage water from the uplands, as well as by the rain falling on the surface along the drains, and the consequent drainage of the parts between the minor drains at the same time, it is in time deprived of its saline constituents. The level, moreover, of the surface has been raised more or less by the silt or mud taken out of the drains in the process of originally deepening, and afterwards keeping them in good order, this soil being thrown out and spread over the spaces between the ditches as uniformly as possible. On many parts, natural herbage—referred to in the first part of this chapter—will have appeared, and will afford 'bites' of pasture to sheep, and in some cases, where the land is most consolidated, to young stock, which are

gradually fed off them, the droppings of which will tend to enrich the soil, as their going to and fro will tend still further to consolidate it, and render it fit to be cropped.

As a rule, it will be the better plan to make this cropping serve for pasturing purposes, which will pave the way, so to say, for arable culture at a later period in the reclamation. The grass seeds sown down will depend upon the soil and upon other circumstances, and it will be well to test a plot or two, to make sure of the best system of seeding to be adopted. The succeeding arable crops will also be dependent upon soil, etc.; but some soils of a heavy character are so rich in manurial constituents, that crops of wheat and beans may be taken off for a long course of years without requiring the addition of extra manures, although this practice is not to be recommended for adoption as a general rule. While these operations of regular culture or crop-raising are going on within the area enclosed by the banks and the inland ditches, what may be called irregular or natural culture is being carried slowly out, where the nature of the coast, etc. admits of it, outside the main embankment seawards. These plots, as we have explained in a separate paragraph, go by the name of 'saltings,' and where the foreland is favourable, no small amount of good pasturage both for sheep and cattle may be obtained from them, on which the cattle thrive well, and of which they are very fond, from the salt flavour naturally imparted to the grass, which all live stock like so well. The only objection to allowing stock to get on the saltings is that from them they have access to the sides and top of the bank, to which they do much damage—so much that it may be safely said that they cause the bank to require repair very much sooner than it would otherwise do. Although somewhat expensive in the first instance, it is unquestionably the most economical plan in the long run to fence off the embankment, so that the stock cannot get upon it from either side. Inland, the 'delph' forms a water fence between the interior enclosed compartments or 'marshes,' as they are generally termed, and the bank; but as the space between the delph and toe of the bank is soon covered with good natural herbage, farmers cannot resist the temptation to turn stock upon

it, hence this side should be fenced also if this practice be followed.

In some cases the 'levels' do not admit of the drainage water of the enclosed area passing off from it naturally through the culverts, etc. to the sea, but machinery has to be employed to lift it from the low level, and pass it over the embankment to the sea. Sir William Fairbairn invented an excellent form of scoop wheel, which has been used with great success, a modification of the well-known mechanism of that name used so extensively in Holland. The centrifugal pump, such as the kind made by the celebrated firm of the Messrs. Gwynne of London, who have fitted up many for drainage purposes, is also largely used. We might cite numerous instances of drainage of reclaimed land by steam-wrought mechanism, but the following description of that used at the well-known Martin Mere, near Southport, in Lancashire, will give a fair idea of the general arrangement of such methods. The embankments were made more than usually steep, with a slope uniform on both sides of $1\frac{3}{4}$ to 1, the width 16 feet, the height 4 feet, and width of top 2 feet. For a width of 2 feet the centre was puddled with clay, the puddling being continued below the foundation-line a distance of 2 feet. The watercourse for conveying the waters to the scoop wheel was placed at a distance of 19 feet from the embankment; the soil taken from the watercourse was used to form the embankment. The dimensions of drainage ditch or delph were as follows:—The width at top 11 feet, the width at bottom 4 feet 6 inches, and the depth 9 feet; to form 20 cubic feet of the embankment, it took 25 cubic feet of excavation. The engine working the scoop wheel is 20 nominal horse power; the diameter of scoop wheel is 30 feet; the width in breast of floats, 16 inches, working in a wheel-race of $16\frac{1}{2}$ inches wide; the length of floats is 8 feet 4 inches, and they are set as tangents to a circle of 9 feet diameter; the extreme dip of the wheel is 4 feet 4 inches; the speed at which it revolves is $4\frac{1}{4}$ revolutions per minute, giving a velocity at the periphery of 400 feet; this is found to be the best speed. The following mode of calculating the water lifted by a scoop wheel may be useful. The following are the data required:—

'The speed of the wheel, its width, and the "dip" or depth of the water through which it passes. To show the application of these, let us assume the depth of water to be 2 feet. As the diameter of the wheel is 30 feet, the diameter of a circle the arc of which passes through the centre of the water will be 28 feet. Then, the diameter being 28 feet, the circumference will be (28×3.1416) 87.9048 feet. From this deduct 10 feet for the space occupied by the 40 float-boards and framing (being 3 inches for each), which will leave in round numbers 78 feet. Next multiply this 78 by the number of revolutions per minute (in this instance $4\frac{1}{4}$), and we get $331\frac{1}{2}$, which, again multiplied by the width of the float-boards or scoops, $1\frac{1}{4}$ feet (the exact width is 16 inches, but half an inch on each side up to the walls is considered unavailable), makes $414\frac{1}{4}$. This multiplied by the depth, 2 feet, is $828\frac{3}{4}$, nearly, say 829, the number of cubic feet discharged per minute. Then 829 divided by 36 (the number of cubic feet of water in a ton) gives 23 tons.'

Warping of Land.—As irrigation is a method of passing water over the surface of land which is either naturally covered or artificially provided with a grassy surface, in order by the action of the water to increase the quantity and quality of the herbage, warping of land may be said to be the converse of this process, being the formation of land or soil on surfaces not previously provided with it, but which may be devoted to the general purposes of agriculture, not specially to that of the production of herbage. Warping is carried out on the banks of tidal rivers, the waters of which contain large supplies of silty matter or soil, which is brought down from the upper lands; and as these are chiefly alluvial deposits, this suspended silt or soil is as a rule of a highly fertilizing character.

Simply described, warping is just the arrangement of certain simple contrivances which collect or arrest the onward flow of the water so as to bring it into a state of quiescence, in order to admit of the suspended matter being deposited, so that when the water recedes through the action of the tide, a certain thickness of soil is found deposited on the surface. This principle, simple as it is, is carried out in

practice in a variety of ways more or less complicated, according to the character and extent of the operations. Possibly the simplest of the plans adopted for warping—and its brief description will give a very fair idea of its general principles—is the carrying out of structures, if the term may be applied to such rudimentary appliances, composed of a series of stakes stuck into the bed of the river at or near its margin; and these, intertwined more or less closely with twigs or fascines, decrease the rapidity of the inward flow of the water, causing more or less deposits of solid matter on the surface of the river bed. As these deposits increase in thickness, the water naturally assumes a less and less depth, till, under ordinary tides, in some cases it recedes and does not overflow certain portions. These in time become more and more consolidated, and vegetation, derived from one source or another, begins to appear in small patches, the extent of which gradually increases, as well as the solidity of the land, till it is able to bear the weight of an occasional sheep or two, the manure of which tending still further to increase the fertility of the soil, and also, by obvious processes, to add to the variety of the vegetation, land is gradually produced. It is in this way, although the simple appliances of stakes described are not used, but the small deposits of soil caused solely by the action of rivulets or rivers passing to the sea from the interior land, that the tracts of land known by the name of ‘polders’ are produced on many parts of the coast of the Continent bordering the North Sea and the English Channel. The soil of these lands is of such amazing fertility, that—more especially, however, those known to us as wheat soils—the richest crops of all kinds are grown for a succession of seasons ranging over a period even so extended as little short of half a century, without the addition of any manure whatever.

Warping on the large scale, as executed in this country, becomes, however, a process involving many details of a complicated character, and also an expenditure more or less great, according to circumstances, but in all cases considerable. The first work to be done is the erection of a river bank, enclosing an area which is to be warped, the height of which must exceed that of the highest spring tides, so that the river water

shall be kept from overflowing. At a certain convenient part of this river bank a sluice is formed, the object of which is to allow the water of the river, as it flows upwards, to gain access to the enclosed area, and after remaining therein for the period necessary to allow its suspended matter to be deposited, during which the sluice is kept closed, the sluice is opened on the ebb of the tide, to allow the water to be drawn off. The withdrawal of the water from the enclosed area, it need scarcely be said, is done slowly, so as not to disturb the deposited matter. This operation is repeated again and again, until the necessary depth of soil is formed, which is, of course, uniformly level throughout its surface. In conjunction with the main bank and enclosed area, a series of drains or channels are formed within the area, these being so distributed, arranged, and worked by means of minor stops or sluices, as to divide it into a series of compartments, which aid materially the regular deposit of the soil, according to the requirements of the cultivator. The area of land enclosed from the river by the bank is on the land side provided with another bank, which has openings at certain points by which the drainage water of the interior district is passed into the area, and what may be called minor banks are formed along certain of the interior channels previously alluded to. All these interior banks are, of course, of the same height as the river bank; and although well and sufficiently formed and strongly constructed, are not so strongly made as the river bank, which has to resist greater pressure. Such may be taken as a general description of the system of warping; but the details vary according to the nature of the land enclosed and the nature of its surface.

Reclamation of Neglected Land.—In many districts there are considerable tracts of land, as alluded to in the opening remarks to the work, which, having been well or moderately well cultivated, have, by a variety of circumstances, been allowed to fall into a condition of neglect, in some cases approaching to that of land which has never been reclaimed. In improving land of this kind there is a wide field for the labours of practical men who know their business,—a field which is sure to yield highly valuable and satisfactory results.

We can but glance in the briefest fashion at its points, for it is obvious that the practice will vary considerably, according to the conditions of soil, locality, and climate, and also as to the point of neglect which the farm may have reached in the descending scale. The following is an example of successful reclamation of waste land, which, when first taken in hand, was in such a wretched condition that any attempt at its improvement seemed, even to the sanguine enthusiasm of the farmer who was concerned with it, to be almost wholly hopeless. The arable land, bad as it was, had been made infinitely worse by a system of overcropping and by general gross mismanagement; while the bad land under pasture, if such it could be called, had been made worse through its soil having been to a large extent denuded by paring, not for burning and returning to the soil as manure, but for the purpose of serving as fuel, thatching the wretched hovels on the farm, and for various purposes in which turf is required. The surface was thickly strewn with stones, and with many boulders of large size. The whole came under the class of moorland overgrown with heather. The soil of the arable land was heavy black earth, resting on a clay subsoil.

The following was the system adopted for improving this wasted land for arable culture. The first operation was to trench-plough the land to a depth of 10 inches in the late summer or the early autumn months, the opportunity being taken to remove such stones as could be removed by the crowbar from the soil. After

the ploughing the land was gone over by a strong iron brake-harrow, in order to tear up the heather, break up the turf, and to loosen as well the surface stones and those lying immediately below it. The land thus prepared was left all winter to be weathered by the action of the atmospheric influences. In the spring and during the summer and autumn months a course of operations was begun and carried on, consisting of the removal of the stones, drainage, and trench-ploughing a second time, this being done now to the depth of from 12 to 14 inches, and liming, at the rate of 24 bushels to the acre, being the last operation, this being done in autumn. Left thus all the winter, the first work done in the following spring was turning into and mixing the lime with the soil by means of the brake-harrow, this being succeeded by a finer harrow, still further pulverizing the soil and bringing it to a condition of good tilth. The land was next manured with farm-yard dung at the rate of 40 cart-loads to the acre, each cart-load averaging a ton weight, from that down to, say, 18 cwt., or a cubic yard of manure. This manure was then well harrowed into the soil. Thus prepared, it was sown down thickly with oats. The rotation adopted was the five-course system, wheat being excluded, as the soil and climate were not suitable for this crop,—the course being, first year, oats (as above explained); second, rye-grass; third, pasture; fourth, oats or barley; fifth, green crop. The average cost per acre of the improvement was within a trifle of £19.

DIVISION FOURTH.



EXTRA OR EXTERNAL SOURCES OF REVENUE OF THE PROPERTY DERIVED FROM OTHER THAN THOSE PURELY AGRICULTURAL—STONE AND LIME QUARRIES—MARL PITS—CLAY BEDS—LIME KILNS—BRICK AND TILE YARDS AND KILNS—BURNING OF CLAY—REFUSE OR WASTE WOOD OF PLANTATIONS—REFUSE OF PONDS OR MUD, AND FROM THE UTILIZATION OF WASTE OR NEGLECTED MATERIALS OF THE PROPERTY—ICE AND SNOW HOUSES—PARTS OF THE PROPERTY ADAPTED FOR GENERAL BUILDING PURPOSES—LAYING OUT OR DISPOSITION OF THE SAME FOR VARIOUS CLASSES OF HOUSES, ETC.

CHAPTER I.

STONE AND LIME QUARRIES, MARL PITS, AND CLAY BEDS.

Introductory.—Hitherto we have been considering landed property as a source of revenue derived from the cultivation of the land, and the various modes by which it could be directly improved, noticing such cognate operations and structures as tended to that end. Some subjects, although apparently coming within the above, have, for reasons connected with convenience of consultation, been purposely omitted, but will be found in the last division of the work. All these come under what some may designate as the legitimate or regular sources of revenue of the property; but even a comparatively slight consideration of the whole subject will show that there are other resources from which this may be improved. Several of these will be seen by a glance at the head of this division; but even in addition to the subjects there named, there are others which must not be omitted in summing up the total sources from which the proprietor may increase his income. It will be seen as we proceed that some of those have been greatly overlooked, many of them, indeed, considered as too insignificant to be thought of. But we trust to be able to show, that even from the most insignificant of the departments named, or what may be considered as such, no inconsiderable amount may be realized by careful management, and that, when all are added together, a sum will be produced which no careful agent will deem unworthy to contribute to the general funds of the property. Nor are we hope-

less of being able to show that the mere attempt to make those neglected sources of revenue available, will result in introducing such order as will enable the property to be looked upon as one in which completeness of management of every, even the most minute, department is a marked and gratifying feature, and one worthy of general imitation. There is little fear that such important sources of revenue as plantations, quarries of different kinds, marl pits, clay beds, shootings, fishings, etc., will be neglected or overlooked as bringing in funds; but there is some chance, to say the least, that other sources, such as we have just alluded to, will be almost wholly forgotten. We proceed, however, on the assumption that it is wise to make available every source of income, to admit of no waste or unnecessary loss in any department of the property. There is scarcely a farm, to say nothing of the property itself as a whole, which does not as a general rule abound in materials allowed to lie here and there in much disorder, but which, if collected and properly used, would be of no small value in one or other of its many departments. To allow them to lie unutilized is not merely a waste of means, which a careful agent will avoid, but they form, as above hinted at, eyesores to those who have the love of order developed. This order has always a reflex influence of a valuable kind upon the mere labourers of the farm or property, making them more careful in every way. But it may be urged that one

does not know very well how such waste materials, as they are generally called, can be used. But in truth, in view of what is now done in almost every other branch of industrial work, it is difficult to say what is waste; and we trust to be able to show how what is now regarded as such on landed property may be turned to excellent account.

Having offered these, we hope not unsuggestive, remarks as introductory to an important department of our work, we now proceed to take up its various details in succession.

Quarries.—The first we have referred to is the quarries of the property, such as stone and lime, and in which may be included slate. Of course it is not to be supposed that every property is so fortunate as to possess quarries of all those materials. Some, indeed, either from their limited extent, or from the geological formation of their soils, locality, etc., may be destitute of them all, or a property may have but one class only of the materials named; but where they are met with, considerable judgment will be required to make the materials so available as to yield the largest amount of revenue. A property may be exceedingly rich in the materials named, but their distribution or locality may be such that they cannot be made available in this way. Quarries may be opened and worked at considerable expense, but it may be found that, save in their immediate neighbourhood, and for the comparatively limited amount of work which the property there will itself require, no extra sources of demand will exist. It is possible to buy gold too dear; the quartz which contains it may be very rich, but the process of crushing may cost more than it realizes. When, therefore, a property is found to possess even extra abundant and good supplies of such materials, it will be necessary to examine carefully all their conditions before deciding upon going to any great expense for working. Nor, under certain very favourable circumstances as regards extent and quality, will it be money thrown away to secure the opinion and advice of a competent mining engineer, who may be able to show that a large amount of revenue may be obtained from the quarries. The best situation for these will obviously be that near to or within a reasonable distance of a town, a railway station, a canal, or

a seaport. But the engineer may be able to show that it might pay well to put down a tram rail or way, leading to one or other of these outlets, should the quarry be situated at some distance from them; and it will be in deciding upon the various circumstances that the *nous* of the agent will be called upon for its display.

The varieties and sub-varieties of *building stones* are very numerous, the classification being the ‘granites,’ the ‘limestones,’ and the ‘sandstones.’ Sometimes the granites and the sandstones are classed together as the ‘siliceous,’ while the limestones are known or classed as the ‘calcareous’ and the ‘argillaceous.’ There are only two varieties of granite—the grey and the red; of the limestones there are many varieties, which are classed generally under three heads—‘oolitic,’ the ‘magnesian,’ and the ‘shelly.’ The first of these classes furnishes the most valuable of building stones, such as the ‘Portland’ and ‘Bath’ stone. Of ‘magnesian,’ that of Bolsover in Derbyshire has a high reputation. Of the ‘sandstones’ the varieties are also numerous, the best in Scotland being the ‘Craigleith.’ In England, the ‘Darley Dale’ and the ‘Mansfield’ are highly thought of. Of the argillaceous class, the only practically useful representative is slate. Stones vary exceedingly in quality, some being practically everlasting, as the granites, whilst others, such as the sandstones, are almost worthless for building purposes. Hence, as in the case of the limestones, will be seen the advantage of having professional advice as to the building stones of the property. It is right, however, to state that we know comparatively little both of limes and of building stones, although professional men, of whom it is only just to state that the Continental scientists have taken, if they are not now taking, the lead, are now paying close attention to the whole subject. Of slate we need say but little, save that if of good quality, and the quarry be extensive, there is a mine of wealth lying in it for the proprietor.

For stone there will obviously be comparatively little outlet on the property itself, unless the quarry be so favourably situated that its materials can be distributed economically over a pretty wide area where road making and building, etc. are going on; and should there be no

other demand for the product, working will of course be of proportionate extent. But where a quarry is situated in a locality from which it may be easily transported to places at which there is a good and regular demand for the stone,—as, for example, in a suburban district where building is going on, for which see a chapter in the present division,—its value will rise in proportion, and its regular and extensive working will then become a matter of the utmost importance. A good *lime quarry* may be considered a most valuable acquisition to any property. There is always a large demand for this material for various industrial operations; and if the product be extensive, it will come under the category shortly before named. But lime plays such an important part in farming, that it will be in the generality of cases worth while to have a kiln or kilns erected for its burning, a description of which will be found in Chap. II.

With some it is popularly believed that lime shell, as it is called, is the same form in which limestone is found naturally. It is scarcely necessary to say that this is altogether erroneous; what is really limestone is the combination of lime, such as is found in 'chalk,' 'marble,' etc., with 'carbonic acid.' When this carbonic acid is driven off by heat, then the result is 'lime shell,' or 'shell lime,' or frequently 'quicklime.' This 'quicklime' or lime shell has a remarkable affinity for moisture; so then, when slaked or slacked with water, or even by absorbing the moisture from the atmosphere, it crumbles or crackles into pieces, and finally assumes the form of a fine powder, which is chemically known as a hydrate of lime. If water be added in sufficient quantity, together with a certain proportion of sand, what is called mortar, or, more popularly and universally, 'lime,' is formed, which has the property of hardening in time. If to the powder or hydrate of lime, water is added till it becomes a thin paste, and if left in this condition for some time, it hardens by again taking up the carbonic acid from the air. Hence the absurdity of allowing lime which is to be used for manurial purposes to lie exposed on being brought from the lime-kiln, for it becomes, simply by process of time, which enables it to absorb moisture from the atmosphere, a hydrate of lime, which in turn hardens, and be-

comes as incapable of being absorbed by the soil as old or hard mortar will be. Limestones are, so to say, very capriciously distributed throughout the country, in some parts being met with in small bulks, and these widely separated, while in others whole districts are formed of it, and to such an extent—as, for example, in Derbyshire—that they are often termed limestone counties. Its position in the soil also varies very much—in some cases cropping up to and capable of being worked directly from the surface, while in others it lies more or less deeply, and quarrying has to be resorted to. Limestones are of different qualities, and the mortar made from them possesses essentially different properties. They are generally classed as 'common,' or 'rich and fat,' and 'hydraulic' or 'poor.' The common limes have not, while the hydraulic have, the property of hardening under water. The hydraulic limes, which are exceedingly valuable in proportion to their quality, are comparatively rare, the most valuable in the country at present being that known as the 'Blue Lias,' which is found at Lyme Regis, Barrow. The 'Dorking' and 'Halling' are also well-known hydraulic limes. From what we have thus said, the advantage will be seen, of the proprietor or his agent having the benefit of professional advice on deciding to work the lime quarries of the estate.

Marl Beds.—While a bed of clay can be used both for the purpose of making drain tiles and tubes, bricks, and flooring and roofing tiles, as well as for manure when burnt and applied to heavy soils, a marl bed is used wholly for manurial purposes, and is highly valuable in improving soils when applied as top-dressing and gradually mixed with them; and some varieties of it, as shell marl, is peculiarly valuable as a top-dressing for grass lands, both in its natural state or when burnt in the same way as lime. Marl is often confounded with clay, to which in many instances it bears so strong a resemblance that it is often exceedingly difficult to decide which is marl and which is clay. It is not easy, therefore, to define what marl is, or to explain its physical characteristics, without going into a close detail of the different kinds met with, which is foreign to the purposes of this work. Generally, it may be said to be an earth or soil capable of becoming pul-

verized or changed in physical characteristics by the action of the atmosphere, and is composed of earthy materials more or less varied in kind, and with which is mixed carbonate of lime in greater or less proportion. It seems to have had its origin in the gradual decomposition of the calcareous rocks, or of shells either of marine or inland formation, and generally is made up of substances partaking of the characteristics of these, as well as of argillaceous or clayey substances. Mechanically or physically it is distinguishable from clay, to which, as already stated, it often bears externally a close resemblance, from the tendency it has to pulverize when exposed to the air, or to become under the same influence, or of that of rain or water, a loose material, capable of being easily spread over the surface of, or mixed with soil, which forms one of its valuable characteristics. In the improvement or alteration of the mechanical as well as what may be called the manrial condition of soils by means of the application of marl, judgment will have to be used as to the kind to be employed. Thus, in the mixture of light and sandy soils, a clayey marl will be required; as, on the contrary, in the case of heavy soils, a sandy marl will have to be employed. The quantity applied must be also carefully considered, for over-marling is calculated to do, as it has not seldom done, a large and, in some cases, a permanent amount of mischief. As before stated, it does not form part of this work to enter into details of uses of manures, or of such applications as marl, clay, and lime; all that we have to do is to point out in a general way their characteristics, varieties, and sources, etc. from which they may be obtained. With this object in view, we have to glance, then, at the leading varieties of marl. Perhaps the most valuable—indeed it is classed as the most valuable—of all the marls is that which is generally known (1) as ‘shelly,’ and to which allusion has already been made. It is found in drained marshes, bogs, lakes, and deposits of water in alluvial districts which have been stagnant for a long period. It owes its formation to the deposit, through long periods, of the remains of minute shell-fish and of the organisms of the infinite variety of insects, etc. which abound in stagnant waters, mixed with sand, mud, and silty matter composed of various

earths. It is a bluish-white in colour, somewhat resembles in appearance the well-known detergent fuller’s earth, and, although close and retentive like clay when dug up, pulverizes on being exposed to the atmospheric influences, and is capable of being spread as a top-dressing for pastures, for which it is exceedingly valuable, as well as for clover, or being mixed with soil under arable culture. (2) Argillaceous or clayey marl is sometimes classed as a subdivision of what are termed earthy marls, in which sand (siliceous constituents) and clay (argillaceous constituents) are predominant over the chalky (calcareous constituents). The clayey marls are exceedingly useful for mixing with sandy soils, rendering them more compact, and adding to their richness and capability to bear crops, which sandy soils *per se* are not calculated to produce, or but poorly. Clayey or argillaceous marl, as its name imports, resembles clay of a close, adhesive character, somewhat softer, and being more oily, so to say, can be worked like paste; but, like all other marls, on being exposed to the atmospheric influences, pulverizes or falls down. It is often found underlying peaty or mossy soils, and when brought up and mixed with the upper layers of peat, it forms with this a dark, unctuous substance, reducing in some way the humus or vegetable matter very much after the manner of doses of mild lime. All the clayey marls are, as already stated, valuable for mixing with and improving light soils, in which there is an excess more or less of siliceous or sandy particles. (3) Sandy or siliceous marl is valuable, on the other hand, for lightening heavy, adhesive, clayey soils; it is less pasty than the clayey marls. It varies in colour from dark brown to a bluish tint; it feels to the touch in working in the hand more or less gritty, and exposure to the atmospheric influences slowly pulverizes it and breaks it up. It is found chiefly in connection with limestone gravel-pits. (4) Stony marl, as its name indicates, is harder than the other marls, and is exceedingly variable in quality,—so much so, that, abounding in shelly matter, it is almost as rich as shelly marl, or so poor in calcareous constituents as to hold a very low position amongst the earthy marls. Stony marl of an average quality, like the sandy marls, is useful in mixing with and lightening

heavy clay soils. (5) Chalky or calcareous marls closely resemble in external appearance nodules of soiled chalk, which, on exposure to the air, crumble away, so as to be very readily mixed with soil. It is scarcely necessary to say that they are rich in calcareous matter. That all the marls are composed, in varying proportions, of carbonate of lime mixed with various substances, is proved by their behaviour when subjected to the action of acids, effervescence in such cases taking place with greater or less vehemence, according to the proportion in which the carbonate of lime is present. As this constituent gives to marls their chief value as manurial agents, at least greatly adds to it in the case of many, this 'behaviour' with acids affords to the farmer a rough-and-ready means of ascertaining the character of any marl he may happen to meet with on his farm. Some marls do not effervesce under the action of acids, yet are they marls, popularly so called; but they are of that class which occupies a position very difficult accurately to be defined, between a true clay and a true marl, and yet they may be found useful in

certain circumstances. Nevertheless, it will be well, before largely applying marl of this class, to have it analyzed, so that its character may be closely ascertained, and the farmer may be able to know how best to use it, and to what soil and crops. In addition to the uses of marl in its natural form as a means of changing the character of soils of certain fixed peculiarities, —sandy marl with heavy clays, clayey marl with sandy soils or light loams, shelly marl with peat soil, which it soon changes into a rich, loamy soil,—they are also specially valuable in the formation of compost heaps, in conjunction with various kinds of organic substances, peat soil, and liquid manure. To conclude, all the marls perform highly important functions in improving soils and the crops which they bear, and those functions are of an exceedingly varied character; still they require to be used under or with a correct knowledge of their characteristics, for, improperly used, they do harm rather than good, or at least by no means yield the benefits which they would do if applied under circumstances calculated to make the most of their useful constituents.

CHAPTER II.

KILNS—LIME-BURNING KILNS—BRICK AND TILE KILNS—CLAY-BURNING KILNS.

THE subject of kilns is one which embraces so many points, and includes such a variety of forms,—those ‘patented’ alone being numbered by dozens, or rather scores,—that a volume of no mean bulk could easily be written upon, without fully exhausting it. For the general purposes of the estate, however, it is only necessary to give descriptions and illustrations of the simplest forms, so that these be efficient and economical in construction and working. The first class which we shall take up is that of *Lime-Burning Kilns*. The simplest and cheapest form, and that which is indeed the most general in use, is that in which the furnace or calcining chamber is excavated out of the solid limestone rock, and near one of the outer faces of the most conveniently situated part of the quarry, the upper or open end being so placed that the limestone can be wheeled on the shortest route from the point at which it is quarried, and ‘tipped’ into the body of the furnace below. The shape of the excavated part is that of an inverted cone, as illustrated in the section in fig. 1, Plate 47, this being drawn to a scale of 1-8th of an inch to the foot. The diameter of the cone at top is usually between 12 and 15 feet, and the height equal to the diameter—as $a b$, fig. 1, Plate 47. The conical part at its lower and smaller end terminates at the level of the fire-bars, $c d$, which rest upon cast-iron bearing bars, $e e$, which are so placed in the brickwork of the lower part that they can be removed at pleasure. This lower part, $c e f f$, is about 3 feet in diameter and 4 feet high, forming the ash-pit, h , the floor of which is on a level with the floor, $g g$, of the store shed in front of the kiln, the front wall and roof of which are shown at $i j$. The front wall, $a c$, of the kiln, $a b c d$, is built of brick,

either 9, 14, or 18-inch work, according to size of the kiln and other circumstances, and supports an arch, k , forming the roof or top of the opening in front of the ash-pit, h . The height from under side of the arch to level of floor, as $k l$, should be such as easily to admit a man standing when withdrawing the lime. This withdrawal is performed by pulling out the middle or central bars of the fire-grate, $e e$, which bars are provided with eyes at their outer end, to admit of a crow-bar being inserted when the bars have to be pulled out. When this is done, the calcined lime-shells then fall into the ash-pit, h , and are withdrawn by the man standing under the arch, k . As the lime-shells are apt at times to get jammed or adhere together, the front wall, $a c$, of the kiln should be provided with an opening just above the level of the fire-bars, this opening being supported by a wrought-iron frame some 3 inches wide: by means of this opening the jammed shells can be released so as to drop into the ash-pit. The opening is also useful in lighting the fuel used to calcine the lime. The back part of the kiln, excavated out of the solid chalk or limestone of the quarry, is lined with brickwork, as $b d$; this being backed with blocks of fresh solid limestone or chalk, $m m$, set in good mortar. It is scarcely necessary to say that the brick used for the back lining and front wall of the kiln must be of the very best quality, calculated to withstand the strong heat; and if fire-bricks can be had, so much the better constructed will the kiln be, and the longer will the lining last without repair. This form of kiln is generally known as the ‘perpetual,’ as, from the fuel and the limestone or chalk being mixed together, or rather placed in alternate layers of about a foot in thickness, and consumed in the furnace

or kiln, it can be carried on as long as may be desired. It is obvious, however, that from its form much of the burning material is placed near the top, and that, therefore, a large percentage of the heat flies upwards and is lost; while another disadvantage is that cinders, etc. get mixed with the calcined lime, and thus render it unfit for building purposes, as coal must be used as the fuel, wood not being admissible. Where, therefore, the lime is required to be burnt for purposes other than agricultural,—for use on the land, where cinders, etc. are no disadvantage, but in some soils, as heavy clays, are rather the reverse,—another form of kiln has to be used. This is known as the ‘intermittent,’ and a simple form of it closely resembles the rectangular brick or tile kiln. In this the chamber in which the lime is burned is heated by two or more furnaces, arranged with arched tops, with openings as in the brick kiln, through which the heat passes up to the limestone packed within the rectangular chamber. A usual size is 14 feet long, 12 broad, and from 9 to 10 feet high, inside measurement. This form of kiln, like that of the brick kiln, is often an independent structure, as it cannot be built against the side of the quarry, like the perpetual kiln already described—one of the advantages of the latter form—although one end may be built up against the wall or solid rock of the quarry, as at *a a* in fig. 2, Plate 47. It also requires greater attention than the perpetual kiln, but, on the other hand, it admits of a superior quality of burnt stone being obtained, and in small quantities as desired; whereas in the perpetual kiln the quantity burnt at a time is large, and to work it most economically it must be kept going for a length of time, as its name implies—a circumstance which makes it available only in a district or on a property where a large demand for lime-shells for manurial purposes exists. Lastly, the intermittent kiln is much less costly in fuel than the perpetual, as the heat is economized almost to a maximum. On many estates where land is to be reclaimed, on which there is a vast number of roots and parts of wood trees, etc., taken up in the course of putting old forest and similar land under cultivation, an intermittent kiln is of great use, as the timber may be used as the fuel to calcine the

limestone, as well as to burn bricks, tiles, and the like. In fig. 2, Plate 47, we give a longitudinal section of a form of one, which, however, may be modified as desired. The number of furnaces will vary according to the size of the kiln, but for one of the dimensions above stated these will suffice: each furnace is 18 inches wide, with a fire-bar surface of like width, and 3 feet long; the height from the floor level of the kiln, as *c d*, fig. 2, Plate 47, is 18 inches to the under side of furnace bars, and 21 inches from top of bars to under side of the arch, as *c f*, and as shown in cross section in fig. 5, Plate 47. These arches are turned in 9 inches deep brickwork—if of fire-brick so much the better, as, indeed, should be the lining at the back, *g*, fig. 2, and the inside lining of front, as *i j*. The fire-bars rest upon cast-iron bearers let into the brickwork, and the usual dimensions of the fire-bars are $2\frac{1}{2}$ inches deep by $1\frac{1}{4}$ thick, and placed with intervals of $\frac{3}{4}$ inch between them. If not buttressed, the walls of the kiln are 3 feet thick, but at ends and front, buttresses, as *a b*, fig. 4, Plate 47, projecting 3 feet outwards, may be constructed, adding to strength of inside wall, as *c d*, fig. 4, Plate 47, while the void spaces, as *c*, may be filled in with small blocks of hard limestone rock, rubble-work fashion, set in mortar, as shown at *f*, fig. 4, Plate 47. The best mortar for inside work to stand the heat is fire-clay, although a mortar made of light loamy clay hardens into good mortar resembling fire-clay, and without cracking. To allow the heat from the furnaces to escape upwards into the body of the kiln, the arches are not solid, but are provided with apertures, as shown in section at *a a*, fig. 5, Plate 47, and in plan of top of arch at *a a*, fig. 6. The distance between these apertures along the length of arch is 14 inches in brick-and-half work, as *b c*, fig. 6, Plate 47, the width across the arch at top, as *a b*, 5 and 3 inches on the under side, as *b*, fig. 5; they, of course, widen out as shown towards the upper side of arch. Courses of brickwork are built up between the arches so as to leave a series of apertures, converting the floor of the kiln into a series of apertures or holes, of dimensions and spaces between as above stated, arrayed ‘chequer’ fashion all over the floor. The limestone is packed in layers, in the first instance

above the floor about 6 inches thick, taking care to leave spaces as nearly above the apertures in the arch and floor as possible, as shown at *a a*, fig. 7; the solid packing being at the parts between the apertures, as at *b b*. By this arrangement there are openings left, up which the heated air of the furnaces passes, and escapes finally by the openings in the roof of the kiln, as at *k k*, fig. 2, Plate 47.

Brick, Tile, and Drain-Tube Kilns.—Where there is a good and extensive field or pit of clay, advantage should be taken of it to make the bricks and drain-tubes or tiles required at the various parts of the property. It does not form part of the scope of this work to enter into any description of the methods of making those important articles, so essential in the improvement of land, and useful in the building of various structures, further than with the kilns in which they are burned, of which more presently. What we have at present to concern ourselves with is the plan of the brick and tile yard. The name has got so established, that although tubes are used nearly universally for drainage, the word tile is retained, these tiles having been used for drainage purposes at one period; although, of course, the name tile may refer to flooring and roofing tiles, which also may be made on the property. In addition to the plan of yard showing the disposition of the various parts, we shall illustrate and describe a kiln which may be adopted with such modifications as may be necessary. The plan of the brick-yard, etc. is shown in Plate 49, the drawings of the kiln in Plates 48, 49, 50, and of which the following is a description. In fig. 2, Plate 49, *a a* are the clay heaps laid up for tempering, dug out from what we suppose to be the bank of clay in the field behind, as indicated by the wavy *b' b'* line above the sheds, situated at *b b*, placed at right angles so as to enclose the kiln, *c*, and flats, *d d*, on which the bricks are laid out for drying; *e e* are extra sheds for storage, or for drying sheds, when there is a push of work. The machines and steam-engine to work them are placed at *f*. Should the upper range of drying sheds be used as a hot-air drying one, the chimney shaft, *g*, may be moved to the position *h*. Fig. 2 shows an arrangement for a tile

and drain-tube yard, of which *a a* are the drying sheds arranged in parallel rows, *b b* extra store or reserve shed; the kiln is placed at *c*, the machine-room in a shed, *d*, behind which are the boiler and engine sheds, *e f*. Another arrangement is shown in fig. 3, which is connected with the improved double kiln for drain-tubes, a description of which will be found at the end of this present section, and the drawings of which we have adapted from a number of that excellent journal, *The Artisan*, which we regret to say has for some time been discontinued. In fig. 3, Plate 49, *a a* are clay sheds, 16×12 feet in the central ones, and 15×10 in the side ones; *b* is the pulp mill for working the clay, in front of which is the drying shed, *c c*; on either side of *c c* are depots or stores, *d d e e*, for the manufactured goods, 120 feet by 25, capable of holding about 400,000 tiles. These are surrounded by the tramway or rail, finished at ends circularly, as shown, and so that the tiles can be brought down from the sheds, *c c*, to the kilns, *g g*, and from thence taken up to the depots, *d d, e e*; *f f* are coal stores, 16 by 12, and *h* and *i* are sheds for a tool-house and office. The following is a brief abstract of the specification of a kiln used by a well-known manufacturer on the large scale, and which differs but in minor particulars from the kiln illustrated in Plates 49 and 50.

The length of the kiln over all is 30 feet, the width or breadth 10 feet; the height from ground level to the top level of walls, from which the covering arch springs, 10 feet, the arch having a rise of 3 feet 6 inches, which, with a thickness of the outside walls of kiln of 3 feet, would make the arch semi-circular, which is the best form, producing little or no lateral pressure on the walls, but chiefly vertical. The number of fire-places on each side is 11. As above stated, a thickness of wall of 3 feet would give a semi-circular arch with a rise of 3 feet 6 inches; but although in the present instance the thickness of walls at low parts and up to the level of fire-places is 3 feet, the thickness above these and up to springing of arch is reduced to 2 feet 4 inches, thus giving an arch less than semi-circular. We should in this case increase the rise of arch, so as to obtain a semi-circular covering arch, for the reasons already stated. The gables of the kiln

are 2 feet 4 inches in thickness from top to bottom, no set-off being used in these; they are provided with buttresses, two at each end, and with a base the width of outside surrounding shed, and tapering up to meet the top of end walls of kiln. These buttresses are placed to counteract the tendency of the end walls to bulge out. This tendency is very great, being caused by the intense heat to which the brick walls are subjected. To provide against this in the case of the side walls, 'flying' or 'arched buttresses' are built, 7 to each side; these are built of brick, the lower base being 10 feet, inside measurement, from the side walls. The width or breadth of face of each buttress is two and a half bricks; the depth on side of buttress one and a half brick. The upper end of each buttress butts against and is well keyed into or bonded with a stone butment, let into the side wall of kiln at top; the length of this butting stone piece is 4 feet, its thickness or depth 15 inches, and its width or breadth 10 inches. The sheds at sides and ends are, of course, in width regulated by the outside line of buttress base, and the walls may be of brick, 9-inch work, or wood shedding. Openings should be provided by which to supply coal to the sheds, but closed with shutters when necessary to protect the furnaces from winds when at work. The outside of covering arch of kiln is to be covered with a mixture of clay and sand well tempered, to the depth of 2 to 3 inches, so that the heat may be retained as much as possible in the kiln. The chimneys of the kiln pass through the arched covering, and are 40 in number; they are about 6 inches square, inside measurement, project above top of arch at centre about 13 inches, the side chimneys being finished off to same level. All the chimneys are provided with rain flap-valves or covers, wrought by rod and lever so as to be easily closed and opened by the work-people below. With 11 furnaces or fire-places at each side of the kiln, the 40 chimneys are made up as follows:—12 on each side, 12 along the centre of the covering arch, and 2 at each end, placed equidistantly between the side and centre chimneys. There is a door at each end of the kiln, arched at top, by which entrance to and from it is obtained. The end door, or lower one, is 5 feet high from the level

of the floor, and 3 feet wide; the sill or step of the opposite door is also 5 feet above floor level, but 6 feet high and 3 wide.

The building of kilns requires to be done with the greatest possible care; no mortar of the ordinary kind is to be used, as it would be destroyed by the intense heat, and thus cause such unequal settlement in the walls as to tend soon to destroy them. The inside of the kiln should be lined with fire-bricks, well bedded in finely-ground fire-clay, for the first brick length in; the heart or interior of the walls has the bricks bedded with a mixture of common clay and sand, while the outside course may be set in mortar, this being the only part of the structure in which the use of mortar is allowable, for the reason above named. The greatest possible care should be taken in carrying up the courses uniformly and in bedding the bricks, these being laid as closely together as they can be, and the joints thin and evenly spread; bonding must also be specially attended to. The covering arch should be built with the bricks not set 'in bed,' as usual, but 'on edge.' The fire-places are built with fire-bricks, and the arched tops are also made with these. As these bricks are apt to get damaged and worn out by the heat, etc., a good plan to build the furnaces inside fire-places, sometimes adopted, is to make the opening for each in the side walls of such a width as to allow side piers or low sustaining walls to be built of ordinary brick on each side of these openings, as at *b b*, fig. 3, Plate 50; these piers support or carry the fire-brick lining, *a a*, fig. 3, Plate 50, of the furnace. Other piers, as *c c*, should be continued upwards and arched over, thus forming a 'safety arch' of ordinary brick over the fire-brick arch, *a a a*, below or inside; thus, when any repairs are needed either to the side or arched fire-brick lining of a furnace, the whole, for that matter, can be taken out without endangering the side walls by causing any undue settlement. The width between inside measurement of the brick piers, *b b*, should, of course, be equal to the intended width of furnace or fire-place, which is usually eight or nine inches; the latter is preferable, being that of the length of an ordinary brick. It need scarcely be said that, for the purpose of easy

removal for repairs, the fire-brick lining of the furnaces must not be bonded into, as with the ordinary brick side lining and arches described above.

Floors of kilns are made in several ways, the chief being two, the 'solid' and 'riddle.' The solid floor is made by filling in breeze, or with broken bricks up to a certain level, then with regularly laid ordinary bricks up to another level, this being such that when the floor is laid with brick 'on edge,' its upper surface will be at the desired height; this upper surface may be of ordinary, but is best of fire-brick. The brick-on-edge floor is well bedded in a thick layer of sand, so that no unequal settlement giving rise to inequalities in floor level or surface will take place. For burning drain-tubes a 'riddle' bottom is by some considered absolutely necessary. This riddle bottom is formed of brick on edge resting on the solid floor—*d*, fig. 3, Plate 50—of the furnace; a space between each brick equal in thickness to half that of the brick is left between the series of bricks forming the riddle bottom, as at *a a* in fig. 5, Plate 50. In order to divide the heat from the two sets of furnaces, as *a a b b*, and *c c d d*, fig. 5, Plate 48, it is necessary to build a wall, *e e*, running in a longitudinal direction along the kiln; in the form of kiln towards the right-hand side of the central line, *f f*, this wall is dispensed with, as the furnaces are built on a different plan, as will be hereafter described. The wall *e e* is carried up only to the height of the under side of the riddle bottom. The object of the wall *e e* is to direct the flames of the two sets of furnaces towards the centre of the kiln, or rather to diffuse their heat throughout its whole interior.

The drawing in fig. 5, Plate 48, shows on each side of the central line, *f f*, the half of two separate methods of constructing kilns of the kind now under description. The drawing will sufficiently indicate the general arrangement, the details being those in which the plans mainly differ. As the heat is very great, buttresses, as *g g*, are provided at the sides, and, as *h h*, at the ends. The side buttresses are frequently, we may say generally, in kilns built on the plan to the left of line *f f*, fig. 5, Plate 48, of the kind known as 'flying,' as shown at *a a*, fig. 2, Plate

50. These buttresses have outside walls, as *b b*, fig. 1, Plate 50, which form sheds roofed over, as at *c c*, and shown in plan at *i i*, fig. 5, Plate 48, and are used as sheds for the storing of fuel, etc. Generally the form of kilns shown towards the right of line *f f*, fig. 5, Plate 48, have no sheds, but are left exposed, as shown in the section to the left of central line *d d*, fig. 1, Plate 50. In this the buttress is formed as at *e e*; and if a shed is adopted, which is always useful, the roof timber, *f*, may rest on the top of this, as shown. The end buttresses in place of that shown to the left of *f f* in the plan fig. 5, Plate 48, are terminated as shown at *h h*; thinner walls connecting the end ones of shed have doorways, *j j*, passing to the side sheds. The kiln on this plan is, in its general details, constructed on the system described in the previous specification, and many of these are described and illustrated. In fig. 1, Plate 50, we have shown a flying buttress formed of cast iron, the roof of the shed under being made of corrugated plates, bent to the form of the buttress; *g g* shows the door or wicket through which the materials are wheeled to the interior of the kiln, the sill of which is at the level of upper side of bottom of the same; in this plan only one door is used, but in that shown to the left of the line *f f*, fig. 5, Plate 48, two are given. A vertical section of the furnaces of the plan to the left of *f f*, fig. 5, Plate 48, is shown in fig. 5, Plate 50. In this, *a a* is the riddle bottom, which, however, rests at once upon the relieving arches, *b b*; *c c*, the furnaces; *d*, the ash-pits. Fig. 6 is plan of same, showing how, by the arrangement of the arches and the riddle bottom, a series of cross and longitudinal openings, as *a a b b*, are made, through which the heat of the furnaces ascends to the interior and upper part of the kiln. This arrangement is effected as follows:—The arches, as *c c*, fig. 3, Plate 50, are nine inches on the face or brick length, as *a c d*, fig. 4. A space, as *e e*, is left between each arch, thus forming the longitudinal openings, *b b*, fig. 6. By placing the bricks forming the riddle bottom on edge, as shown in cross section in fig. 5 at *a a*, and with spaces between them as already described, these spaces form the cross ones, *a a*, fig. 6, intersecting the longitudinal, *b b*, in the

form of kiln as that to the right of *ff*, fig. 5, Plate 48; and in others of a still more simple description the furnaces are built in a less elaborate form than now described. Thus fig. 7, Plate 50, illustrates in cross section at *a*, and in longitudinal or side view at *b*, a plan of building the furnaces of the unburned bricks; the floor being also formed of these on what is called the 'chequer' principle, the main feature of which is having bricks placed in longitudinal rows, with others disposed angularly, something after the style adopted in filling in certain forms of brick walls.

Drying Sheds.—Drying sheds in tile and brick works are generally of a very simple character, being merely constructed of rough wooden shelving, with inexpensive roofing. We have illustrated in Plate 49, in figs. 4, 5, 6, 7, 8, and 9, a shed which, for its simple construction, possesses some details worthy of notice. The description of this will be found in the section in this chapter descriptive of an improved double kiln. Sheds are almost universally left open to the atmosphere, which is the only drying power depended upon; indeed, from the rough character of many of them, sheltering the materials from the wet seems more the object of those who use them, rather than that of making the air available as a drying medium. That, however, much economy of fuel in the kiln drying would be effected by previously placing the tiles, etc. in proper drying sheds, and withdrawing by some means or other much of their natural moisture, is obvious enough. Various attempts have been made, therefore, by different manufacturers and inventors to introduce a system of drying sheds, so arranged and constructed that the power of artificial heat could be made available for the drying of the goods placed within them. The simplest of the plans of this kind which has been adopted is a structure, low-roofed, of great length as compared with its breadth, and along the centre of which runs longitudinally a flue, which rises to some height above the floor level. A furnace is placed at one end, a chimney at the other, and as the heated products of the furnace pass through the flue to the interior of the chimney, the sides and top of flue give out heat which raises in time the

temperature of the air within the room. There are two great objections to this system—first, the expense of a special furnace; secondly, the lack of an efficient system of ventilation. From all kilns, however efficiently they be constructed, there passes off a large percentage of air heated to a very high temperature, without giving any useful effect. That air so obtained can be made available for many useful purposes, is shown by the great success which has attended the plan adopted at ironworks, etc., by which the heated air passed from the furnaces is made available in raising steam, etc., without the use of any fuel. That the principle could be applied to drying sheds—and, indeed, to some other agricultural processes—is obvious, and would involve no great trouble or expense; but with many constructors the idea is prevalent that there really is great difficulty in dealing with the leading of heated air in different directions. But the truth is, that, given a good draught, the matter is one generally of extreme simplicity. We have experienced little or no difficulty in conducting the waste heated products in various directions, and in some instances where failure was considered certain from the apparent difficulty of the position. Even the waste heat of an ordinary steam boiler can be made available for some useful purpose.

Mr. Hands some years ago introduced, with great success, drying sheds for brick and tile works in which the waste heat of the kiln was made available. But great as have been the obstacles to the extension of the artificial system of drying, from the cause above named, the real difficulty arises in making the system of heating efficient, and from failing or being unable to carry out a good system of ventilation.

Drying by means of artificial heat does not consist merely in subjecting materials to a high temperature; to use a familiar expression, the materials subjected to it merely get soddened, as it were, and it takes a considerable time to carry off the moisture which the heat causes to arise from them. But the case is altered at once if means are taken to carry off the heated vapours as fast as they arise from the materials. We have, in another chapter, gone briefly into the subject of ventilation; to that, therefore, we

refer the reader, and pass on to describe a few details connected with the subject. In fig. 8, Plate 50, we give the section of a drying-house which may be adapted for various purposes, but which will illustrate the application of the waste heat of kilns to drying sheds, in which the tiles, etc. may be partially dried. We say partially, because it should be remembered that there is danger in over-drying, especially if this be done quickly, and with a high temperature; for the exterior surface is apt to get as it were baked, which prevents the interior moisture from escaping. Indeed, some manufacturers object altogether to the system of artificial drying of tiles, etc., on this very ground, maintaining that although by it they may save something in the kiln drying, the goods themselves are often very unsound and cracked. In fig. 8, Plate 50, the hot-air flues, *a a*, are supplied with cold air passing in by the ventiducts, *b b*, which, after becoming heated by passing in contact with their surfaces, passes up through the apertures made in the floor, *c c*, and comes in contact with the drain-tubes, etc., placed on the racks, *d d*. The heated air and moisture pass upwards towards the ceiling, *e e*, through which it passes to the external atmosphere. This may be done in one of two ways: first, by passing the products through a series of ventilating-tubes, *f f*, placed at intervals along the length of ceiling, and passing through the space between the ceiling and the outer roof. The ventilator, *f f*, is provided with a cord or cap, *g*, while the current is regulated by a valve placed near the ceiling, as shown, and which is operated on by a cord or chain. The other plan is the well-known one of the old-fashioned louver, passing along the whole length of the roof, which has no internal ceiling. The fresh air is regulated in the amount of its admission to the flues, *a a*, by valves, *i i*, placed as shown; the whole of these may be adjusted at one time, if required, by a simple bell-crank movement, as shown in fig. 11, Plate 50, the central shaft of which runs along the whole length of the shed. The ventiducts, *b b*, fig. 8, are placed only at certain intervals along the length of wall of shed, as shown in fig. 9. Fig. 10 gives a part section of one of the flues, *a a a*, fig. 8, showing how the

hot air can be led by a vertical flue, *a a*, conducting the air from the kiln; the dotted line *b* shows a horizontal tube. In some cases the flues are arched at top, but it is the simpler way to cover them with flat stones or rebated tiles; if stones are used, the outer corners should be rounded off, as in fig. 12, or splayed, as in fig. 13 at *a a*, Plate 50.

Improved Double Kiln.—The following is a description of the kiln, plan of which is given in Plate 49 at *g g*, fig. 3, and referred to in last page. Fig. 1, Plate 48, is half ground plan from the central line, *a b*, of this double kiln, the position of which in the general arrangement of the yard is shown in fig. 3, Plate 49, and at *d d*, as in the drawing, Plate 48 (scale 20 feet to the inch). It is capable of holding, say, thirty thousand inch-and-half tiles, with collars. The contents form a cube of 12 feet, *i.e.* 12 feet square at the top and bottom, and 12 feet in height. To have a kiln which would hold more pipes than the shed would dry in a week would be useless, and if it held less there would be a waste of fuel. One of the items in saving coal is the size of the kiln, and for this reason it is made 12 feet in height, as not requiring much more fire than one half that height. The walls are designed as 3 feet in thickness, being built with the very best bricks, the joints being less than quarter-inch if possible, for upon the solidity and excellence of the work the cheapness of its future working depends. Should you save £20 by using inferior materials and bad workmanship, it will entail a constant waste of perhaps ten shillings worth of coal per week, in consequence of the escape of heat from the sides of the kiln. The building should proceed slowly, and in regular courses, during dry weather, and fires should be kept constantly lighted, so as to dry the work very thoroughly before a kilnful of tiles is burnt. Lack of these simple precautions has often been the cause of the first two kilns of tiles being completely spoiled in what is called 'seasoning the kiln,' incurring a loss of from £15 to £20 thereby.

In fig. 1, Plate 48, *a a a* shows the openings of the ash-pits under the fire-places, 12 inches wide by 18 inches in height, widening

out to 18 inches on the exterior face of the wall, in order to increase the draught of air to the fire-place. They are three in number, and extend to within 2 feet of the opposite end of the kiln, as shown in the part elevation, fig. 2. The enlarged drawing, fig. 5, on a scale of 2 feet to an inch, shows a sectional elevation of the ash-pits and fire-places. Two courses of fire-brick project each $2\frac{1}{4}$ inches from each side of the ash-pit at the height of 18 inches, leaving a space of 3 inches in the clear between them, and at every third brick an additional space is left at the side. The fire-place widens out to 18 inches at the springing of the arch. It is adapted either for turf or timber, or a mixture of both; where coals are used, a moveable iron grate could be laid on the bricks, or a wider aperture might be left, and the number of iron bars increased. The bricks for lining the interior of the fire-places, and also for both rings of the arch over it, should be made to pattern of the very best fire-brick, with joints radiating to the centre of curve, so as to avoid using much cement.

The floor of the kiln should be laid perfectly level, with fire-brick 9 inches square by 3 inches thick; at the distance of every 18 inches, a cross flue is built 6 inches wide, crossing the fire-places at right angles, and running into the vertical flues in the walls of the kiln. They commence from the level of the springing of the arches over the fire-places; if carried down lower, they would merely be filled up with ashes to that level.

The vertical flues are shown in fig. 2, *a a a*, running up to the top of the kiln, 6 inches by 9 inches in depth. An enlarged plan of a part of these flues is shown in fig. 6, Plate 50; at every fourth course, a brick is inserted across the front to pack the pipes against, thus leaving a space of $4\frac{1}{2}$ by 6 in the clear behind them.

In ordinary kilns the fires are made merely in the thickness of the walls, so that the heat has to be transmitted through the mass of tiles from one side only (the under one); but in this kiln the heat is at once carried to four sides of the cube out of the six, and equally divided over the whole surface.

In order to increase the draught of the fire-places when necessary, and also to make use of the waste heat from the kiln at other times when cooling, five rows of pipes are laid down 3 inches in diameter, which at the level of the fire-places pass through the wall of the kiln under the railway, and open out at equal distances along the two drying sheds. The hot air from these pipes will not only assist in quickly drying the pipes in damp weather, but in case of frost it will save perhaps £20 worth of pipes at a time from being cracked all to pieces. These hot-air pipes are shown in fig. 1, *cccc*. Opposite to the fire-places, a shed is to be built with two arches in front, see figs. 1, 2, and 3. It will serve the double purpose of sheltering the kiln men, and also be used as a platform for packing and emptying the upper half of the kiln; the ground in the tile-yard, at the point where the rails are laid down, being level with the floor of the kiln (see fig. 2). The lower half of the kiln is filled through an aperture 18 inches square (see fig. 2); and for the upper half, the tiles are handed up to the platform, *p p*, and through an aperture 18 inches square at the top of the kiln (see figs. 2 and 3), both being bricked up when the kiln is full. They are pitched up and filled by boys, by hand, just as bricks are loaded into vessels through a hole in the bow. In the section on drying sheds in this chapter, we referred to a form of shed adapted to the double kiln now described; the following is a brief explanation of its details. In fig. 9, Plate 49, we give an end elevation of an improved shed, showing how, while the shelves contained in it are more protected from the weather, they are more freely exposed to the action of the air than in the generally adopted shed. This latter closely resembles in end elevation the central part of fig. 9, Plate 49, but is much wider (30 feet) and lower, the roof being made to overhang considerably over the sides. In fig. 7, Plate 49, a plan of the shelving is shown. The timber is sawn up into 6 feet lengths of $1\frac{1}{2}$ by 1 inch, and so placed on the cross-bearers as to leave spaces of 2 inches in the clear between them, as in fig. 4. The cross-bearers, as shown in fig. 5, are 3 inches wide, and placed at distances apart of 6 feet

from centre to centre, as in fig. 7. The shelf scantlings, $1\frac{1}{2}$ by 1 inch, may simply be laid on the cross-bearers, butting end to end, as in fig. 5; but they will be more secure if laid in grooves made in the cross-bearers, a cross section and a plan of part of which with grooves are shown in fig. 6. Fig. 8 gives part front elevation of the range of shelving with cross-bearers. The height over all is 7 feet, as shown to the left; and as there are to be 10 shelves—only 8 are shown in fig. 7—this will give a distance between the shelves of not quite 7 inches. A height of 7 feet 6 inches would be required for 7-inch intervals in the full, which will be space sufficient for 4-inch tubes or pipes. For small pipes the number of shelves may be much increased, or the height decreased, according to circumstances. The scantlings are laid on the cross-bearers on the flat, and in place of simply meeting with a plain butt joint, as in fig. 5, they may be made with a half lap joint to be more secure.

A Kiln or Furnace for Burning Clay to be used as a Manure.—Our readers are well aware of the value of burnt clay as a manure for application to heavy clay soils, in opening up their texture, so to say, and otherwise improving their mechanical condition, in which way it may be said principally to act. With its agricultural features we have here, however, not to concern ourselves; it is solely with the mechanical or rather constructive features of clay burning. Clay burning is generally, we may say universally, done in large heaps, the fuel—generally coals of a small kind—and the clay being placed in alternate layers; and when the lower ones have fairly become ignited, and the various layers added till the required height is obtained, the whole is covered over with clay, and the burning allowed to go on very slowly. It may be questioned, however, if this is the most economical method which could be adopted, and whether a plan of kiln or furnace could not be arranged to meet the circumstances of the case, and secure the fullest economy. The following is the description of one designed by Mr. Walter Long, and given in the *Journal of the Royal Agricultural Society of England*, vol. vii.:—'Our soil,' says Mr. Long, 'is a thin, dry, flinty loam upon chalk; and we suffer unless we have

abundance of rain in spring and summer; everything, therefore, is beneficial to our land that has the property of attracting atmospheric moisture, carbonic acid gas, etc. etc. With this object, the first point is to obtain ashes; those that are burnt in the fields from weeds and grass round the headlands, or from the grubbing of hedgerows, being full of vegetable matter, are the best and cheapest. These, however, can only be burnt in summer; and sooner or later, on farms that are kept clean, the materials are no longer to be found. Yet an inexhaustible supply may be obtained, and employment afforded throughout the winter, by burning clay and strong earth in kilns, protected from the rain; the only difficulty having been that many persons, and myself at first, produced a hard substance, more resembling brickbats than powder. This difficulty I obviated by (previous to burning) well saturating the soil with water, working it and treading it to the consistency of mortar, for water will separate any particles, however adhesive; and then the fire, expelling the water and the carbonic acid gas, leaves the particles previously separated, when burnt, in a state of very fine powder; and if any should not at first be quite separated, it slacks immediately on the application of liquid. Having saturated the soil thus with water, as much as a spade will hold is rolled up to the size of a large cannon-ball, and is handed to a man in the kiln, who places it on the bars, or the coping of the brick arches over the furnace. He places each ball as he receives it side by side for two or three tiers, one above the other, and then lights the fuel in the furnace. In a short time the balls, wet as they are, become set or firm, and will not run into one another from the accumulated weight, as they would do if thrown in together in a rude, wet mass. These tiers of balls are then covered with a layer of small roots or wood (which become charcoal), and then over this wood the moist earth is laid on in spits as loosely as possible, till the kiln is nearly full, and finally topped up with turf, or rape roots, or any vegetable rubbish.

If the first tiers of balls be laid on overnight, and the fire be kindled about seven the next morning, all work of continuous burning may be so forwarded as to enable the men to block up

the mouth of the furnace with roots or stools by five o'clock P.M., leave it to burn, and go home; and the next morning the whole will be found burnt out. In this way, there being three kilns, and one lighted every morning, one will be cooling, one will be unloaded and charged again with balls, and one will be burning out, and so on in rotation. And by burning off two kilns any one day at the close of the week, and leaving them to cool, seven kilns may be burnt in each week, each containing about 160 bushels, and thus 1000 net bushels may be obtained weekly. When the ashes are taken out of the kiln, they are sifted very fine, and made free from stones, chalk, etc., and wheeled to a covered shed, 50 feet long, and there laid out in beds or pools, embanked by themselves all round, about two feet deep; a portable cask and pump annexed then continually brings from various tanks the overflowings of the farm-yards, the liquor from the stables, cow-sheds, piggeries, the house, and the laundry, and discharges it into these beds of fine ashes, which, when they have absorbed the liquor, are covered with a coat of gypsum. They are then repeatedly turned and repeatedly flooded, until they have thoroughly imbibed the moisture, and remain fully charged with valuable matter. It is then packed away in another close shed or store, and then trodden down by men, as hard and close as you may fancy guano to lie in its rocky bed; and so it remains, piled up to the upper tie-beams of the shed, and covered over with boards and hurdles, until dug out with a pickaxe for use. We thus have always a large store of manure, ready to drill for turnips, swedes, and roots of any kind, and a most excellent top-dressing for grasses and meadows; and in the kitchen garden and flower gardens it has been found a perfect substitute for farm-yard manure, and less productive of weeds. In its process it heats a good deal, and sends out crusts of saltpetre.' In fig. 3, Plate 18, we give the plan of the kiln or furnace, in which the length, $a b$, is 12 feet in the clear; the breadth, $c d$, 4 feet 2 inches; the parts as o are of solid brick, the intervals or air spaces, x , 3 inches wide in the clear. The kiln at its upper part slopes off on both sides, as shown in the vertical section in fig. 4, Plate 18; the width at bottom, $a b$,

corresponding to $c d$ in fig. 3, being 4 feet 2 inches, the width, $c d$, at top (fig. 4) being 6 feet 3 inches. The front view is shown in fig. 2, Plate 18, in which the width of furnace opening, $a b$, is 2 feet, the height of ditto, $c d$, 3 feet. The kiln is built in a dell or hollow, so that a roadway or gangway, as e , fig. 4, can be constructed on the level or thereby, so that the kiln can be emptied and filled with the least labour, while the road, f , in the lower level is used to gain access to the furnace entrance, as in fig. 2, to feed it with fuel, etc. The thickness of the sides, g , fig. 4, is 9 inches, or brick length thickness. The great advantage of this system of Mr. Long's, so far as the burning of the clay is concerned, is that it produces it along with the wood ashes in the form of a powder, or small lumps capable of being easily reduced to this state. In the ordinary heap system, the clay, as pointed out by Mr. Long, is apt to harden in too large pieces, and these very hard.

Brick Kiln for Burning Waste Wood as the Fuel.

—The following is a description of the form of kiln introduced by Mr. Johnston of Culross for the consumption of waste wood in place of coal. The dimensions are those suited to what is technically called a 'twenty-thousand kiln,' that is, one in which 20,000 bricks can be burned. The construction has, of course, to be such as to meet the peculiarity of the fuel, which burns with great quickness and fierceness as compared with coal. The kiln is started, therefore, from a foundation the level of which is 8 feet below that of the ground. This position checks the free admission of the air, and makes the combustion of the wood much slower than it otherwise would be. There are three fire-holes to the kiln, but open on one side only; they pass, however, right across the whole breadth of the furnace. The height of the fire-holes is 3 feet, and the width 2 feet. These dimensions, it will be observed, are greater than those of coal-consuming kilns, but this extra size is given in order to make the firing more easy. In order to prevent the flames from passing through the flues and coming in contact with the bricks, the flames are allowed to expend themselves, so to say, before they reach the actual interior of the kiln, so that heated air only passes into the

interior of the kiln. This is arranged for, by extending the fire-holes for a distance of some 7 feet beyond the outside walls, taking care to load the arched tops with clay, and buttressing the extended fire-holes with the sides of the kiln. In order to distribute the heat in a manner as uniform as possible over the whole interior of the kiln, to regulate the draught, and to shield or protect the bricks or tiles from the too fierce flame and heat, the flues in the interior of the kiln require to be smaller and more numerous than those required in coal-consuming kilns. As the combustion of timber is very unsteady and uncertain as compared with coal, great care is required to maintain the necessary degree of uniform heat required for the drying of the bricks or tiles; this process preceding the actual burning, when the full heat is sent into the kiln. The drying heat has not only to be uniform, but of a gradually increasing temperature; the point is reached when the vapour or steam at first issuing from the kiln is changed into a smoke, or vapour resembling it. The wood used for the drying process is or may be of different quality and condition from that used for the burning; for drying heat the timber must be as free from moisture as possible, as this passing into the kiln adds to the dampness of the bricks or tiles. Roots of trees, such as the ash, elm, maple, and hazel, are well suited for the drying wood; but any kind may be used for burning, a convenient length for firing being eighteen inches. In firing

there is some art necessary; immediately after pushing forward the previous charge, a fresh supply of dry roots should be pushed into the mouth of the fire-hole. This is done so that they serve not merely to lessen the draught, but to become partially consumed, so that they can be pushed forward with greater ease at the next stoking or charging. The mouths or charging apertures of the fire-holes should have sheet-iron covers, in order to enable the fireman to regulate the combustion. When these points are attended to, the heat produced is very little inferior to that of coal. As regards the relative cost of the two systems of heating kilns by means of refuse wood and coal, Mr. Johnston found a decided balance in favour of the wood, and this under what he considered unfavourable circumstances, inasmuch as, for example, the kiln was too large to yield the most favourable results. No commercial value was put upon the refuse, the clearing of the land, and any trifle that accrued from it, being considered as its value. The estimate of burning per thousand bricks by means of wood being 3s. 9 $\frac{1}{4}$ d., that of the coal system being 5s. 1 $\frac{1}{2}$ d. 'The small balance,' says Mr. Johnston, 'of 1s. 4d. per thousand in favour of the wood, together with 3s. per acre saved in the clearing of the land, was considered sufficient to warrant the application of such refuse to this purpose; but it would have resulted much more profitably with a 22,000 kiln instead of a 35,000 one.'

CHAPTER III.

UTILIZATION OF SUNDRY MATERIALS.

THIS chapter might be extended to a much greater length than our space admits of, so numerous are the materials lying, as may be said, almost everywhere, varying more or less in value, but all having enough to make them worthy of attention, and to repay that by utilizing them in the best and most economical way. What we give, however, must be taken more as hints to the observant reader, rather than by any means as an exhaustive treatment of what is really a most interesting and suggestive subject. The first we take up is upon—

The Use of Pond Mud, Peat, and Boggy Matter as additions to the Manure and Compost Heaps.—We have elsewhere shown that the increase in the productive powers of our farms depends largely upon the increased supplies of manure which we can obtain, and that, again, depends upon the increase of our live stock; and have shown the cycle or circle which all the operations of the farm make, these revolving, so to say, on central points. Now, although this refers chiefly to farm-yard dung, the mainstay of the manurial resources of the farm, still there are other ways in which manure of greater or less value can be added to the general stock at little cost. Thus, in another part of the work, we have offered some remarks on the value of the compost heap, and how this can be greatly added to. One source from which material for this can be got is the horse-pond, water-filled old clay pits, marl pits, etc. These are allowed very often to remain, as a rule, for years uncleaned, evidently, in the case of the horse-ponds at least, deteriorating the quality of the water, and in so far prejudicially affecting the health of the horses and cattle partaking of it. Now the deposits in these ponds, clay and marl pits, are exceedingly valuable as manure, con-

taining as they do, in addition to the earthy matters which are in themselves of no mean value when applied to certain soils, a large amount of vegetable matter in a more or less advanced stage of decay. Again, in some districts there are swampy parts, in which are deposited vast supplies of this material. As a rule which has but few exceptions, we may say that these manurial deposits have been wholly neglected in this country, and we have to go to other countries to learn their value, and how best they can be made available; and of these, perhaps America has done most in this way. Should the reader be possessed of Professor Johnson's work on agricultural chemistry,¹ he will do well to consult its pages for some practically suggestive remarks on the uses of this mud, or 'muck,' as it is called in America. Another writer suggests that the muck swamps so frequently met with in America, containing such vast supplies of vegetable matter, the slow deposit of centuries, are the incipient states of future fields of coal; but failing this change, he says, 'they seem to have been reserved by a kind Providence to supply the rapid waste of vegetable matter going on in dry cultivated lands.' The coal-fields are the great wood-houses of nature, so the 'muck or mud swamps' are the great manure beds, at one time dreaded, and justly so, as the hotbeds of malaria. Drained, they have been transformed into rich pasture and corn fields, while their mud, at the same time, has contributed to restore the failing fertility of other fields placed at a higher level. The experience of American farmers

¹ The reader must note that this is an American work,—not the admirable volume he ought to possess, if a Proprietor or Farmer, on the same subject by Professor Johnstone, published by Messrs. Blackwood of Edinburgh and London.

has shown that, as a basis for compost heaps, nothing can equal the mud obtained from the sources we have indicated. In a dry condition it is an admirable deodorizer, which, indeed, has been well proved by what Mr. Moule, with his earth-closet system, has shown us. Thus a dead horse or a cow, thoroughly embedded and covered over with the dry porous mud, and allowed to remain quiescent for about a year, and then well turned over and mixed, will produce six or eight loads of a rich manure. From this our readers may obtain a valuable hint, not only as to utilizing animals which unfortunately die on the farm, but a wide variety of animal substances which they can obtain if situated in the neighbourhood of a large town or village. The application of the mud itself directly to land requires some judgment. To soils of a sandy or gravelly character it may be applied directly, but to heavy clay and cold land it should be applied in the state of compost, or when dried; but the best and quickest way to gain the advantages of the mud is to use it in conjunction with farm-yard dung. The ways of treating it thus will suggest themselves readily to the practical farmer. Thus a good method is to place occasionally a layer of it on the top of the manure in the dung stance, and it may also in its dried state be spread in the lair of the live stock. Mixing with the dung of the animals, it exercises a remarkable influence on it, acting, as an American farmer says, as a kind of leaven, causing the manure speedily to ferment and decay. When used as a compost heap along with farm-yard dung, the best proportion of mud to the dung is two-thirds. With lime, also, mud forms a good compost, and salt should always be added. A good way to add the salt is to slack the lime with a strong brine. But while the manurial or chemical value of mud is great, its mechanical must not be lost sight of. Mixed with soils of a light and dry nature, it renders them more dense, moist, and compact, and with clay soils, stiff and adhesive, it opens them up and makes them more friable.

Another addition to the manurial resources of the farm is peat; indeed, where peat in moderate extent is on a farm or estate, it may be looked upon as a manurial mine. Dried naturally or

artificially,—or, if a kiln be available, made into charcoal,—it forms a most valuable deodorizer, and, mixing readily with farm-yard dung and the ordure of animals, it can be used in a variety of ways which it is not necessary here to specify. We may note, however, one way of using it when in a dried condition—that is, by placing it in front of the cattle or cow stalls, or making layers of it in the pig styes, the liquid will be absorbed by it; and the droppings of the animals, if covered up from time to time by it, will form a rich manure, and be at the same time deodorized. The litter may also be cut into short lengths, and sprinkled, when taken from the styes, etc., over the dried peat. The resulting manure, when taken to the covered dung-pit, will very speedily form a black, unctuous, rich manure. It has been estimated by an eminent agricultural authority, that manure made with dried peat, in the proportion of three loads to one load of the live stock droppings, is equal to three loads of the same quantity of pure or unmixed droppings. Assuming this to be correct, the reader will perceive how large a saving will be effected by using peat, which only costs what is expended in carting it from the place of deposit and the labour in drying it. Whatever the condition in which peat is—whether in an advanced stage of decomposition or peat mud, as it may be called, or solid enough to cut for fuel—it may be equally made available as a manure. The best quality is to be found in the deposits between ranges of hills, more especially if the uplands, or part of them, have been under cultivation, and which drain into the deposits in the valley.

On the Utilization of Tree Roots and Waste Timber.—Where there are tracts of wooded land on the estate which are to be reclaimed and brought under cultivation, a vast accumulation of waste timber for which no market can be found is generally the result. The roots of trees are, perhaps, the most unmanageable, as they are the most unwieldy parts, and they are found to be a nuisance which, under ordinary circumstances, cannot well be got rid of. They are of little use, for example, as firewood for the cottagers on the estate, from the difficulty of transporting and distributing them to the various localities; and when transported, they could not be easily cut up. To allow them to remain as waste incurs

a double loss, for, from their number and bulk, they occupy a considerable space of ground; while, properly used, they are of considerable value. Thus one use which may be made of them is to collect them into a heap and burn them, as they lie, for the mere ashes they produce. Although this is the least economical way, still the ashes are of no small value to be mixed with the upper materials of the compost heap, or used as top-dressings for grass land and for the various arable crops, either simply by themselves or mixed with lime and salt. The value of such a fertilizing material is considerable; on the Continent it is highly esteemed. Another method is to make charcoal of the roots; this, either in the shape of small nodules or crushed into a coarse powder, may be used, as we have shown in the chapter on the 'Cultivation of Clay Lands,' as a manure. Another use to which both ashes and charcoal can be put is spreading on the stall floors of live stock. They absorb the liquids, while in some measure they act as deodorizers, and the manure formed will be a beneficial addition to the dung-heap. Perhaps the best way to use the roots and waste timber is the method introduced by Mr. Johnston of Culross, and described by him in the *Journal of the Highland and Agricultural Society of Scotland*. Mr. Johnston had to deal with an enormous number of roots, and it struck him that, as drain tiles were required for the reclamation of the land which had produced them, they could be used for the heating of the kilns erected for brick and tile burning. In the chapter descriptive of kilns of different kinds will be found a notice of Mr. Johnston's system.

On properties on which there is a considerable extent of acreage under timber, there is of necessity a large amount of comparatively *small* pieces of timber, much of which may be said to be literally wasted. This is produced from the pruning, thinning, and cutting down of trees. We have repeatedly seen huge bonfires made of parts which would have sold freely, and at a good price, if selected, assorted, and made up into faggots; to say nothing of the good which might have been done by adding to the comfort of many a poor man's hearth by judicious distribution of some portion of it. There is scarcely

a district but in which there are towns and even villages of moderate extent, where there is an absolute dearth, so to say, of timber for household purposes. Such, indeed, is the demand for firewood, that prices are readily given greatly in advance of its actual intrinsic value. Mr. Johnston, above referred to, shows in his paper how much can be made of the waste timber of plantations; and it will be well worth devoting some time to a perusal of it, as full details are given as to the way of making the most of this source of revenue, which certainly should not be neglected by careful managers.

The Burning of Clay for Road-making and other Purposes.—In the preceding chapter we have given a description of a kiln for the burning of the refuse or waste clay of regular clay banks, or tile-making yards. We now give a few remarks on a simpler method, which is also available for burning clay on the fields. In the remarks there given we referred chiefly to the uses of burned clay as additions to soil; but it is useful for other purposes, such as the making of concrete, or filling up foundations, or for treacherous or defective parts of the sites of buildings. And in default of broken bricks, stone shivers, or other hard and durable materials, lumps of burned clay may be used for forming concrete walls, along with Portland cement. Again, in districts where more appropriate and generally used materials for road-making are not to be had, or if so, at a heavy cost for transport from a distance, the burnt clay nodules will be found to form by no means a bad substitute. Indeed, where the clay is burned in a kiln, as described in the preceding chapter, so that its quality is rendered more superior than when burned in the ordinary heaps, it is often harder and more durable than some kinds of stone. We should, indeed, have no hesitation in classing it as a superior means for road-making to the generality of sandstones. But even if made in the ordinary clump or heap, the clay nodules ought to be used rather than allow the roads to get into bad order; for the loss sustained by this state of matters in horsepower and in time will be vastly greater than that brought about by the lower durability of the clay pieces. The easiest way of burning clay is the clump or open heap, above referred to.

The process is identical with that of lime-burning in an open kiln, the material used for burning being small coal. The heap is formed with alternate layers of the coal and clay arranged as a series of circles, the diameters of which are regularly decreased as the successive layers increase, a conical or rather rounded heap being formed. The lower layers of coal being once fairly ignited, the heat is communicated to the upper ones through the interstices of the intervening layers of clay, till the whole becomes a mass highly heated. As too rapid a combustion, however, would not only waste the fuel, but would injure the quality of the burnt clay, it is necessary to cover over the surface of the heap with soil. This should be increased in thickness gradually, as the intensity of the heat increases. When finally completed, the heap is left alone till ignition ceases, and the whole mass is gradually cooled down. If the soil for covering is of a light and friable nature, it may be used with excellent effect in compost heaps, as all weed roots and seeds will have been effectually destroyed; if of a close character, or the clay itself has been used to cover the heap, nodules will have been formed, which, although of a less hard nature than those in the interior of the heap, may still be used for concrete, or for mixing with clay soils, or for side walks of roads, etc. Where refuse timber from plantations is plentiful, it may be used for burning the clay in place of coal; and it will certainly pay, in districts where stones, etc. cannot be had for road-making, to put down a kiln adapted for this fuel. The reader is referred to the appropriate paragraph in the preceding chapter for a description of a kiln for wood, introduced by Mr. Johnston of Colross. It is worthy of notice that Mr. Johnston states, that of clay used for forming no less a length of roads than thirty miles, part of which had been burned along with coal, and part with wood, he could trace no difference between their respective qualities. We have thus indicated some ways in which a clay pit or bank on the property can be utilized; and after the banks or pits have been exhausted, and become, as they will become in process of time, filled with water, we have in another paragraph shown how these naturally-formed ponds can be utilized by transforming them into permanent fish-ponds. And

should such ponds crop gradually out to the level of the surrounding land, they may be still further utilized by growing on their banks belts of greater or less width of willows, for which there is always a great demand at good prices, while at the same time the aspect of the landscape will be improved. In brief, as in other departments of the management of property, so in this, by a very little observation and thought, places and parts otherwise and too generally left waste, can be made sources of revenue, which, taken singly, may be despised, but in the aggregate form no small item in the receipts.

The Utilization of existing Ponds, Reservoirs, etc., and the Formation of new Collections of Water for the Breeding, Collecting, and Storing of Fish.—To many the mere reading of this heading will be the cause of creating a smile, as thoroughly out of what may be said to be the popular notion of work connected with the improvement of landed property; and although we are free to admit that at first sight it does seem so, yet we venture to think that, after its points are duly considered, those who are disposed at first sight to treat it lightly will be convinced that there is 'something in it after all.' Viewed in the broadest and most practical aspect, the great and important subject of property improvement embraces everything which can add to its value, and, by consequence, to the income of its proprietor. Little things, therefore, in their place and way, are sometimes of importance, which promise, even however slightly, to aid in this, if, indeed, it be not worth while remembering that the greatest are made up of an aggregation of little things.

A great deal has been done of late years, our readers are aware, in the improvement of river fishing, by what may be called artificial stocking; and the success attendant upon that plan shows what can be done in a humbler way, such as we have indicated in the heading to this paragraph. And although the subject may have struck many,—for we can scarcely conceive that the lessons and hints of the larger system have not directed attention to the smaller,—it is probable that little or nothing has been done in connection with the subject, because the opinion is held that its practical working out involves not only much labour, but also the possession of great

scientific knowledge and manipulative skill. But that this is not so, very little consideration will suffice to show. In a very able, although all too brief a paper on the subject, published in the *New York Times*, the writer points out that really very little is required to lead one, in order to ensure success in what is not merely a highly interesting pursuit, but one also highly lucrative. For, as bearing on the latter point, it is worthy of notice that the carrying out of the system of farm fish-ponds in many cases effects a double good. Thus, in utilizing swampy pieces of land, or rather marshy water, which, as the writer of the above-named article says, are at present quagmires, useless and dangerous, they might be dug out to a depth of two or three feet, and the mud profitably used for fertilizing fields, and these swamps thus be changed into ponds, every acre of which would furnish nutritious and acceptable food at least three times a week for a family of ten persons; and he cites the case of a farmer in Pennsylvania, who in this way utilized three-quarters of an acre of bog, obtaining from it over a thousand loads of most valuable manure, and in three years after he stocked the pond with cat-fish, the cost of which was but a shilling of our currency per hundred; the pond which he had thus formed from a quagmire was swarming with fish. We ourselves had at our own place a small reservoir, worth a trifle for the splendid fish it contained, and which reservoir had been formed at a very trifling expense by throwing a dam or embankment across the lower end of a natural valley. The supply of water for this was obtained from the drainage of the uplying districts, so that a highly ornamental feature was added to the grounds, in addition to its being an excellent fishing place. We have known, also, even old marl and clay pits utilized by being stocked with fish, a mere trifle only being required in order to make the ponds have a running stream through them. These facts, and others which we might cite, indicate with sufficient suggestiveness that a wide field of utility can be opened up and worked at a very small expenditure either of money or labour; what is chiefly wanted being the exercise of a little common sense, judgment, and observation, so as to take advantage of the sources of water supply, which are much more

numerous than the majority of people have any conception of; and their conversion into the necessary collecting, breeding, and preserving ponds is by no means a difficult matter. Thus the writer in the American paper we have named, who evidently has a thorough practical knowledge of the subject, says that the requisite care and precautions are very simple. For trout, for example, 'the necessary requirements are pure water, a temperature not over 60° in the summer time, a gravelly bottom in places where the fish can make their spawning beds, and a few deep holes in which they can hide during the hot days. All these conditions are met with in a swamp with a subsoil of sand or gravel, through which occasionally springs break, or such a swamp through which the water of a spring brook can be turned by means of a dam and gate. The muck (*Anglicè* mud) may be dug out in places to expose the bottom, and the borders of the pond should be sown with grass and aquatic plants, and planted with willows. The portion of vegetable matter left in the pond, and the grass and neighbouring trees overhanging, will encourage the presence of numerous insects, upon which the trout will feed. It is necessary to provide against overflow by freshets, by permitting only a certain quantity of water to flow through the pond, and making room for any unusual quantity to escape by the original bed of the stream. If there is no danger of freshets, the stream itself may be dammed, and the adjacent ground flooded. As soon as the pond is made, a thousand or two of young fry may be purchased in November or December, and patience for two or three years will accomplish all the rest. The great danger is overstocking, but with a pond of an acre, to which a few farmers' boys have access once a week, there will be little danger of crowding the fish. The next danger to be avoided is overfeeding. If the pond is stocked with minnows or other small fish, and a few roots of the water lilies, or the common water flag, be planted on the borders or shallow places, and some watercress be sown in the places where currents exist, a large growth of aquatic insects and animalculæ will take place, sufficient to support a large number of fish. Bass and perch will flourish under less favourable circumstances than trout. They will not object

to a muddy bottom, nor to water whose temperature for a part of the year may rise above sixty degrees, nor to water without any current passing through it for some time. Temporary streams may be dammed for these fish, or ponds in which there is only spring water enough to supply the evaporation will meet their needs. A considerable supply of food may be gathered from the offal of the farm for these fish, and in a short time insects and worms will accumulate in the pond, which will furnish food.

In cases where the most is made of these water deposits, by planting willows, etc., in addition to stocking them with fish, such easy work as will be necessary to keep them in order may be undertaken by some old and faithful servitor on the property, who is past the labour of regular and

heavy work. A double good will thus be done at once to the proprietor or farmer, and to the old servant; for the latter will be gratified, as all good servants are, with the knowledge that he is of service. And it is not a trifle, as some may think, to add to the gratification of even the meanest and poorest of our dependants, but it is that which will afford more mental satisfaction than employers may at first sight think likely. Indeed, it is perhaps one of the advantages attendant upon the utilization of the waste materials of the property, that much, and in some cases all, of its work may be done by those who are past, or nearly past, the period of active service. We make no apology for thus throwing out a hint which will be serviceable, and gratifying when followed out, as we believe it will, to right thinking men.

CHAPTER IV.

ICE-HOUSES.

In the chapter on dairies, we alluded to the extensive use of ice in the new modes of working them, and referred to the consequent necessity of a means of preserving ice so used. But it is not alone in reference to dairy-working that this material is employed, for one of the peculiarities of the present day is the extensive use made of ice, and this not merely as one of the luxuries, if indeed, under many circumstances, it be not a necessity of life in its ordinary conditions, but as forming a highly useful and effective substance in many branches of industrial calling. But while this is so in those which may be called external to that of farming, this one which is so little popularly esteemed is supposed by many to be quite independent of the use of such a substance, as not having any branch or department of it to which it apparently can be applied. But this is a mistake—one of the many mistakes which are made and obstinately maintained by those who place farming as an advanced or scientific calling very low in the scale. No doubt the value of refrigeration as a process, useful in the preservation of edible substances, has been more widely understood and appreciated, and its use, therefore, much more extended in other countries than in our own. Of these America offers the most striking example, although other examples are met with in several countries and districts of the Continent. Nor need this be wondered at, when we consider the nature of their climates, long periods of high temperature constituting one of their marked characteristics; the result of this being that the use of ice, merely as a necessity of living, has been from a pretty early period of their modern history almost universal. In process of time, however, its value for industrial purposes became

recognised; and, looking only to the aspect in which it is most interesting to us at present, the one which first came in for its most direct and extended application was that of dairy farming. As will be seen from other and special paragraphs treating of the subject, American dairymen have long been famed for their practical knowledge of the various details of dairy-working, as well as for the readiness with which they availed themselves of what science showed as likely to be of service to them in carrying these out in the highest state of possible perfection. Amongst the many methods and appliances of working, the introduction of ice has not been the least marked. And although it has long been occasionally used in this department of farming in this country, it is only recently that attention has been called to it as an absolute necessity, brought out by the peculiar circumstances connected with the supply of our markets with certain edible substances. For the making of butter, and for its preservation when made, it is specially valuable; nor can it be made less so in the cooling of milk, now recognised as a specially necessary process to be gone through when that milk has to be transported to a distance, or even used in the dairy.

On dairy farms, therefore, means of storing up and preserving ice may be said to form an essential part of those appliances which modern experience and science have opened up for us. But in truth, while ice can be made thus useful, its utility may be even more extended on farms. Thus, for mere family use in the household, if only esteemed a luxury, it is at least a healthy one; while it may be made to serve in a most effective way the claims of economy in the preservation of *wheat*, etc., kept for family use, or

stored up till it may be sent to market. Having thus, then, shown the value of ice, we purpose devoting a few sentences to the points connected with the best way of storing it up and preserving it. And that the appliances useful in this way will repay the cost of their construction and fitting up, is abundantly evident, especially on farms so situated with reference to towns that they produce various kinds of food, as milk, butter, poultry, and the like, to be sent up to their markets, where, in these days of high wages and more enlarged means and desires, they fetch the highest price. Now, it is established beyond all doubt that such edibles bring a far higher price when they are sent to market in a state as closely approaching the condition in which they are when first prepared, killed, and dressed for it, than if sent as they may be said generally to be sent, in a half-melted, partially decomposed, or trashy, 'not fresh-looking' condition.

The appliances and constructions required in employing ice for the varied purposes we have indicated, are divisible into three classes: first, those in which the ice is preserved for use in structures above the ground; second, those which are subterranean; and, third, those which are called composite, part of which are above and part below the ground level. These are illustrated in Plate 22, in figs. 1 to 8 inclusive. But however arranged and constructed, one principle affects them, or must be applied to all, and that is the packing or placing of the ice in such a way that it will be as little subjected as possible to the influence of conducting materials. In some cases, as in Sweden, for example, they keep ice without a structure of any kind, simply by placing it upon a foundation of sawdust, and surrounding it with a non-conducting material, as tan-bark, sawdust, dried peat, or the like; and so effectually that the annual loss of the mass so covered does not amount to more than 25 per cent. of the whole. But however small this loss may be considered in a country like Sweden, where ice can be had in great abundance, this percentage of waste represents a loss which, with us, would be considered a heavy item in the keeping of a material which is certainly not cheap in this country. Special structures, therefore, must be made in which to store it, and

every means taken to keep the waste down to a minimum. Fig. 1, Plate 22, illustrates an ice-house of the first of the three classes into which we have divided this kind of structure, in which the whole is above the level or surface of the ground, *ab*, fig. 4, which is a suggestion for an elevation in which rough timber and branches of trees are used to give effect to the whole. Fig. 1 is a plan which shows the principle of constructing a hollow wall of timber posts, either round and rough, as boles of trees of suitable diameter,—pine being the most lasting,—or dressed off to dimensions about 4 by 6, or 6 inches square, which are placed at distances of 3 feet apart, in two rows,—an inner, *aa*, and an outer, *bb*,—the distance between the rows being about 18 inches. The space thus made enclosing the desired area, *cc*, of the ice-house, is filled with the best non-conducting material which can be obtained, and which has, at the same time, the least affinity for damp or moisture. The only opening to the interior space is by a door *e*, fig. 4, placed in the centre of the side, the posts being so arranged, as shown by the dotted lines in plan in fig. 1, that the door, while in the centre of the side, is between two posts, the width between which regulates the width of the door. The door is made double, the casing being completed by filling in the parts between the rows of posts, as at *aa* in fig. 3, leaving a vacant space, as *b*. The two doors open outwards, as shown by the dotted lines *e* and arrow, being supposed to be the outside face of the house, the double dotted lines representing the doors. The floor, as shown in plan, is dished, sloping from the four corners of the house to the centre, *e*, at which point there is a grating, giving entrance to the (dissolved) ice water, to the drain which is underneath the floor, and which is led to some convenient spot. As this water is very cold, it might be preserved for drinking or other purposes, by passing through carefully laid and cleanly made glazed earthenware tubes, and led to a well, from which it might be pumped at intervals. We shall see presently how this can be carried out in the second class of ice-houses, in some of which it may be absolutely necessary, from the difficulty of having a drain cut at a moderate depth from the surface. In fig. 2 we

show part of vertical section of the posts *aa*,—fig. 1 *b* being one of the rustic (tree branch) brackets, *cc* the ground level, *d* the wall-plate to support the timbers of the roof. The house should have either a double roof, with a space between, or a ceiling, the space of which should be filled with the non-conducting material. In fig. 3, *d d* shows part of the dished or sloping floor of house in fig. 1, leading to the central drain trap or gully, and *ee* small grooves or gutters, made at intervals in the floor, to conduct the water quickly down and concentrate it till it reaches the drain. We suppose in this case the floor to be of concrete, which readily admits of the formation of these small surface grooves.

In fig. 6, we illustrate an ice-house of the second class, which is formed at the side of a hill, which will admit of a comparatively easy drainage, the drain leading off to the valley at the left side. Still, even in this case it will be expensive work, from the depths of the drain from the surface *a*; and it would be better if a site could be obtained so that the ice-house, *bb*, could be near the face of the hill or cliff, as shown by the dotted line *c*. The main body of the house, *bb*, is conical, or rather an inverted cone, this being the form adopted, as it enables the ice to pack closely together, as the blocks have a tendency to slide down the sloping sides; the form, also, facilitates drainage, and the filling and emptying of the house. The upper part of the house is circular, and is approached by a covered gallery or subway, *d*, closed by an outer door, *e*, and having, in order still further to isolate the ice and prevent all access of the outer air, an interior double doorway, *f*, the doors of which open outwards. During the process of taking out the

ice, the outer door, *e*, is closed. The outer door is supposed to be reached by a narrow gangway or bridge, *ii*, crossing the valley, the dotted line representing the hand-rail of same. An important part of the construction of an ice-house is the drainage, as already stated. That in fig. 6 is shown as surrounded by a vertical drain, *gg*, which conveys the water to the gully trap, *h*, at bottom of ice-house, and from thence to the drain, *il*. The same drain carries off the dissolved water of the ice-house, *bb*. We have already said that the drainage of underground houses is often very difficult to be effected, especially where they are made on sites the declivity of which does not admit of the shortest possible line by which to lead the drain, it obviously being a costly work to cut a subway through solid soil, rock, etc. Hence the utility of the well already alluded to, and the mode of forming it, which is shown in fig. 7. In this the bottom of the ice-house is provided with openings between the bricks, leading to a space *b*, into which the dissolved ice water, as well as the drainage water of surrounding ground, as in fig. 6, is led, and collected in a small central well, *e*, from which it is withdrawn by the pipe of the pump, the latter being placed on the ground level above. To prevent the water or soil surrounding the ice-house still more completely from entering it, it is a good protection to puddle the well all round with clay, as in fig. 8.

An example of what we may name as a third class of ice-house is shown in fig. 5, in which it is partly in and partly out of the ground; the ice-house proper, as *aa*, being subterranean, and covered either with a brick dome, as shown at *b*, on one side of the central line, or a timber roof, *c*. The closed gallery, *d*, with its double door, gives access to the ice-house.

CHAPTER V.

LAND ON THE PROPERTY SUITABLE FOR SUBURBAN DOMESTIC STRUCTURES—THE POSITION, SETTING OFF,
AND LAYING OUT OF THE PLOTS.

THERE is no circumstance connected with the social progress of the times we live in more remarkable, striking, and suggestive, than the extraordinary rapidity with which all our towns are adding to the variety and numbers of their buildings. That their populations are increasing is no doubt true, and this might appear to be the reason why new buildings are necessary. We do not here, of course, refer to the public buildings. But this is not the only reason, for private buildings, or, to call them by their more specific title, new domestic buildings, are increasing and have increased in a far higher ratio or proportion than the population. We must look, therefore, for another reason for this extraordinary development of building we see everywhere around us, and from which not even the smallest village is wholly exempt. The reason, in truth, is not very far to seek; it is found in the change in the habits of living of the better and well-to-do classes, chiefly those engaged in business or commercial callings of one kind or another. In times not long gone by, tradesmen, for example, thought it not unbecoming their wealth or position to live either at or not far from their place of business; and the higher classes of commercial and professional men also lived in the towns, although, of course, in houses of a superior class. Now, however, it is the fashion to leave the town after business hours; and it is the ambition of every one either to have a house wholly in the country, or so far out in the suburbs that by a slight stretch of imagination it may be called a country house. The general wealth of the country has also increased vastly of late years; and with this increase of riches has come an increased desire for luxuries and comforts

unknown to, or at least uncared for by, our ancestors. This has not stopped merely at personal or household increase of expenditure, but has almost as a matter of necessity extended itself to that of the houses. Hence has arisen a class of domestic structures in many respects altogether new, not merely in the general style of their exterior, but in the kind and character of the internal accommodation which they afford. These are now known as villa residences, and are subdivided according to the accommodation they afford into villas proper, and villa cottages and mansions. They are also further classified according as they are situated. If standing isolated from other buildings, surrounded by grounds or gardens of greater or less extent, they are called 'detached villas,' or villa cottages. If two are built together, they are called 'semi-detached;' and if built in numbers, of which the lines are straight, they are termed 'terraces,' or the like; and if the lines are curved, 'crescents,' or quadrants.

But while the desire to have house accommodation of a superior kind has increased to a wonderful extent amongst the wealthier and well-to-do classes, and has prompted them to go from the interior of the towns in which their ancestors were content to dwell, to the suburbs and even to greater distances in the country; many causes have brought about a new system connected with the classes immediately below them. These causes have been numerous, not the least forcible in its influence being the enormous destruction of houses of the old style by railway companies and also by corporations. There has also been, although in a less marked degree, of course, the same desire on the part of the working classes to improve their condition of living, as has been

evinced on the part of the classes above them. Taking, however, the whole of the circumstances into account which we have either specifically named or less obviously hinted at, the result is, that what may be called a revolution in the building trade has of late years taken place. But while there has been, and is now, an enormous extent of building going on, it is open to grave doubt whether improvement, either in the style of the exterior decoration or in the conveniences of the interior accommodation of the houses, has kept pace with this rapid extension of construction. Domestic architecture is not the simple art or science which some seem to think it. It is not merely the placing together of the materials, so that the minor details and the general *tout ensemble* shall form an object pleasing to the eye, although in sober truth this effect is by no means often attained, even after the outlay of a lavish expenditure of money; nor is it the giving of large and lofty apartments,—‘entertaining rooms,’ as with a kind of covert sarcasm they are called. Domestic architecture, considered in its higher and broader aspects, involves points of infinitely greater importance than these, important to some as these may be. The houses which come under its range, and which should be designed in accordance with its correct principles, are meant to serve a higher end than merely as objects to look at and admire, or be admired by the owners or occupiers, or the passers-by. They are designed to be lived in, to minister at call to the health and comfort, and to add to the conveniences of the inhabitants. Yet the investigation of not a small percentage of the houses of the present day shows that they scarcely come up to this, the true and only standard by which, as *houses*, their value can be judged.

Although these latter points ought not to be left out of account when the subject of the present chapter is considered as a whole, still they are but of secondary importance, as coming more within the domain of the architect than of the agent, surveyor, and builder of the property; the primary points being those connected with the decision as to what parts are best suited for buildings, and how they can be so arranged for this purpose as to yield the largest amount of revenue.

As stated in our introductory chapter, it is only or chiefly those proprietors who have either detached properties abutting, so to say, upon the lands which are essentially urban, or the boundary line of which is continuous with mere city or borough properties, that are concerned, so to say, in the sale of certain parts of them for the purposes of building. The circumstances, then, to which, in the beginning of this chapter, we have alluded as giving rise to a demand—which is certainly one of the features of the age—for dwelling-houses of all classes in the neighbourhood of towns, cannot but have tended to raise, as they have indeed raised to a greater or less extent, the value of suburban parts of properties. In view, however, of the fact that for land possessed of good qualities of soil suitable for the peculiar class of farming known as suburban, high rents are asked and as readily obtained, the agent must carefully consider whether and where it might not be more advantageous to retain the suburban parts of the property for such farms than to cut them up into plots of varying size, suitable to the wants of building speculators, or of individuals who may wish to build houses for their own special wants.

To decide how best to proceed for the true and permanent interests of the property, a number of points will have to be taken into account, and these may vary in number and importance according to circumstances. They will in all cases, however, be of such importance as will demand from the agent the exercise of no small degree of judgment, skill, and acute observation. For example, he will have to consider in what direction building—using the generic term here—is likely to go, and whether there are causes existing, or likely to arise, which will change that direction, or bring about a change in the peculiarities of the neighbourhood, such as the spread of factories or industrial workshops, which, when present in a neighbourhood studded over with houses of a good class, cause them to deteriorate rapidly in value; next to which, or rather, we should say, worse than which, is the spread and rapid rise of the cottages of the workmen, which go along with or follow upon the erection of those factories in which they are engaged. Even worse still is the rise of that peculiarly low and de-

graded class of houses—if, indeed, they are worthy of the honoured name—which seem to follow the building of factories and workmen's cottages, much in the same way as those wretches who track soldiers to the battle-field, in which they will mercilessly strip the fallen, and often kill the wounded in their eager lust for spoil. But just as some districts will fall in value as sites for domestic structures of a superior kind,—or, where these may be built at some future time, may at a remoter period be deteriorated by some such causes as those we have named,—other parts of the property may rise in value through some cause or other, which may bring about what is called a 'run' on it for building sites. While, on the other hand, it will be noticed that through the operation of what may be called a 'law,' the tendency to increase of building will be invariably in some towns in a definite direction, in others it will be in one entirely opposite. The direction, however,—in perhaps the great majority of towns,—taken by or for superior houses is the west. The term 'West End' is well known. All these and other circumstances must be taken into account by the agent or the surveyor and valuer, in laying out parts of property for building sites; and care must be taken to watch the probable results of certain movements, as well as to decide whether such movements will or will not take place.

The value of building sites may be greatly lowered. For what in every respect offered such superior advantages that wealthy men would be tempted to erect their dwelling-houses there, may at once and for ever be utterly ruined by the landlord permitting a mixture, so to say, of different classes of structures to be erected in the same locality. We have known part of one property being laid out for houses of a superior class, for which in every respect it was admirably adapted, and on which some fine houses were erected, with every prospect of many more plots being taken up by well-to-do and wealthy people, thus making it a superior quarter of the town, when in an evil hour, why or for what reason done it was difficult to say, the proprietor was tempted or his agent permitted to allow a number of cottages to be erected on the very best part of the land laid out for buildings, and in the immediate vicinity of some of the finest dwelling-houses which had

been erected. This proceeding was, strictly looked at, a breach of faith on the part of the landlord, or his agent acting for him; for those who had erected large houses had done so, if not on the positive, at least on the implied understanding that the 'amenity' of the neighbourhood would be preserved, that being one of the reasons, if not the main reason, why those parties had elected to build in that particular locality. But the breaking through of this implied understanding effectually stopped all further progress so far as the erection of superior and good paying houses were concerned, with the exception of one or two built by a 'speculator' ignorant of one phase of human nature, but who soon and to his cost was made aware of its existence by the imposing structures which he had erected standing for years unoccupied. Nor was the proceeding successful so far as cottages were concerned, as no other offer was made for *their* extension. The fact was here obviously forgotten, that classes of domestic structures situated at the two extremes of the line, so to say, occupied by rich and poor, do not coalesce; like oil and water, they may be mixed up with each other, but they do not mingle permanently, but ultimately separate. So it was in the case now under notice: the land was spoiled for both purposes; the 'mansion people' would not go where the 'cottage folks' were, and the latter did not care—not feeling at home—to go where the former were. We note this case specially, inasmuch as it is one which is likely to occur, and is one, indeed, which has not seldom spoiled the paying prospects of good building land; at all events, it may be suggestive to the agent of some points worthy of consideration in the portioning out of parts of property for the object now under discussion.

We have referred to the existence of a special class of farms, for which there is generally a good demand, in properties 'marching' or coming close up to that which is strictly urban. There is another class to which, in our introductory chapter, we have also referred—namely, that of small or amateur farms. On the special points of these we have yet somewhat to say; meanwhile we are noticing them chiefly as forming part of the property designed to be laid out for building purposes. Such farms

may be situated in a locality on the property which will come strictly under that class popularly said to be 'in the country;' or they may be placed near the town. Generally, those who like amateur farming, being possessed of means, prefer to be, for obvious reasons, within as easy reach of the town as may be.

To meet the varying wants or wishes of various classes of purchasers, the land to be let out—which, as a whole, may be said to be suburban—might be set out into zones or circles, more or less concentric, or as part of such zones. Thus the land devoted to houses alone might be placed nearest the town; the small farms, with their houses, next; while the suburban farm proper would be in the zone, or part of the zone, farthest from the town. This arrangement would be one obviously decided by the fact that the nearer the town the more valuable would be the land, which naturally, as it were, ranges itself under the class or variety known popularly as 'building property;' while that farthest from it would as naturally range itself within that class designated as 'farm land.'

As already stated, no small judgment will be required in arranging the building land into plots or portions calculated to suit different purchasers. We do not here refer merely to the size or extent of the plots, but to the class of purchasers. There is always existing a certain degree of exclusiveness in the well-to-do classes, ending in the formation of what are so well known as 'cliques,' 'coteries,' or 'sets'—the phrase 'our set' being admirably illustrative of this peculiarity; and these 'sets' are not confined to merely social developments, but they extend their principle to and exercise their influence upon even the houses which the 'sets' inhabit. Hence, one of a certain class or set, who builds a house in a certain locality, does not care—indeed, it may be said, strongly objects in many cases (in so many, that possibly it may with safety be said that it is the rule)—to have a house of a cheaper kind built in close contiguity to his. And so strongly does feeling operate, that if one first-class house, for example, is erected at a certain part of the 'building land,' others follow the example, so gregarious are those who make up the 'set'—or rather, to put it more correctly, so

anxious are its members to keep up the exclusiveness which they call 'keeping up the select character of the neighbourhood.' However much this feeling may be deprecated, from one motive or another it exists, and has a potent influence in many ways, and not the least marked perhaps in the department of social economics now being considered. Indeed, investors or speculators in building land, with tact or worldly wisdom, avail themselves of the feeling in many instances, and so far minister to its weaknesses—or legitimate expression of its wishes, if this term be preferred—by having certain districts or parts of their land placed under such restrictions, that not only must a certain extent of land be taken, but a house of a certain value built upon it, a minimum being in both cases named in the terms of agreement. It is thus that we see certain districts exclusively occupied by houses which, however they may vary,—as they do vary in architectural design,—are pretty uniform in the one respect of value as buildings. But this, viewed from another point, is an arrangement on the part of the proprietor of the land—whether he be the original owner or 'lord of the manor,' or a speculator who has invested in the purchase from him of a certain extent of land, with the avowed purpose of letting it or selling it for building purposes—which is quite legitimate. For it is obvious that by this precaution—for precaution it is—he hedges himself round, so to say, by the requirements of a provision which keeps out or prevents from building those who would erect structures of inferior value, thus deteriorating those of a superior kind which might have been previously built.

To this we have already alluded as a point of importance, influencing, as we have shown, the selling and letting value of building land; and it is one to which the attention of the agent of the property must be specially directed. This may in many cases almost of necessity compel him, so to say, to carry out the principle of dividing his building land into zones or districts, to which we have already referred, setting out the part most likely to be adapted for houses of the first class, another to those of the second class, and so on, down to the cottage and factory plots. Here

—so far, at least, as those buildings inhabited by people who are ‘independent,’ even if in but a limited degree, are concerned—he will find the spirit of ‘exclusiveness’ existing in such force as will make his otherwise apparently invidious and difficult duty to be one of easy attainment. For it is quite a mistake to suppose that the ‘sets,’ ‘cliques,’ or ‘coteries’ do not exist amongst those of small but still independent means; it exists even amongst cottage occupiers. Indeed, it may be reasonably doubted whether they are not more strongly developed amongst these two classes than amongst those immediately above them. He knows but little of the various phases of society who imagines that exclusiveness is confined to the upper classes only; let him mingle amongst what are called the ‘lower classes,’ or even the ‘working classes,’ and he will be somewhat rudely disabused of his notion.

In laying out the land for buildings of a superior class, care should be taken to have the various plots as attractive as possible, both in position and as to form and dimensions, and to have as much ‘front land’—that is, nearest the road, and that which has the finest prospect—as possible. ‘Back land,’ for obvious reasons, is much less valuable, and so much a ‘drug in the market,’ so to say, that where, owing to bad disposition of the plots, there is much of it, the agent has a difficulty in disposing of it for building. No one cares to build in such a position that his house looks out upon the back of another man’s building, and overlooked also by the back rooms thereof.

It is in the zone or district set apart, or what seems best fitted to be set apart, for cottages for the working classes that the factory or workshop building plots are placed. This is a natural arrangement, as the nearer the work-people are to the places in which they are employed the better. Indeed, in view of the great inconveniences to which many workmen are put by having to walk great distances because their ‘shops’ are far from their houses, it is worthy of consideration whether, in setting out plots of suburban properties for building, it would not be a paying—assuredly it would be a philanthropic—arrangement to set out a zone or district in which cottages and factories, etc., would be

placed in near, but yet regularly arranged, contiguity.

The price or value of land for building purposes will vary not merely with the varying locality, but with circumstances which may be called, for lack of a better word, a fictitious, or rather conventional, value. These may arise from a number of causes—a ‘run’ upon a particular part of the property, making it an object for parties proposing to build, to build there rather than on another part; a fashionable whim or prejudice; certain presumed or real advantages, making the site particularly suitable for a certain class of property, as factories or the like, and so on. It is often difficult to account for certain parts of the property being considered by the public as more valuable than another, as not seldom is it seen that choice is made of sites by no means so advantageous as others; but, however arising, an agent possessed of tact will take care to make the most of such peculiar circumstances tending to raise the value of the land. Nor, indeed, has it been quite unknown that an agent of this class has been able by clever diplomacy to get a part of the property to be looked upon as good or fashionable—with many the terms are quite convertible—which in reality possessed no great claims to the first named of these. It is doubtful, in brief, whether there is any department of the management of property which calls forth on the part of the agent so much of business skill, tact, and knowledge of human nature as that connected with the sale or letting of land for building purposes on property, part of which is bounded by the neighbourhood of towns. Suburban land, when well managed, gives a value to a property far in excess of that which it would possess considered merely as farming land; and where it is situated near a manufacturing town especially—coming close up to, or, better still, cropping out or merging into land already occupied or begun to be occupied by buildings on land belonging to other proprietors—this value is so increased that the proprietor becomes exceedingly wealthy. We could name more than one proprietor who has founded a ‘family’ and taken rank amongst the wealthiest of the kingdom simply from being fortunate enough to possess land situated as now

stated, and which, of course, is much more valuable than when situated near towns or villages in strictly rural neighbourhoods.

Land for building is disposed of under various systems, and the customs of one district are different from those of another. Generally, however, the systems may be classed as three: first, 'freehold,' in which the land is sold to the purchaser 'out and out,' as the phrase goes, he becoming actually the owner of the plot he so buys; second, 'copyhold'—that is, in which the land belongs to the purchaser for a certain term of years,—generally ninety-nine,—on the expiry of which it and all the buildings erected upon it revert to the proprietor or his heirs: in some cases 'copyhold,' so called, is extended to nine hundred and ninety-nine years, which case is one virtually equivalent to a "freehold" purchase; third, by the payment of a certain rental for the plot, based upon a charge generally of so much per square yard. This in the south of the kingdom is known as 'ground rent,' and in the north as 'feu-duty.' So long as this is paid—the payments being annual, with certain terms or days of 'grace'—the purchaser, so to call him, retains possession of the land. But should he fail to pay, the landlord can then take possession of it and the buildings thereon, the claim for 'ground rent' or 'feu-duty' taking precedence of all other debts, no matter how contracted or to whom they are due. The landlord being always secured (see next paragraph on 'Contracts or Agreements'), the buildings can be sold or transferred by the original purchaser or occupier of the land to other parties, the landlord claiming his rental from the then occupier of the land and buildings. There are other modes of holding land, but to these, as they are now seldom if ever carried out,—being relics, so to say, of other and older times,—we need not refer.

The agreement or contract between the proprietor of the property on the one hand, and the purchaser or party proposing to build upon a certain portion of it on the other, is an important document, and requires to be drawn up with considerable care. There is no model contract; each one must be drawn up on its own basis. This is obvious, as there may be a necessity to introduce certain restrictions in one

contract, which the circumstances under which another is drawn do not demand. In all contracts, however, there are certain clauses which may be called standard ones: amongst these is the important one, and which has the first place, that the buildings shall begin to be erected within a certain period from date of agreement, and shall be of a value when finished not less than a certain specified sum. This is necessary in order that they shall be of such value as to 'secure the ground rent' to the landlord. The purchaser or his architect must present plans, specifications, and estimates, or at least plans, to the agent of the property, who must examine and pass them before the purchaser can begin to build: this precaution is necessary to enable the agent to judge of the value of the intended buildings. In some cases, the party purchasing is bound down to build according to a certain plan of arrangement of the building land; this, however, is chiefly if not only in cases where the buildings assume a certain form, as streets, crescents, or the like, so that uniformity be secured. In land situated more completely in suburban districts, or those more approaching to the character of rural, and in which the buildings are of the class known as detached or single, or at the most semi-detached or in pairs, such restrictions as the above are seldom made; the only ones generally insisted upon on the part of the landlord being that the house shall not come nearer the main road than a certain specified distance, this applying also to the boundary lines of the plot,—these last being necessary in order that the value and the amenity of the next contiguous plots shall be preserved. Another restriction, almost always made on the part of the landlord, in districts appropriated to domestic structures of a superior class, is that the purchaser is not to erect on his plot certain structures named, which are or could be used for carrying on certain manufactures, processes, etc., likely to create a nuisance to or detract from the value of the land in the neighbourhood.

The 'agreement' is the document which is first given to the purchaser, and it contains the statement of the terms upon which the land is to be sold or let, and attached thereto is a plan

of the plot, the area of which has been ascertained by a certified or proper professional land-surveyor. The agreement is followed by the 'deed,' drawn up in proper form, and engrossed on parchment, duly stamped; and it is only the possession of this document by the purchaser which enables him to raise, if necessary, money on his building by mortgage, and to transfer it by sale to another party.

But while the proprietor of the property takes care to secure his interests, the purchaser must look to it that his own are not neglected; and just as we would counsel him not to be his own architect, so would we advise him not to be his own lawyer, but to secure the services of one upon whose integrity and ability he can rely. This gentleman will look over the deed before it is signed, and will likely be able to draw attention to some points which should be altered or inserted in the interests of his client. These, we need scarcely say, may not have been omitted by design, they may have been overlooked; but in either case, if not attended to, and made right, the practical and unfortunate result is all the same. We have known, for example, the case of the purchaser of a plot which was bounded on one side by a private road belonging to the proprietor, and the use of which was granted to him, he placing his entrance-gate leading therefrom, in preference, for obvious reasons, to having it on the main and public road. But in the *draft* of the deed, which should always be seen before it is engrossed, no provision was made for the right of use of the private road for carriages or vehicles conveying goods, as coals, etc., to the house of the purchaser, so that virtually and legally he was restricted in its use to walking only. The practical inconveniences of such a restriction are clear enough. Take one example only: when coals had to be brought to the house, they must have been carried in piecemeal, so to say. The matter was at once set right on being pointed out to the agent, who saw the reasonable nature of the case, so far as the purchaser was concerned. We note this to show that what appears to be a very simple restriction or provision may act very inconveniently, if not prejudicially to the interests of the party

building. But mistakes are not always against the purchaser, so that it behoves the agent to look more to the interests of his employer in all points, however trivial, if any point indeed can be called so in business arrangements.

We cannot, of course, be expected to run over every point, not even, indeed, all of the more important points, connected with the management of that part of the property. But we have, we believe, said enough to show in what direction attention should be given, in order to secure from it the largest amount of revenue. As we have already said, the management of this department is one which calls forth the exercise of no small amount of business skill, tact, and energy, and of knowledge of 'men as they are.'

The Laying out or Disposition of the Land for Buildings of Different Classes, and of Single Plots.

—As regards the first of these subjects, we have already named some of the points which require to be attended to, but these have had reference to the general disposition of the building land as a whole. We have therefore now briefly to draw attention to some of the features of more special plots or parts, designed to have erected on them domestic structures of various classes. The subject is one on which much could be written, but it will be sufficient for the purpose we have in view if we glance only at its leading features. The land in the immediate vicinity of a town will have the method of its laying out decided more or less by the class and style of houses already erected near it. These, indeed, afford a pretty safe indication of the direction in which certain classes are taking, as mere street property, or that devoted to factories, etc., or that which is taken up by domestic villa structures. But the different classes vary as to their value, so that even streets, or rows or lines of houses erected continuously, may be made up of structures of a highly expensive kind. But superior houses, however arranged or disposed, will be found, as a rule, to be erected in one or in certain parts only of a town. Thus a very general direction, as we have already stated, is the west,—the 'West End' being a distinctive term not applied merely to London alone,—although the 'upper ten' of society sometimes migrate to other quarters,

as the east. Much, of course, depends upon circumstances, and these act, as we have said, in a very eccentric way, so that no law can be laid down as that which dictates the direction of locality. Another rule, pretty generally met with, is that, so far as the superior quarter of the town is concerned, the streets or continuous rows, as terraces, crescents, etc.,—and which have, as a rule, no garden ground attached to them, unless, indeed, that term can be applied to patches of land in front, and drying-grounds for clothes at the back,—give way gradually to other classes of buildings, such as what may be called broken-up or partial streets, consisting often of short rows of houses, four in number as a pretty general rule.

Next come another and more distinct class of structures. These belong chiefly to the semi-detached or pairs, and detached or single, but all of these classes have garden grounds of greater or less extent attached to them. These grounds are so arranged in the latter, that considerable space is left between each pair of houses or each house. And as the true country or rural district is reached, the houses become more and more sparsely dotted over the land; this being portioned out to them in increased and still increasing areas, till mansions, with what really deserve the term of 'grounds' attached to them, form the feature of the part of the property devoted to building land. And as the houses become more and more broken up, and the extent of the land given to each increases, so also does the necessity increase of giving greater attention to the way in which the land, as a whole, is laid tastefully out, so that it will form an attraction to purchasers. Here the skill of the agent may not be such as the exigencies of the case demand, nor is this at all derogatory to his value as an agent considered generally; so that it may be necessary, and we may say it will be prudent and politic, to call in the aid of a professional gentleman to lay out the land to the best advantage. In the disposition of this for crescents, etc., in which the classes we have named as rows of four or more, or semi-detached and detached houses, may be arranged in the zone, so to call it, immediately beyond that occupied by street houses proper, there is a wonderful difference displayed between

the work of one man and that of another. A portion of land really possessed of most attractive natural features may be utterly spoiled, or greatly so, as we have known, by one man; while by another these may be positively added to. Natural and really beautiful features are taken in hand by some in order to 'improve' them, which literally means spoiling them, while the object in view ought to be to make the most of these, adapting the peculiarities of the plan to them, rather than attempting to alter their features to the necessities of a preconceived plan.

It is not easy to improve upon nature; the site should, in brief, decide what the plan of laying out should be, not the plan the site. If the land on one side only of the public road be given to building purposes, the other being devoted to farming or other purposes of the property, the north side of the road should always be chosen for the building land, as then the houses will have a southern aspect. Although an extraordinary indifference exists as to the aspect of a house, some thinking that a north outlook is as good as a south, it is the fact, nevertheless, that a south aspect is not only healthy, as we have elsewhere in this work shown, but in making a house look cheery and pleasant adds positively to its selling value. For, however much people when living in a house may shut out sunlight, few indeed would care to purchase a gloomy-looking house, with gloomier-looking rooms, which one having a northern aspect is, and is sure to possess. The point is perhaps even of much greater importance when, as above hinted at, the health of the inhabitants is concerned.

The proprietor of the property often enters upon building speculation himself. This is frequently done, not so much with a view to carrying it on for profit, but to act as inducement to other parties to build in the neighbourhood. Opening it up thus, it behoves the agent to see that every attraction possible be given, not merely by the class of houses built upon the plots, but by the way in which these plots are themselves laid out. There is a great deal to be done in this way in adding to the value of a house. Many an inferior building, which would bring but a low price in the market, has really

a high value given to it by the attractive way in which the grounds surrounding it are laid out.

Much, indeed a great deal, of the attractiveness, and therefore, as we have just said, of the value of suburban and rural dwelling-houses, depends upon and can be obtained by the way in which the grounds about them are laid out, and in the way in which the peculiarities or characteristics of the surrounding scenery, or even the irregularities of the site itself, are taken advantage of, to add to the general effect of this 'laying out of the grounds.' It is amazing how little progress we have made in this department of house arrangement, as we hold it to be. We have travelled again and again through districts in which nearly every house, however good or expensively constructed, stood bald and bare on its site, and many a site most beautifully adapted for laying out attractively; and even where attempts were made to lay out the surroundings, they were poor in the extreme, and gave rise to the idea that an attempt to do something had been begun, but suddenly stopped in the despair of the worker at finding himself able to do nothing. On the other hand, we have travelled through districts in which nature had not been so bountiful in her attractions, yet almost every house, however humble, was placed amidst most attractive surroundings, gained wholly by a fine taste in designing and skill in laying out the site, and in taking advantage of such natural advantages as it might possess, few and poor as these might be.

Much of the neglect observable around us in making a home attractive by its surroundings arises, we believe, from this notion, that to lay out grounds properly is a very difficult thing to do, and as skilled labour must be called in, that this is very costly. This is quite a mistake. Much if not all of the work can be done by common labourers, and the work of design by the master of the house, assisted by the lady part of the household. Indeed, not much knowledge of design is required; for if we start with a general notion of what the whole should be, it will be found that as one portion is done, it leads to a suggestion for the doing of another

portion, and so on till a very good and effective whole is obtained. Again, the very nature of the site dictates how it should be laid out.

It will not be expected of us that we shall here enter into anything like a full detail of the principles involved, and illustrations of the practice of laying out grounds attached to dwelling-houses, as it is a very wide subject, and would require the space of a treatise of considerable length to do ample justice to its details. We can at best glance at a few of its leading features, explaining these by a few simple illustrations.

We have just said that it is surprising how little is done in this department, and have named one reason which may urge some proprietors to pay a little attention to it; another is the very general notion which is prevalent, that nothing can be done in the way of making attractive the comparatively small plots which the majority of houses have, but that large and extensive surfaces are required in order to find 'room' for the display of taste in setting them out. Of course finer effects are undoubtedly obtainable on large than on confined ground; but we venture to say that the skill of the designer will be more shown in setting out a small space to the greatest advantage, than even when he has larger space at command. We have seen, not seldom, the 'tiniest' plot so laid out that it formed a little paradise. In the laying out of the plot, the chief point to be aimed at is getting as wide a variety as possible, but uniformity being carefully avoided. This may be illustrated by the case of a house of moderate size set back, as is usually the case, for some distance from the road, leaving a clear space of land to the front. Now the house may be approached in two ways. First, where the object is what some people delight in calling the 'absolutely useful,' the ground is laid out with plots, most of which are taken up with vegetables; a central walk leading from the gate to the house dividing the plots on either side. The walk will be straight, and as narrow as possible, in order to carry out the economy of the system. And if any concession be made to a taste for the beautiful, it will probably be by laying down a narrow flower border along the front of the house. The second plan of laying out the same ground

will possess different features; utility will not be lost sight of, but it will be so treated that it will add to, rather than detract from, the general attractiveness of the grounds, of which the main feature will be the variety we have already noticed. This will embrace several details, but all of which will go to make up the complete whole. The walks, for example, will, as a rule, be curved; and the forms of the curves adopted will obviously influence materially the shape or contour of the intervening spaces, so that some attention should be given to the best line of curvature. By varying the direction of the walks and filling up the spaces with shrubs here, a standard tree or two there, knolls or rising grounds put down, so as to mask the continuity of a walk, the whole will give the impression of a much larger plot of ground than it actually is; while with the minor accessories of vases, flower-tubs, masked by rustic woodwork, sunshades, etc., together with tastefully arranged plots, filled with flowers of various colours, a little gem of a place may be arranged, which will be a delight not only to its owner, his family, and their visitors, but must of necessity add largely to the value of the property.

The Laying out of the Grounds of Villa Plots on the Suburban Land of the Property, and their Exterior Structures and Garden Appliances, as Stables, Cow, Poultry, Pig, and Wash Houses, Greenhouses and Conservatories, etc.—We have already very briefly alluded to the influence of the way in which suburban land is laid out for building purposes in adding to its value,—a point which the agent will take care to keep in view. This refers, however, more particularly to the general distribution of the plots, in order to suit different classes of property. But there is another department, which comes more under the head of detailed work, and this is indicated in the heading of the present paragraph.

In one sense it is difficult to overrate the importance of this, inasmuch as it tends, as we have already hinted at in another part of this chapter, to raise the value of building plots in a much higher proportion than some will be disposed to admit. It will be the care, therefore, of the agent or manager to see that the most is made of this; we shall therefore give a few

hints, which may be of service to those who have not hitherto closely considered the subject. Leaving for the present our remarks on the laying out of the grounds attached to villas, we shall draw attention to the fact that the external accessories, although generally considered to be confined to the ornamental structures, such as greenhouses and conservatories, and those more useful ones attached to the fruit and vegetable gardens, we place in our category other structures which, although in no sense thought to be ornamental additions to the property, but are simply useful, may also be made in some degree to add to the attractiveness of the grounds as a whole. These may be summed up as wash-houses or laundries, small stable and coach-house, to which may be added a poultry-house; and in the districts which approach more closely those of a rural character, where a paddock or small field forms either part of the property or the use of which can be obtained separately, and where a cow is desired to be kept, to the classes already named will be added a small cow-house and dairy, with the probable addition of a piggery, when beyond the bounds or influence of that police supervision which prevents the keeping of such places.

Taking up the subjects thus named in due order, the first claiming our attention is 'the laying out of the grounds immediately surrounding the villa.'

In connection with this, it is obvious that the taste of the owner is displayed very much by the way in which the grounds surrounding his house are laid out. But it is a very general mistake which is made, that in order to display this taste, large space of ground, extensive operations, and expensive modes of laying out and of fitting up the various accessories are absolutely essential. On the first of these little need be said, so obvious is the truth conveyed by it. Indeed, some have gone further than what it conveys, and have held that a man's character may be judged of by the way in which his grounds are laid out. Be this as it may, and all such theories can be pushed to absurdity, on the second much more can be said,—so much, that there is room for a pretty fair treatise upon it, which may some day engage our attention.

While stating that large and extensive grounds are not essential to the display of taste in laying them out, we do not mean to imply that finer effects are not obtainable when larger spaces are at command, but simply that good taste can be displayed to wonderfully great advantage even on very small plots. Nay, it may almost be said that the smaller the plot the finer the taste, inasmuch as its exercise is much more fully taxed than when greater facilities are at command. These remarks are but very commonplace, or are mere truisms after all, yet, like many truisms, are very apt to be overlooked or forgotten, the practical result of which is that much is neglected to be done which might be done, simply because the means are considered too limited to do anything at all with. Thus opportunities for creating around a house much in its surroundings that would not only be beautiful in itself, but add greatly to the attractive value of the house, are neglected to be taken advantage of. It is, at all events, worth the trial to see what can be done with the space at command; better than allow it to be neglected and 'waste,' and to do little because more is not within one's reach. We have seen the 'timest' spots so artistically laid out, every inch of ground so utilized, and all made to work one part with another, that the whole was quite a 'thing of beauty;' while, on the other hand, we have known large spaces so treated that they were the opposite of this.

Some may object to great—or indeed much, if any—attention being paid to the external surroundings of the house, merely because they do not care for such things. But another view may be taken of the matter, and it is one which may possess greater weight than that just named, viz. that the grounds of a house, however limited in extent these may be, if laid tastefully out, always improves the look of the *house itself*, and doing this raises its selling value materially. We have known many instances where the laying out of the surrounding grounds, and the accessories with which they were supplied, have been so admired by intending purchasers, that, having taken such a 'fancy to the place,' they have not hesitated to give a 'fancy price' for it, far, indeed, above its value; so that attention to matters of taste are not always and

altogether thrown away, or lost money to the proprietor.

In the laying out of the grounds attached to a house, the great point to be aimed at is the attaining as much variety as possible, and the avoidance of the bald uniformity, than which nothing is to our mind more unsatisfactory. Take the case of a house of moderate size, set back, as is usually the case in suburban villas and villa cottages, some distance from the road. There are two methods of setting the front ground out, which will be followed according as the owner or occupier belongs to one or other of two classes. If of the strictly utilitarian class, of whose members Ruskin says that they 'think, as far as such men can be said to think, that the meat is more than the life, and the raiment than the body; who look to the earth as a stable, and to its fruit as fodder;' the ground will likely be laid out on that vaguely expressed principle of 'making the most of it.' That is, there will be a walk to reach the house,—that being a necessity scarcely to be dispensed with, although some may go the length of grudging the land it occupies, as we have heard of one who did so grudge it, as so much that was wasted. This walk will go straight up to the front door of the house, and on either side will be plots laid out for the cultivation of the 'plainly useful crops'—potatoes, cabbages, and the like. Not an inch will be spared to lay out in plots for those lovely flowers which at once delight the eye with beauty of form and colour, and fill the air with fragrance. No, not a flower will be there 'to waste its sweetness in that desert air!' If there be those who think that such a style—if style it be worthy of being called—cannot be, or never is, adopted now-a-days, we assure them that it is so, and much more frequently than one would be disposed to admit, who believe that the old and ugly style is a thing of the past.

If the taste and aspirations of the owner be a grade above the last named, the laying out will display some improvements. The prim and straight walk may still be seen, bordered on either side by the plots of the kitchen garden, but the ground nearest the house will show some desire on the part of its occupants to look out upon other than potato plots or cabbages. An attempt to form a lawn will likely be made, and

in which some flower plots will be seen. Still ascending in the scale, we get to the first stage of the work of the second class of owners, who deem ground not wasted which adds merely to the attractiveness of the house, and pleases their eye and gratifies their taste. Shrubbery now begins to be seen; and upon the judicious use of this, and the relation it is made to bear to the walks and to the house itself, depends much, if not all of its effectiveness.

We have said that variety should be aimed at in the laying out of the grounds, and if it be not attained the main object will be lost. This variety should embrace not one but *all* the details,—the walks, as well the way in which the intervening spaces are filled up, as with knolls, clumps of shrubs, trees, pieces of ornamental water; and in the minor accessories, such as the vases, flower-tubs, sunshades, summer-houses, etc. The small sketch plans shown in Plate 66 will give the reader a fair idea of what can be done in the way of obtaining variety without much expense, and with comparatively small or limited spaces of ground. It is to be understood that those sketch plans are given as suggestions merely.

The filling up of the various parts where flowers, plants, and shrubbery are required, will be done by, as it ought to be left to, the gardener; but all details of a structural nature should be within the domain of the architect or builder. True, they are generally supposed to be so now; but although it may be, not seldom, to their own chagrin, and to the hurt of the good taste of visitors who know the principles of the art, the most incongruous fittings have been put down by 'somebody,' equivalent to the 'nobody' who is always doing mischief and is never caught in the act of doing so. By employing the architect to aid the gardener in fitting in the parts of the grounds with accessories in keeping with the style of the villa, much may be added to the beauty and completeness of the whole.

The spaces of ground left open or unoccupied, for the purpose of being filled in with flowers of different varieties, require, therefore, to be treated with skill and judgment. The effects obtained in these parts by means of colour must be of course left to the gardener, who will know best

how to secure them by his choice of flowers of different hues, tints, and tones. The effect obtained by means of form is usually looked for from the gardener also as part of his peculiar department, and he does his best to give them. But that best is often what is not wanted, inasmuch as the forms which he assigns to his various plots, in place of being in, are often sadly out of keeping with the style or design of the house and its structural accessories, such as the conservatory. Nor can he, or ought he, to be blamed for this, as the matter is clearly beyond his province. A little consideration only is required to prove this. But while the architect and he alone can arrange the position and define the forms of the plots, which in their turn will be influenced more or less by the intersecting walks and alleys, mounds for shrubs, sun-dials, pieces of water, or lawn ground, he will be none the worse, but likely much the better, for taking the gardener into his counsel. A combination of the knowledge and skill of both will give better results, or ought to do so, than if one alone were to work out the plans of ground plots and walks, etc. Landscape gardeners, who occupy a higher position in the art, bearing the same relation to ordinary gardeners as architects do to builders, are, in the majority of cases, quite competent to design every detail both connected with the laying out of the grounds, the formation of the flower plots, and the design of the conservatory, etc., so as to be thoroughly in keeping with the style of the house. But skill, of course, of this kind must be well paid, although it is well worth paying for if the extent of the ground and the number of the garden structures, etc., will justify the outlay. In cases even where the grounds are of small extent, they should not, however, be laid out, and such buildings as are to be erected should not be designed, out of keeping with the style of the house; so that the advice we have already given had best be followed, that the architect should himself design the whole details, where style and form are to be maintained, according to correct rules.

The designs for flower plots may be said to be endless, as it is difficult to place any limit to the combination of lines which the taste, skill, or eccentricity of the draughtsman or designer can produce; but it is, or should be, obvious that the

limit should be placed somewhere, up to a point below which every design shall have the characteristics of the 'fitness of things,' beyond which all will be mere eccentricity and bizarre grotesqueness. To hit this happy point, it must be confessed, is a difficult thing, but it is worth attempting to hit it; and some do succeed with remarkable good fortune in doing so. There are certain principles which will aid the designer in getting good work, such as having a consistency in the style of the plots with that of the house; but this is not always attainable, inasmuch as there are not styles of gardening adapted to all the styles of architecture,—at least, not always recorded or published examples, or of gardens actually laid out, to be easily met with. And where the house, as regards its design, comes under that singularly repulsive class as 'no style,' there is no help for it but making the garden plots to possess the same happy or unhappy characteristic,—a task, by the way, infinitely more easy than to adapt the garden style to that of the house where that happens to be designed after a known style, and where the style has been well carried out or adopted. A rule generally applicable, is to keep the designs of the plots as simple as possible, although this by no means excludes those which may be truly classed as elaborate. And it is just here that the skill of the designer will best be shown; for, while giving designs which may truly be classed as simple, being composed of but few parts or combinations of lines, he may also give others which have many lines, and yet so skilfully regulate one to the other, that the eye will be pleased with it as being in one sense very elaborate, and yet very simple. And the most pleasing designs of an elaborate kind are those in which the eye can follow all the lines, no matter how numerous they may be, with ease, following them up so as to take in the whole design without the feeling of having the 'eye distressed,' as it is called, and yet upon any single part of which it can also look with ease,—a sense of 'repose,' in fact, being that which distinguishes the act of examining the design either in detail or as a whole. Simple designs, that is, composed of few lines, are more easily dealt with by the draughtsman, and more readily comprehended by the spectator;

but the same sense of 'repose' should be felt in examining even such simple designs, and wherever this does not exist, it may be taken as the most unfailing sign that the design is faulty. Where the lines are partly straight and partly curved, the greatest care is necessary to have their junction effected in easy flowing parts. Hitherto we have been considering plots as single ones; but often a combination of several plots or figures, so to say, is adopted, the whole forming, however, one design, of which the main part is external, enclosing the smaller figures or plots. This is exemplified in the case of lawn plots,—an external figure or boundary line being cut out in the grass enclosing a space of dug soil, which is again occupied with figures, small or subsidiary plots with flowers. In such cases care must be taken to have a congruity between the internal or small figures and the external one which bounds or encloses them. This congruity is not always observed, and such fanciful designs are sometimes to be met with, in which the outer figure is made up wholly of a circle, parts of circles, or curved lines, the internal plots being all with straight formal lines. The two parts should have a distinct relation to each other, the inner flowing out, as it were, from the outer, and *vice versa*. Where the plots are large, affording space for shrubs or tall growing plants, judgment must be exercised in the placing of these, so that they shall harmonize with the general design.

Very popular accessories of the garden are the greenhouse and the conservatory. Those structures are frequently considered as one and the same, and this is true in the case of extensive gardens and large mansions, where there is a full complement of garden structures, embracing vineries or graperies, peach houses, &c. &c., the greenhouse and conservatory being often named one for another, and both used for the reception of choice flowers and plants. But in smaller gardens, where the structures are very limited in number, the greenhouse is devoted both to useful purposes, as for growing grapes, and ornamental, for enclosing flowers and plants. But where means allow of it, the two structures are essentially different, the greenhouse being of a much plainer character as regards design, comparatively limited in dimensions, especially in

those of breadth, length only being unlimited and defined by circumstances. The conservatory, on the other hand, is the garden structure on which the greatest amount of money is expended, in order to obtain the finest display of architectural design and large and striking dimensions, in which the effects of rare and large flowers and plants can best be displayed. The greenhouse in such cases is therefore placed in that part of the garden where useful structures and operations are carried on, the conservatory occupying a position where it can be seen to the greatest advantage. It may either be completely isolated from the house, or be so arranged as to form part of it. In this latter case, it is generally arranged so that access can be had to it from the interior of the house, the part chosen for this being one of the principal rooms, as the drawing or dining room.

As a rule, this arrangement is rarely made the most of. To judge, indeed, from the examples too frequently met with, we may say that, as a rule, its capabilities for striking and beautiful effects are overlooked. In this the gardener is just as much, or perhaps more, to be blamed than the architect. The method too often adopted by some gardeners, in arranging the materials in the interior of the conservatory, is simply placing here and there certain plants ranged in pots placed on shelves, or in tubs resting on the floor. The whole are so arranged that not only is confusion and want of system prevalent under ordinary circumstances; but when the doors are opened between the conservatory and the room with which it is connected, the view presents little or none of the effects of a fine open and striking vista, which is capable of being imparted to the whole. Now, by the exercise of no great amount of care and skill in design, the objects placed near the doors of communication may be so arranged in relation to those beyond, that when these are opened the mind and fancy are set to work as to what there is to be seen, and the desire is at once created to go in and explore. Not only should the gardener endeavour to arrange each section of the conservatory so that it shall be complete in itself, and all its parts go to make up, for lack of a better word, a tasteful collection, but he should aim at making

each part one of a general whole; this, as viewed from the drawing-room, for example, to which it is attached, when the doors are thrown open, or before entrance, conveying to the mind the idea of a much larger vista, and a much wider and larger space than in reality exists,—to aim, in fact, at creating ‘perspective.’ This is sometimes done with great judgment and with exquisite taste, and at no greater expenditure than where the opposite system is carried out; but it is not so often done as it might be, for lack of examples of it, arising chiefly, we believe, from people not thinking about it, not from the absence of ability to do it.

The central space of a conservatory should not be wholly filled up. This prevents at once all attempts being made to secure the perspective we have above alluded to; but by having the plants arranged so as to leave a space more or less wide in the centre, this is much more easily obtained. Fine effects can be secured also by other adjuncts, such as arched work, vases, ornamental brackets, pendant vases, and the end or further extremity finished off with some arrangement of exquisite ‘greenery,’ such as ferns or the like, these arranged also so as still to convey the idea of farther and prettier spaces beyond, by filling in the back with mirrored panels, some flat, some at angles. A great deal could be said on this subject, and it is a tempting one on which to say much, but space, and illustrations, which require more, would be necessary, and that we have not here to give; but the object of this ‘note’ is suggestive, and that we hope we have to some degree made it. One word as to the interior fittings. These are generally the shabbiest of the shabby, and all the more conspicuous in this unfortunate direction, from being often so immediately near to the handsome furniture of the drawing-room close at hand, and indeed to the beautiful flowers which they support. Why should the shelving, for instance, on which the flowers are ranged, be such miserable affairs as they too often are? And why should the plain ugly boards be supported by brackets—the name, indeed, is too good to be applied to the carpenter work put up—uglier still? Very pretty effects could be obtained by adaptations of what the French call

'bois de coupé,' or wood cut into fine outlines, and these often again perforated at their solid parts with beautifully designed scrolls. Those who have travelled much abroad must have had their attention frequently directed to the very beautiful work of this kind met with in gardens, conservatories, etc. etc. In this department the architect can do much to aid the gardener, independent of others which a little consideration will suggest to him. More, also, can be done by him in external work than he may be apt to suppose at first sight. Thus, for example, should it be desired to make the conservatory enter from the drawing-room, and this be placed on the second floor, very striking and novel effects may be obtained by raising the conservatory on cast-iron pillars, etc. etc. The space under the conservatory may be made available by the gardener to produce effects which will aid those of the architect, so as to render the whole an arrangement which, from its novelty as well as beauty, cannot fail to increase the selling value of the property.

The relation which the kitchen should bear to the flower garden and the ornamental parts of the grounds, is a difficult problem to solve,—difficult, if the true aesthetic points be considered. Some solve it very simply, by relegating—as the fashionable word now is—the kitchen garden to such a part of the back ground that nothing is seen of it; and in case any one should even suspect its position, high fences are put up to secure this desideratum. All this proceeds on the assumption that the kitchen garden is a thing to be ashamed of so far as seeing it is concerned, and that nothing can be made of it artistically. We have long held the opinion that this view is erroneous, and that, by the exercise of skill and judgment, it might be made to form—partly at least—an important feature in the general ornamentation of the grounds. How to attain this end, the skill and judgment noted above would require to be of a passably high order; and as this is not to be had without being paid for, and that at a moderately high rate, this is probably why it is not employed, and why it is that so seldom we see the kitchen garden treated as it ought to be. While, no doubt, the most beautiful objects of the garden should be so placed that they will at once be visible from the best

rooms of the house, the plain vegetables should not be wholly and designedly shut out from view. Many of our useful vegetable plants are exceedingly beautiful in the gracefulness of their foliage. Some are taller, some of brighter hues than others. Now, by a judicious arrangement of the different varieties, bringing those the most beautiful and graceful to the front, and keeping those of a more lowly kind to the back, very fine effects might be obtained. There is, for example, not a more delightful vegetable, or a more economical one, in virtue of its extraordinary prolific qualities, than the tall scarlet runner, and few plants, at the same time, that can vie with it in the elegance of its foliage and the exceeding brilliance of its variegated flowers, which are, moreover, 'out' for many months. Now we have known an ugly fence converted into a 'thing of beauty,' which was the admiration of every one who saw it,—and more than that, a thing of utility, for endless were the dishes of delicious vegetables obtained from it. This is named here as a hint to show that to gain beauty much money need not be expended, for the seed cost but a few pence. The 'beauty of the thing,' as the man said, 'lay in its application.' What we have here said as to the relation between the kitchen garden and the other parts of the garden and the house, will show that at least there is no necessity that it should form an ugly feature in the general arrangements; rather, indeed, by the exercise of taste, skill, and judgment, that it can be made an ornamental one. That we have yet to learn something in our treatment of the utilitarian part of our gardens, that it may, in combination with flowers, etc., form an ornamental feature as beautiful as novel, may be seen in some parts of the Continent—in Germany, for example. From what the gardeners there do with the simplest of means, and certainly in no way with the largest or even a moderate amount of pecuniary means, we may derive some notion of what could be done amongst us with our wealth unbounded, and practical skill in turning things to the best account. The only thing apparently wanting is the will to introduce an innovation in practice, which, at the first at least, would be certain to draw down censure and severest criticism. But

courage and perseverance would overcome all this. We honestly believe that the innovation promises so much, that it is worth the trouble of some one to risk the performance of it. One has almost a positive pleasure, or at least a pleasurable degree of excitement, in braving public opinion, more especially when that is against an innovation which promises to be useful. But this goes a step farther, as we have hinted, and secures, if judgment is exercised, the beautiful as well. Only those who have seen the combination of flowers with vegetables, and those with fruit trees—dwarf or trained espalier or cordon (French) fashion, of course, only in such case being admissible, large fruit trees being relegated to the orchard proper, if there be one—can have any conception of the suggestive loveliness of the variety of beautiful organic life displayed. Much of it, however, especially amongst the vegetables, must be looked for to be appreciated. It is surprising how much one loses in life from lack of having the habit of observation. The leafage—to cite only one case—of nearly the whole of the garden vegetables affords most lovely examples of form and outline. Some most exquisite designs could be culled from the foliage of a small plot of cabbages even, or of turnips, parsnips, and carrots; that of the latter crop is most beautiful in the lace-like delicacy of the foliage, if it may be so called. We have said enough, we trust, to prove that something can be made of the kitchen garden as an ornamental accessory to the villa or country house.

Of the remaining classes of villa accessories which we have named,—the laundry, etc.,—little requires to be said. The extent of the accommodation will obviously depend upon the size of the house, and the situation should be chosen with a due regard at once to the convenience of the domestics, and to the requirements of taste, etc., of the occupier of the villa. As regards accommodation, we give in Plate 67 the plan of a laundry comprising nearly all the points which that of a first-class villa will require.

Market Gardens.—A department connected with the laying out and the letting of suburban land, which is of great importance, and which when judiciously done adds largely to the revenue of the property, is connected with market garden-

ing. The same objection which obtains to land devoted to this when situated in the near vicinity of superior dwelling-houses, does not exist in the case of inferior buildings so placed. At least the same reason ought not to exist; as certainly the prospect from the windows of a mansion or villa cannot be said to be much injured which takes in the varied products of a market garden. To these if objections be made, the occupiers must be most fastidious, or exceedingly ill to please. At the same time, there is a right and a wrong way of setting out or disposing of even land most pleasant to look upon; and some attention ought to be paid to the way in which market garden land is laid out in relation to building land immediately contiguous which is devoted to houses of a superior class. One point, at all events, ought to be looked after, but which is, nevertheless, strangely neglected—that is, the style and position of such buildings as may be required on the market garden land. These are generally, we may almost say universally, of not only the plainest, but even of the most ugly character, frequently indeed wretched, tumble-down-looking structures, ‘knocked up’—if erected *de novo*—of the poorest and flimsiest materials, or the remains, ruinous and decaying, of the more substantial structures of preceding times. If buildings such as these are on the land, they should be pulled down and replaced by neat if not picturesque-looking structures, or altered—as they can by a skilful man be altered—so as to be a decided attraction. Market garden land generally brings a high rental; but if near a town, as building land brings even a higher rental, even market garden land is in many districts being rapidly built over. Hence we find the market gardens are now often placed in districts which are strictly rural; but the apparent difficulty of distance from town is overcome by the facilities of railway transport. When so placed, it is obviously a necessity to have the market garden as near the station as possible. It is worthy of note that there is a growing tendency to combine with ordinary farming some of the special departments of market gardening, this being, of course, wholly confined to those farms in the immediate vicinity of towns, and which are classed as suburban farms.

CHAPTER VI.

THE LAYING OUT OF PART OF THE PROPERTY FOR AMATEUR FARMING.

To this department of the management of property, situated in its suburban and partly rural districts, the attention of the agent will be frequently called.

We have, in our introductory chapter, alluded to the causes which have brought about the remarkable changes in the development of the resources of landed property. One of these causes, and in some respects a powerful one, was the extended and extending desire on the part of men engaged in other businesses, who, having either retired from their actual labours, or realized a fortune, to use a popular phrase, 'have a hobby to gratify,' gratify it in the form of amateur farming, and, having abundance of means, gratifying it regardless of cost, by this means give altogether extravagant or purely conventional rents for the farms they take a liking for. This very frequently acts to the detriment and exclusion of those who are legitimately, so to say, dependent on farming for a living, and who cannot afford to stand against competition such as this. But this is not by any means the rule, although we have heard farmers more than once complain as if it was, and that it acted very prejudicially against their class. This, however, is certainly making the most of the matter, the fact rather being that amateurs prefer, as a rule, to have a small acreage under their care. What they chiefly aim at is the carrying out possibly of a hobby or two in farming, while the supply of dairy and other produce for the family is another and important consideration with them. No doubt there are not a few cases of men who have been very successful in other classes of business, who do take to what may in every sense of the term be called farming on the large scale. Pos-

sessing abundance of means, such farms are so conducted that lessons of value in one way or another may be and are frequently derived from them. Nor are the amateur farms of small extent without influence in this way.

It will be well, therefore, to glance briefly at the question how far and in what way this system or custom exercises an influence upon the progress of practical farming, and of course on the improvement of landed property, throughout the country; for it is a custom which extends over the whole kingdom, although in some districts—as, for example, the seats of manufacturing and industrial callings—it is more extensively carried out. As a rule, amateur farmers have a real taste for farming, and this may be safely premised, otherwise they would not take to it as an amusement, or merely to gratify a whim. They therefore take what may be called a natural pride in having everything done in the best possible way, to aid which they are lavish in expenditure for machines, appliances, and materials; and, generally speaking, even where the farm is very small, they secure the services of an overseer thoroughly acquainted with farming. Many a good lesson is therefore to be learned, even by practical farmers who have been all their lives at the business, from their amateur neighbours. And although this influence may not be acknowledged, there is no question of the fact that amateur farms, managed in the way we have stated, dotted here and there over an estate, must be productive of good. The amateur farmer, being a man of education generally, is likely to be a reader of all the new things which come out in agricultural literature, and is almost certain to be a member of the leading societies, or an attender at their shows. Every recent improvement and sugges-

tion will therefore likely be adopted and tried by him. Even although the motive be but one of curiosity, the result is the same as regards his observant neighbour; for if the trial be a failure, he will learn as much from it possibly as if it had been a success. It is the custom to say of such amateur farmers that they are not practical men; but it is difficult to define very clearly, so far as certain departments of farming are concerned, what a practical man is. He may be more successful than those who are trained to the business, and live by it, in rearing a certain class of stock, for example, or raising a certain crop, and his system in doing so may be worthy of adoption by others; so, although dependent in no degree upon his farm, he has so far shown that he can do something practical. And there are more examples than one in the country to prove that men who are eminent for their business qualities in their own particular calling, have made themselves as eminent for the like practical qualities when they have taken to play farming, as it is sometimes called. It does not follow that, because an amateur farm is small, good farming cannot be displayed on it; for if its owner or occupier, availing himself of all the resources which abundance of capital can place at his disposal, by farming ten acres, for example, so well, can produce as much as a neighbour can make twenty yield, the amateur is evidently ahead of the practical man strictly so called. It is not, in farming, so much the extent of land or number of stock which is worked and possessed which is the point, but the profit obtained from them. Hence an amateur farmer may make more of his small holding than his neighbour may make of his large one, so that, in addition to the profits which may accrue, there is the satisfaction arising from the fact that he may in his practice be of some slight service to the science, and therefore to the community at large. It is difficult, therefore, to say what good influences amateur farming may produce; but certain it is, apart altogether from the question whether it is carried on with profit or not, that these influences must, if notice be taken of them by surrounding neighbours, be of some service; and certain also it is, that whoever is the gainer by the establishment of 'play farms,' the landlord must be one,

for he may rely on this, that full justice will be done to his land.

Amateur farms, to use the language of a practical farmer, unquestionably 'furnish striking examples of what may be done in the field, the garden, and the stall; and their influence in improving the general style of cultivation and management around them is confessedly very great. Those who can afford to establish and maintain them are or may be public benefactors; but our farmers generally must be content to learn what they can from them,—both the successes and failures of such high farming,—and to follow at a respectful distance. They can neither put up such fences and farm buildings, nor go so largely into drainage and irrigation, nor purchase such costly fertilizers, nor own such expensive horses, cattle, and sheep; and, we may add, display such care and skill, or give so much time to gardening. 'Nevertheless,' continues our author, 'they can see the importance of concentrating expense and labour on a smaller extent of land, and in and amongst a smaller number of animals.'

In view of these facts, it will not be advisable for the amateur to be restricted in his course of cropping; however much this system may be deemed necessary in larger holdings, it is quite uncalled for in the case of these small ones. As a rule, amateur farms are of small extent, and but a small proportion of their area is devoted to cropping, to which generally restrictions in farming are confined. This arises from the fact that a large number of amateur farmers take to the amusement, as it may be termed, from the desire which they and their families have to be supplied with dairy produce, poultry, pigs, etc. This can be easily understood when one considers the circumstances attendant upon the town life to which they were accustomed before taking to their newer one in the country. In addition to these circumstances, which would make it politic not to restrict the amateur farmer in his cropping, it would not be less politic in view of what we have already said of the amateur farmer indulging in all sorts of experiments. The results of many of these may be trifling, and almost valueless, but it will go hard if others do not yield something of practical value. Of course, in the

lease or bargain made with the amateur farmer, the landlord will take care to insert such conditions that his property shall not be injured, or its local features altered, without special permission. Thus, old and valuable pasture fields should not be ploughed or dug up excepting under certain conditions; for although the amateur may be enamoured of dairying at one period of his lease, at another he may take as strong a fancy for increasing his experiments in arable culture; or, still keeping to dairying, he may give up pasture feeding and take to soiling his cows, which will require land for extra crops. Internal or accommodation roads should also be arranged for, while fences dividing certain fields should not, without permission, be taken down,—should the farmer wish to make two small fields, for example, into a large one. Buildings, also, should not be altered without permission. Save these and other obvious restrictions, the amateur farmer should have wide scope for the enjoyment of what practical men consider his erratic or eccentric farming. As to what the landlord is to give him, this is perhaps a more difficult point; and the most difficult of all to decide will be that connected with the buildings. Here, if anywhere, the eccentric character of amateur farming will display itself; for some have such very peculiar notions of what is wanted, or what they would like, that it is not easy to decide what should be given and what should be withheld. A good deal of the difficulty arises from the circumstance that it is not merely the gentleman who is to be dealt with, or rather his notions met, but the ladies of the house come in with theirs, which are very much more erratic, as far as farming is concerned. It is not so much the mere kind of buildings which they wish, as the style in which they are to be erected,—the ornate and the complicated figuring pretty largely in the ladies' minds. The difficulty will best be met by adopting the common-sense plan of ascertaining what the general notions are of the farmer as to his style or proposed method of farming, and, if no buildings be already existing, putting down only those which a calculation will readily show are necessary to meet the requirements of the style of farming decided on, giving a slight excess, rather than a deficiency, in the extent and kind

of accommodation required. The extra buildings desired by the farmer, either to suit his own peculiar notions in some direction or another, or those of the ladies of the house, will of course either be constructed at his own cost, or, if put down by the landlord, a certain percentage of their cost must be added to the annual rent of the farm. And as it is very likely—indeed, almost certain—that the farmer during his lease will take a fancy for some branch or other requiring new and special erections, or an extension of the old ones, some arrangement should be entered into as to the terms and way in which these are to be dealt with at the expiry of the lease. In short, nothing should be left to chance, or to be dictated by such circumstances as may arise at that period. Everything, to use a common expression, should be put 'in black and white,' which is the true system to prevent disputes. It does not follow that these may arise, for however clear may be a bargain made 'orally or by word of mouth,' with the best intention to adhere to it, neither of the parties may have the best memory as to what the terms of the bargain were, especially after the lapse of the many years to which a lease generally runs.

Although sometimes placed under separate agreements, it will be best to include in one the house, garden, and ornamental grounds, if there be any of the latter, including arrangements as to the garden structures of whatever kind, whether these be built at first entry of the farmer or constructed by him at any period of his lease. The same accuracy and strictness of agreement should be adhered to in all the details connected with the above department, as in the case of the farm buildings proper. Here, in this department of house and garden, the amateur farmer will be more likely to put down new structures and carry out improvements than on the farm, as the influence of the ladies of the house will likely be more felt. Altogether, the probability is that the landlord, at the expiry of his lease, will find his property as a whole greatly improved; the land, roads, and fences will be left in the best condition, and the garden also will be at its highest point of culture; while any extra buildings or structures put down during the lease will likely fall into his hands on very easy terms,

presuming, as we do, that the amateur farmer is an educated gentleman, which he is almost certain to be. It would be easy to go farther into the treatment of the subjects we have but glanced at, but this we do not deem necessary; enough has been given by way of hints—which was all we had in view—to serve some practical purpose,—those embracing the leading features of the subject. What few words we have farther to give will be connected with the buildings necessary for the amateur farmer, and as to which we have already hinted at. The extent and accommodation of these will depend not so much on the extent of land, as upon the wishes, and in many cases the mere fancy, of the farmer. Very frequently the buildings put down on amateur farms are greatly in excess of the land rented by the farmer, and this simply because, having hobbies of his own, they require, to do them, as he thinks, justice, certain classes or styles of buildings. In such cases, the uniformity in extent of accommodation, observable in farm buildings where regular farming is carried on, will not be attended to, so that a certain class of apartments will largely exceed in number those of another class. Thus we may cite the case of an amateur farmer who took a mania, as it might be called, for pig-keeping, the practice of which, according to his own belief, he was about to completely revolutionize. The result was, he got his landlord to put down most extensive and expensive ranges of piggeries, the number of which would have sufficed for the wants in this department of a dairy farm of larger acreage. And when, in due course of time, the amateur having either got tired of his experiments, or having found that his revolution was not so easy to effect, the piggeries lacked their inhabitants, it was somewhat of a melancholy sight to see them deserted, forlorn, and useless, or at least nearly so.

In cases such as this, the amateur, as we have already hinted at, must make a special arrangement with his landlord, the nature of which will be dictated by the peculiar circumstances. It is

not, however, all landlords who will agree to put down extensive buildings of some particular class only or chiefly, inasmuch as they might very probably not suit the next tenant,—who might, by the way, have a hobby of his of the same exclusive character,—and form also, in his opinion, an eyesore from their somewhat obtrusive oddity, as were the piggeries just alluded to, and which for a time were the talk of the country, and finally christened ‘So-and-so’s folly.’

In general circumstances, the plan of the farm buildings for the amateur will be some modification of regular farmeries, and of which we have given various plans, details, and suggestions. In a large number of farms, the accommodation for stock will be sufficient if it comprises a cow-house for two cows, and a calf pen, a pigsty for young pigs, a farrowing sow, and one for fattening; a poultry house will also be required. An important part of the buildings will be the stable, as the amateur farmer, being presumed to be wealthy, will, as usual in such cases, be, or affect to be, fond of horses, and both for family and farm-house the accommodation will be in excess of that which would be in strict proportion to the demands of the farm. This, indeed, will not always require horse-power at all,—that is, to be kept specially,—as the land under cultivation will be small in extent, and will be ploughed chiefly by hiring the services of some neighbouring farmer. The case, however, will be different as regards the family horses, riding and carriage. In these the stable accommodation may not only require to be pretty extensive, but also superior as regards style of building, arrangement, and fitting up. As affording accommodation for a pretty large class of amateur farms, we give in Plate 68 the plan of buildings suitable for the minimum number of live stock kept. This, taken along with the plans of regular farmeries which we have given in various plates, will enable plans of varying accommodation to be designed, to meet the varying and varied notions of the amateur under a wide variety of circumstances.

DIVISION FIFTH.

THE ADMINISTRATIVE DEPARTMENTS OF THE PROPERTY—DISCUSSION OF VARIOUS POINTS CONNECTED WITH THIS—LEASES AND TENANT RIGHT—SMALL FARMS—THE LABOURER, HIS POSITION, WAGES, AND PRIVILEGES IN PERQUISITES, RECREATION, READING CLUBS, GARDENING ALLOTMENT, ETC., AND EDUCATION.

INTRODUCTION.

IN commencing this important department of the work, it is somewhat difficult to decide upon its title,—fixing upon a phrase or term which exactly denotes its character. In one sense it might be called the legislative department, inasmuch as it takes up the consideration of points which clearly come within this category; while at the same time, embracing, for the purpose of convenience of arrangement and reference, if for nothing else, topics which come more within the range of social and moral considerations, it can scarcely be classed amongst the legislative work of the property. We have therefore chosen a title which, if not exactly appropriate in all respects, will at least embrace both legislative and social subjects. The administrative work of property certainly embraces every department of it, even those which have already passed under review. But from the title of the division it will be seen that we have confined its subjects to those connected more closely with the relationship which exists or should exist between the various classes who carry on the regular work of the property,—work which ought to be arranged in such a way that the best paying result will follow, and that all concerned with it will work harmoniously towards the common end, and each class have at the same time its own interests fully cared for by the agent or general manager of the property. All this work clearly falls within his province, under whom a staff, more or less numerous in proportion to the size of the property and the work to be done on it, is organized. He it is who 'orders' what is to be done in every depart-

ment—responsible himself to one party only, namely, the proprietor or landlord—of the various sections or districts into which, if the property be extensive, it is divided. The duties of the sub-agents or managers of these districts, in fact, are very similar in detail to that of the chief agent. In some cases, each district in extensive estates, where these happen to be made up of properties in different parts of the country, has got its own agent in chief, each acting quite independently of the other. In other cases there may be one chief agent only, who takes the general management of the property as a whole,—an arrangement which has many advantages, the most important of which will be obvious on consideration, a very obvious one being the securing of a unity of management.

Next to the agent or general manager comes the bailiff, who has the practical carrying out of the work of certain districts. The tenants or farmers come next in order, who again have or may have bailiffs, according to the extent of their farms, to carry out their orders and see that their work is properly executed. The overseer or foreman, or, as some call him, foresman, has the direct supervision of the last, and not the least important, of all—the labourer.

It does not form part of the plan of our work to enter into any details as to the nature of the duties, and the characteristics or requirements which enable those duties to be best performed, of the different classes we have named, and which go to make up what may be called the administrative and working 'staff' of the property. What

we propose doing is to enter at once into the consideration of some of the leading questions connected with the management of the property. One or two of these may be supposed by some to be without the range of our work, but a slight glance at the contents of the chapters taking up their consideration, will show in time that they have a very close connection indeed with the general prosperity of the property, and demand, therefore, a very close investigation as materially influencing this.

Before taking up the different subjects of the division, we would draw attention to a point too often overlooked, but which exercises an important influence on the way in which the work of the property is done. The point is, that each of the various parties employed on the property may be of great service in giving hints to one another. And we would therefore impress on each of those in a superior condition, the value which suggestions coming from those even in the most inferior conditions may possess. It is worthy of remembering, that although in no sense educated, they at least have a practical knowledge of the departments in which they are engaged, and may have, for aught those above them know, an aptitude to communicate that clearly and forcibly to others. In other callings, many a fortune has been made by the master deriving, from a servant holding a very inferior position, a hint of great value in connection with his own department; and the same, although in different or lesser degree, holds good in agriculture. The difficulty to be overcome is getting the men to communi-

cate what they know, and this from lack of that natural confidence which ought to, but which, we regret to say, rarely does exist between those occupying different positions. But this may be overcome, as in numerous instances it has been overcome, by the exercise of tact, by studying character, becoming acquainted with various phases of human nature; but, above all, combining these and other obvious points with a thorough kindness of manner, and displaying in everything a true interest in the welfare of the inferior parties, than which nothing is more powerful in the way of overcoming prejudices, and in making the parties actually anxious to please their employers, by doing all they can to promote their interests, repay, as it were, the kindness which they themselves have received. A man must be very hard indeed who can for long time withstand the softening and enlightening influences we have named. A property well managed should be like a family, the various members of which are as closely interested in the welfare of others as in that of their own; not a collection of cliques, so to express it, each of which deems its own interests paramount, and antagonistic to those of all the others. This view of the management of one department of a property may seem to some to savour somewhat of the 'too romantic;' but a close investigation—the closer the better—will show that it embodies a hard practical fact, and one which largely influences and decides the point whether the property will, in the highest sense, be a paying one.

CHAPTER I.

LEASES AND TENANT RIGHT.

IN connection with the subject of leases a very great deal has been both written and said, not always with judgment,—too frequently, in fact, with a warmth and heedless personality scarcely befitting the position and dignity of either one party or the other who engage in such discussions. No doubt it may be said that it is not an easy thing to keep very calm on a subject that concerns so closely one's living as it does that of the tenant, or the interest of the property as it does in the case of the landlord. But the very importance of the subject should make it one to be discussed calmly, and it should not be forgotten that the interests of both tenant and landlord are really identical, and not antagonistic, as some writers and speakers on both sides seem to take for granted.

In beginning to treat of this important subject, we confess that it is one surrounded with so many difficulties, that it is not an easy matter to see one's way out of them. And so many points have to be considered, and many conflicting interests,—at least, interests which are made to conflict,—that their reconciliation has taxed the best endeavours of those who have come to the discussion of the subject as free from the prejudices, either of one party or the other, as it is possible to be. The crucial point of the subject is that connected with the restrictions placed upon the farmer, both as regards the system of cultivation of his farm and the selling or disposal of certain parts of its produce. What these restrictions are we shall presently see. But it should not be decided off-hand that the relation of the landlord to the tenant is entirely one in favour of the former, nor that the removal of such restrictions complained of by the tenant is to be done at once by

the landlord, without his having it shown to him that it is as much to his interest as it is to that of the farmer. Taking the simplest or first view of the matter, it would appear that the easiest way would be to allow the tenant to farm the land in any way he liked, without restrictions of any kind, inasmuch as he would be likely, as a rule, to farm in the best possible way for the sake of his own pocket; just as a manufacturer is permitted by his landlord to adopt any system he deems most likely to yield him the highest profits. But the cases, although they have been cited as exactly parallel, 'do not run,' so to say, 'on equal legs.' Self-interest does not always enable a man to decide upon doing that which is really the best for it. As human nature is constituted, its doings are sometimes erratic; and as there are two ways of doing things, the right and the wrong, some will do the wrong, either through ignorance or prejudiced self-will. We could cite from experience, even in the practice of manufacturers, instances in which some have persisted in carrying out a system of working which could not possibly pay, although it was contrary to established practice, and yet persisted in it notwithstanding the advice of friends interested in their welfare. In this case the landlord does not interfere, as the loss is simply that of the tenant. But it is wrong to say that the manufacturer is altogether free from restrictions; as regards the buildings, for example, his lease or covenant does place him under certain restrictions, and that because the landlord is therein interested. But farming and manufacturing are essentially different things, and although it does appear at first sight that it would not matter to the proprietor of land whether his tenant farmed to make money or to lose it; but just as the manufacturer

is restricted from doing certain things with the building, on the ground that it would injure the property of the landlord, so is the tenant of a farm restricted from doing that which will injure the property. In the case of the manufacturer, no doubt, the restrictions do not affect the work to be done within the buildings, as the landlord's interest is in no way affected by the way in which that is done; but, as we have said, farming is different to manufacturing work, for the tenant on landed property may so farm as to greatly injure the productive powers of the soil, and thus largely reduce its value as a property. All those who know what agriculture is, know how this can be done. The landlord, therefore, in order to prevent the fertility of his soil being deteriorated, either by the adoption of a certain course of cropping which is or may be exhaustive, or by the disposal of produce which, under a certain system, yields manure, which, if not given to the land, reduces its productive powers, places the tenant, by means of the lease, under certain restrictions, to prevent him from following those systems destructive of the value of the property. There is another reason why the landlord deems it in his interest thus to restrict his tenant, and this is, that those interests on his side are permanent, the land being his in perpetuity; the tenant occupying the land for a period only more or less limited, his interests are limited also. If the tenant, for example, had his farm let to him in perpetuity, or, which would come to the same result, if it was sold to him freehold on the payment of an annual 'ground rent' or 'feu duty,' and on terms with which both parties would be satisfied, it is obvious that it would be a matter of supreme indifference to the landlord whether the tenant exhausted his land or not. If he did not, it would be clearly to his own gain; if he did, the loss would be entirely his own, the landlord being secured from it, as he would get his rent in perpetuity, which rent would be satisfactory to him. But even in this case, on the side of the landlord it may be said that a certain restriction was required, inasmuch as he might say, 'On the first view of the matter I cannot lose, but would I have the payment of the rent guaranteed to me in a secure way? Your bad farming may land you in bankruptcy, so that you could not pay me

your rent, and I would thus not only lose my money, but I should have my land thrown upon my hands in a condition infinitely less valuable than when you got it.' This is, of course, putting the matter in an extreme point of view; still, it goes to show that it is one, as we said before, which cannot be decided in an off-hand way from one point alone, while it shows that there is at least a fair and reasonable ground for placing some restrictions on farming in the interests of the landlord.

A very strong point, however, in favour of the tenant's view, that he should be left free to farm as he liked, seems to lie in this, namely, that the restrictions generally adopted in leases are those which, being founded on the style or mode of farming many, many years ago, are by no means adapted to that now in existence. It is a fact so patent to every one that it needs scarcely to be mentioned, that agriculture has, during the last thirty or forty years, gone on progressing so steadily, that the practice of to-day may be said to be an improvement on that of yesterday, so that any restrictions founded upon old are not applicable to the practice of modern times. Now, if restrictions are necessary, or continue to be claimed by the landlord as a right, protective of his interests, it appears to be no unreasonable thing that such restrictions should keep pace with, and be based upon, the improved practice of the time at which the lease is made. Nay, seeing that improvements are being constantly made, it would be as little unreasonable for the tenant to claim some provision by which the restrictions could be altered in accordance with the altered circumstances of farming. The difficulties attendant upon an arrangement like this are obviously such that it would be no easy matter to overcome them, so that certainly the easiest way of treating the whole question would be to adopt the plan advocated now so widely, of giving the tenant absolute freedom for the cultivation of the soil; but then, as we have shown, the difficulties on this side are just as great, if not greater. It appears, therefore, that the complexion to which things must come at last is that of a compromise, based upon the good old plan of give and take,—the best of all methods of settling conflicting claims, which, if more adopted

than it is, the wheels of everyday life would run smoother than they do. Not that compromises in themselves are easy to adjust, but fortunately the very principle carries with it that which renders its details much more easily settled; for when two parties come together with the wish to adjust the difference, a large proportion of the difficulties are got rid of. The reader must not suppose that these last remarks are out of place here; on the contrary, it would be well if the principles they involve were more attended to, for then the business of the estate would be more easily and satisfactorily adjusted. It is hard to place the limit to which the evils of disputes can reach; and anything which can prevent them being fought out to the bitter end has really a high money value,—to say nothing of other considerations which moralists would rate higher than this one.

As affording many suggestions of high practical value, and what, indeed, may prove in many cases the basis of such a compromise as that to which we have above alluded, the reader will do well to give grave consideration to a paper read by the eminent scientist, Mr. J. B. Lawes, before the Society of Arts, and published in their journal under date 14th December 1877.¹ We shall do the reader a service, however, by referring to a few of the leading points of this paper. Mr. Lawes sets out by showing that the interests of the landlord and tenant are, in his opinion, identical in every point but one, namely, that those of the landlord are permanent,—of the tenant, limited. With a view of maintaining the fertility of his land, the landowner introduces into his lease the restrictions to which we have alluded; and as he maintains that any profit which the removal of these would enable the tenant to obtain would be obtained at his expense, and would lessen the value of his land, and as, moreover, these restrictions have been 'habit and wont,' Mr. Lawes thinks that the burden of the proof that these restrictions might be removed without injury to such interests, rests with the farmer. Mr. Lawes first notes the nature of these restrictions—'1st,

not to grow two white crops in succession; 2d, not to sell straw, hay, roots, or, in fact, any fodder crop, of the farm; 3d, in some districts a second white straw crop in succession may be taken in the course of a rotation,—that is to say, three in five years, instead of two in four years. In such cases it is generally stipulated that the second corn crop shall differ from the first,—that wheat shall not follow wheat, nor barley barley.' The points to which Mr. Lawes directs himself are: 1st, Are the restrictions 'necessary for the protection of the landowner? 2d, If once necessary, are they equally so now? 3d, Does a comparison between past and present prices of agricultural produce, or our increased knowledge in regard to the action of manures and to the exhaustion of soils, or the fact that large external sources of supply of fertilizing materials are now at our command, justify us in concluding that these restrictions might safely be modified, or even in some cases removed?' The arguments for and against such modification and removal Mr. Lawes classifies under two heads—1st, on behalf of the landlord; 2d, of the tenant. We, of course, do not intend here to state what those arguments are; but the sum of them, so far as the landlord is concerned, is that, all things considered, restrictions are as beneficial to the tenant as they are to himself; while the sum of the arguments on the tenant's side is, that the restrictions, while injurious to him, could be removed without being so to the landowner. Certainly, so far as considerations bearing upon the improvements introduced into agriculture of late years and their influence on systems of farming is concerned, no one can come to the full and accurate investigation with higher claims than Mr. Lawes. And when he, therefore, sums up the whole case by concluding that it would be to the interest of the nation at large as consumers, to the interest of farmers as producers, and not injurious to the interest of the landlords as proprietors of the soil, it would appear that the time has at length arrived when the latter should take the whole subject under consideration, with a view, if not to remove, assuredly to modify, the present system of restrictions in covenants or leases.

We confess, however, to feeling that while this is the case, and that all the departments of modern

¹ The paper is entitled, 'Freedom in the Growth and Sale of the Crops of the Farmer, considered in relation to the interests of Landowner and the Tenant Farmer.' Price to non-members, 6d. Published by George Bell & Sons, York Street, Covent Garden.

farming indicate it to be correct, their *modification* would be more the thing that is required in absolutely strict justice to the landlord than their positive removal. In a preceding paragraph we have shown one or two considerations bearing upon this which we think fair. At the discussion which followed the reading of Mr. Lawes' paper, a modification, such as might be adopted, was explained by Mr. Clare Sewell Read, M.P., as being the system adopted by the present Lord Leicester, a descendant of the celebrated Mr. Coke of Holkam. Lord Leicester grants leases for twenty years, the first sixteen years of which he does not insist upon the tenant following the four-course system of cropping, which the reader knows was introduced into Norfolk by Mr. Coke, and which may be said to be the basis of the modern improved system of agriculture; but during the last four years of the lease Lord Leicester insists upon the tenant carrying out the four-course cropping. Further, of course, if a renewal of the lease was granted, this cropping would not be insisted upon. Further, Lord Leicester had a reservation in his leases, that, to quote Mr. Read's words, 'in case he saw during the first sixteen years that the tenant was going to the bad, and farming his land in an exhausting way, he should be able to pull him up and insist on the four-course system being adopted at once.' This method of modifying the restrictions in covenants appears to us to be one which would meet the circumstances of most farmers—would constitute, indeed, the compromise which we have alluded to. Mr. Read has such a good opinion of it (and he is one of our highest authorities), that he says if all landlords would follow Lord Leicester's example, 'a great deal of the agriculture of this country would be improved, and they would not hear of so much agricultural distress as at present.'

On referring to what, in an early part of this chapter, we have said on the subject of the condition of the farmer during his lease, it will be observed that it comes closely on the principle insisted upon by Lord Leicester just described, only that we have gone farther, and shown that the financial condition of the farmer will exercise—cannot fail, indeed, to exercise

—an influence on the condition of his farming. Hence, in fairness to the landlord's interest, one would be inclined to say that there should be a reservation in the covenant bearing on this point, where a man is actually insolvent. The matter is not of easy solution; for it is unquestionably one of extreme delicacy where his condition is only clearly pointing in that direction, although he has not actually reached its end. How to deal with the case in this condition without injuring the credit of the farmer, and thus bringing about the very thing which it is desired to avoid, is no easy matter. But the solution of the problem is certainly worth attempting, for there can be but one opinion, that a farmer can do no justice to his land where he is short of the necessary funds. It might be said that some of these family lawyers, evidently no great favourites of Mr. Read, might devote some of their time to as good a purpose in attempting to solve the problem we have pointed out, as in perpetuating those antiquated leases so complained of by Mr. Read. We think we have thus gone over the principal points connected with the important subject of leases, and we now direct attention to one, if not equally important, at least one which has received perhaps a larger amount of discussion, and unquestionably a greater demonstration of warmth and personality; and this subject is

Tenant Right.—Some readers will say that leases themselves, without restriction, form the all-important part of tenant right; we prefer, however, chiefly for the sake of clear arrangement, to treat the subjects separately. From what we have said as to the way in which tenant right has been discussed, the reader may gather that a large amount of information connected with it has been presented to the public. We have, however, no intention to do more than glance briefly at some of the leading points of the subject,—one which, at the outset, we may say, what indeed our practical readers know too well, is surrounded with great difficulties. It is too much the case with some writers and speakers on the subject to represent those difficulties as arising mainly from the position which the landlord takes in reference to the whole question,—a position antagonistic, they say, to any attempt to get rid of them; rather, indeed, as if the land-

lord, either from prejudice or on principle, was determined not to concede tenant right at all. But a fair investigation into all the points involved will, we think, show that the difficulties which surround the subject really arise from the practical points of farming. Certainly the landowner cannot object to have his land improved, for that would be clearly to his gain; nor do we think that, if it was shown to him that a part of the cost of this improvement, treated on fair commercial principles, should be repaid to the tenant, he would object to do so. But when we come to inquire what really constitutes an improvement, and as to the method by which such improvement can be estimated, we find such a diversity of opinion on these all-important points, and this, too, held by practical tenant farmers, that the landlord may well be excused for granting off-hand, a principle as to the working out of which practically those who make the demand are not agreed amongst themselves. Nor are the landlords as a class the more likely thus to concede it, when they read what is said or written of and about them,—in some instances matter which seems to savour more of the demagogue's appeal to mob passions, than of the quiet, manly discussion which ought to be given to a subject bearing so closely on the most important interests of the country.

On the other hand, desirous to hold the balance fair between the two great parties concerned in it, we do not conceal from ourselves the fact that the tenant farmer, whose very living is, as he conceives, injuriously affected by the lack of what he deems essential, is in the best position to treat the matter calmly; and further, it is only just to the great body of the mass to say, that while some of its members do, as above named, deal more in recrimination than reasoning, as a rule the subject is discussed from the tenant farmer's side with wonderful fairness and calmness. The truth is, as it appears to us, that if ever this exceedingly knotty point in farming economics be ever settled satisfactorily, it can and will only be by the adoption of what is graphically termed the 'give and take' principle already alluded to. Concessions and allowances must be made by both sides, with a due regard to the interests of each. It will not do for one party to say to the other,

'come;' there must be some 'going,'—at least a mutual approach must be made.

There is, however, a third party to the settlement of this long and hotly-disputed question, namely, the general public; and when they read or hear decided opinions as to the low condition of farming, even with all the admittedly great improvements of the past few years, they are naturally disposed to ask, 'Cannot this be altered?' and when, further, they hear it said that it can be so by the establishment of what is called 'tenant right,' they at once assume that it ought to be at once carried out. For example, as representing the tenant side of the question, a well-known practical man states that 'many cases may be quoted where the fee-simple of the land has been doubled in value by improvements, and where large tenant capital has resulted in increased profits by increased production. We should never forget that improvements both by landowner and tenant not only afford additional employment for labour and machinery, but they also provide better customers for agricultural produce.' And, on the other hand, as representing the landowner's side, a well-known nobleman, who has the reputation of being one of the most cautious of speakers, states 'that the land of England did not produce more than one-half the food which it might do if it were properly cultivated—if all the capital were laid out on it which it was capable of receiving.'

When such statements as these are made publicly, and wide circulation given to them, one can scarcely feel surprised at the general public feeling that they have a direct interest in the settlement of a question which they are led to believe would introduce such vast increase in the produce of land; and not knowing the difficulties which beset the case, they jump to the conclusion that, if improvement is hindered by any obstacle, it should be at once removed; and if improvement could be made in one case, it ought to be in all.

Reverting to the opinion given above, that land is kept unproductive owing to capital being, as it were, diverted from it, the question arises, How is this unfortunate state of matters brought about? From the tenant right point of view, this question is very easily answered. It is right,

however, to say that some who may be called the extreme men, class under the causes of this certain points, while the more moderate confine themselves to two, chiefly, if not altogether, these two, namely, 'security of holding' to the tenant, and secondly, 'payment to him for all unexhausted improvements.' For obvious reasons, we shall confine ourselves to these, refraining from considering all points connected with what is called broadly the 'land transfer' or sale system, and the 'game laws.'

The security of holding above alluded to is evidently one of very great importance, and many arguments brought forward in favour of it are not easily refuted; certainly it does appear but common sense to suppose that a farmer will be much more likely to do full justice to the working of his land, by adopting all improved methods, when he holds his land for several years, than when he holds it under yearly tenancy, which involves the risk of his being turned out at six months' notice.

At this stage of our remarks, it would be well to state the different terms or modes in which land is held in England. The first we name is the yearly occupation or tenancy, which terminates at the same period of the year as that on which it commences, and the 'notice to quit' at six months must be so stated that the six months terminate at the same date; so that if the notice be given any time after the day which determines the occupancy, whether by landlord or tenant, the notice is legally null and void; if the tenant, therefore, for example, wishes to leave and neglects the above precaution, the landlord can compel him to hold on for another year, and *vice versa*. Hence it has been said that a yearly tenancy is only so in name, so far as the liberty to give six months' notice to quit on either side is concerned, for this notice cannot be given, as some suppose, any day within the year; for if so, the notice might be given the last day of the year, thus making the occupation practically an eighteen months' one. The reason, therefore, is obvious for making one day only in the year the legal point, so to say, determining the occupancy; this, however, does not preclude the notice on either side being given *any time before* this particular day. It is necessary to make this point clear, for many have been misled,

to their loss and inconvenience, by supposing that a six months' notice legally meant that this could be given at *any time before the year actually expired*, dating from their entry. It is necessary, or at least a wise precaution, to draw two copies of the notice (for it must be given in writing), one of which must be delivered to some person on the premises, the other retained by the party giving the notice, both being endorsed with the name of the party, principal, or servant to whom, and the date on which, the notice was given. A yearly tenancy commences at various periods of the year, according to circumstances or the custom of various districts. So far as the farmer is concerned, the best period is the autumn, for reasons elsewhere stated. Another form of tenancy is an extension of the term under lease varying from eight to twenty-one years, including terms of twelve, fourteen, and sixteen years, those granted generally by corporations, as city or collegiate, and based pretty generally upon the system of rotation adopted. These are the chief methods so far as tenancy is concerned. We do not deem it necessary to allude to other methods by which land is held, and which approach to and include the actual possession, as 'copyhold' and 'freehold.' In Scotland, yearly tenancies may be said practically to have no existence, the nineteen years' lease being the general method of holding farms. Long-term leases in England are decidedly the exception, yearly tenancy may be said to be the rule.

Security of tenure or holding may be said to be the first and leading point in the question of tenant right. Various are the modes by which this security is proposed to be obtained, but the simplest of all methods open—short, of course, of the actual possession of the land under one or other of the forms in vogue, as copyhold or freehold—is that of a lease of pretty long duration. We have said that nineteen years is a term very common, or rather general, in Scotland, and this has worked wonderfully well; indeed, in the Lowlands, for example, where the system may be said to be universal, the splendid farming which distinguishes that district is admitted by all competent authorities to owe its existence entirely, or almost wholly, to it, inasmuch as the tenant, knowing that he is sure of the possession of his

farm, is not only encouraged to carry out all the improved methods of working, but is enabled to adjust them, with due regard to his own interests, with a fair degree of accuracy, proportionate to the length of his occupancy.

This last point, in the absence of arrangements between landlord and tenant as to compensation for such unexhausted improvements as will obviously benefit the landlord at the expiration of the lease, is clearly one which closely interests the tenant, and affects the whole question of the length to which leases should extend. Short leases, such as we have shown to exist in England under corporate bodies, obviously restrict the tenant in carrying out improvements, the effects of which can only be exhausted, so to say, by having a certain number of years to run over. A tenant farmer, who is a great advocate for 'tenant right' as being the one thing necessary to remove, as he thinks, all the burdens under which farmers labour, advocates a twenty-one years' lease, and for the reasons as follow:—'Seven years will just enable him to put his farm in good trim for a rise of rent; and a renewal (fourteen years) would allow him, clock fashion, to run his farm up in condition, and then run it down again, but putting just as much capital in the soil the first seven years as he can extract in the last seven, thus leaving his farm as he found it. Twenty-one years is more tangible: it gives a man a firm foot; he looks upon his farm as his home; the improvements are his own creation; his parish shares his regard; and with himself and his landlord there exists a more kindly feeling. He is looked upon by him as part of his estate, like his ornamental trees, not to be parted with.' But in all leases the question of restrictions comes up of necessity in cases where the farmer is not allowed to exercise what is called free farming, which we need scarcely say are exceedingly rare. The arguments *pro* and *con* on the subject of restrictions have been glanced at in preceding paragraphs, to which, therefore, we refer. But we may here draw attention to one objection to restrictive leases which affects the interest of landlord and tenant alike. This is, that in the case of a farm which has been allowed to run down, or one which has never been brought into good condition, and is

therefore beyond all dispute one which requires improvement, the difficulty is to know what really are the improvements required, and to foresee all the obstacles which may arise in the course of the lease, modifying materially the course of proceedings considered to be best, and upon which the restrictions named in the lease are based. Enough, certainly, is given in the pages of this work to show the uncertainties which surround and are connected with the details of farming; so much so, that the more fully a man knows what farming is, the more readily he will admit that the plan which he may to-day consider the best to be adopted, may, by unforeseen circumstances and occult causes, wholly or greatly alter the results he anticipated. In a case like this, no doubt, the restrictions as to certain methods of management to be adopted, may be modified or set aside by the landlord, when the necessity for doing so is obvious. Still, as it is difficult to predicate what men may do, even when it opposes their own self-interest, it would appear to be the safest way not to have restrictions at all; and, as the great majority of our practical farmers suggest, as the best security for the landlord, he may protect his interests by taking care, in the first instance, to have for a tenant one whose known position as regards character, capital, and farming skill affords the best guarantee for his doing every justice to the land. There is, however, of course, the points connected with the possible deterioration of a farm by the tenant's bad or peculiar mode of management, against which it is obvious the landlord should have some security. But these points we have fully gone into in the preceding paragraphs. So much, then, for such security of tenure as can be obtained by leases; but it is in the case of farms which have been really improved that the next point of tenant right claims to be considered.

This point involves several details, all based, however, on the general principle that the tenant ought to be compensated for such improvements as he may make during his lease, and of which a proportion, greater or less as the case may be, goes to the benefit of the landlord, and which justifies him, or appears to justify him, to demand a higher rent from the farmer should he wish to

remain on the land, or from some other party, who may be preferred. So many opinions are prevalent upon this department of tenant right, so much has been written and said in connection with it, that even a *resumé* of the briefest possible character would extend to a much greater length than our space would admit of. A pretty fair view, however, of the points as put by a tenant farmer, and which will be amply sufficient for our purpose, will be found in the following statements:—‘1st, Permanent improvements; 2d, Unexhausted improvements; and 3d, Unexhausted manurings. Under the first head, such as improvement of premises, bringing into cultivation waste lands, moors, and bogs, stubbing up old fences and woods; under the second head, such as draining, marling, chalking, liming, and steam subsoiling; and under the third head, such as manurings, consumption of corn and cake, green crop feeding during the last year. This law would allow people to let and hire upon what principle they please, except that the tenant could by law get compensation for what has hitherto been refused, except in some few remarkable instances, and by custom in some part of Lincolnshire. I go further; I would, by lease of not less than twenty-one years, with power to renew at the end of fifteen years, establish free farming upon the tenant right principle, with an inventory taken of the farm premises, the state and condition of each field and meadow at the time of entry; if the farm is left in an improved condition, compensation should be given, and if deteriorated, damages should be awarded upon Lord Leigh’s principle of *umpirages*.’ We next give the statement of another authority on this side of the question:—‘1st, That, in the interest of landowners, tenant farmers, and consumers alike, it is desirable to encourage the application of capital to the development of the resources of the land, by granting to outgoing tenants, whether leaseholders or yearly tenants, a legal claim upon their landlords for the unexhausted value of their improvements. 2d, That the amount due for improvements should be settled by valuers, their decision, or that of the umpire they may select, being final; and that the same means should be adopted for the settlement of the landlord’s claim on account of deteriorations and dilapidations,

now recoverable only in a court of law. 3d, That, in order to protect landlords and tenants respectively against unjust demands, the term *improvement* should be defined to mean anything that increases, and *deterioration* anything that diminishes, the letting value of the farm. 4th, That although it is preferable that building, draining, and many other durable and permanent improvements should be executed by the landlord, yet, if he neglects them, after having been requested by the tenant to execute them, and the tenant carries them out at his own expense, the latter, on quitting his occupation, should be entitled to the unexhausted value of those improvements, whether made with or without the landlord’s consent. And if the valuers decide that any buildings or works thus carried out by the tenant are not improvements according to the definition given in the preceding resolution, the tenant should be allowed to remove the materials, making good any damage occasioned by such removal. 5th, That any agreement between landlord and tenant, nullifying any of the aforesaid provisions, should be legally void.’ From these conditions, which we may take as being considered necessary by tenant farmers—at least by many of them—in order to secure what they deem to be their right, we can gather enough to prove, what we have already stated, that the whole subject is one surrounded with difficulties. The mere answer to the question, ‘What are improvements?’ is one by no means easy to be arrived at. Those who know farming well, and as generally practised throughout the kingdom, are sufficiently acquainted with the fact that what some farmers consider a good method of treating their land, is decidedly the reverse. For example, as has been well pointed out by a practical authority, certain ploughing, which, carried out in conjunction with other processes, is beneficial, in some instances actually injures the land where those are neglected. Again, the difficulty of estimating the value of the improvement actually made in many departments is very great,—indeed, in some cases may be said to be insuperable. Deep culture of the soil, to which we have elsewhere referred as effecting a very remarkable change for the better in arable land, may be carried out thoroughly by the tenant; but as it takes some

time to yield its best results, he will very likely do it at the early part of his lease only, and if a yearly tenant, he may not do it all. If, however, he determine to do full justice to his land, irrespective of any contingency, and should he have to give up his farm before he receives the full benefit of the process, and as, therefore, he thinks he has a good claim to be paid for that which he has not received, and hands it over to his landlord, upon what principle, and by what standard, is the value to be decided? It may appear a very easy thing to do, having to measure the extra depth to which the process has been carried, and compare it with the known or admitted depth at the period of entry. If the standard is the inch, we should like to know what is to be taken as the value of the improvement which that inch of deep culture has brought about. We suspect that, if the question were put in this way before a congress of farmers, the diversity of opinion elicited would somewhat surprise the agricultural world. So with compensations for manures unexhausted, or said to be so, draining, &c. &c. The great difficulty—we were about to say the great mistake—in connection with this subject is the assumption that the results of all the processes of farming are so obvious, easily ascertained, and well known, that they can be estimated and valued with precision, like cotton and other processes; whereas the very opposite is the fact, nearly every process or method met with in practice operating differently, according to differences in soil, materials used, and climate; nay, even under what are precisely the same circumstances of soil, &c., the results of one season will be markedly different from those of another. All this is well known; and the very uncertainty which characterizes the various processes of farming certainly causes, to say the least, no small amount of difficulty in valuing their results. This specially so where what may be called the chemical points are involved, which are occult; but even in certain departments which are purely mechanical, difficulties arise thus. Who can tell what is the actual condition of underground drains, or any one which is not visible? and failing this knowledge, who can estimate their value? We need only refer to the well-known

fact, elsewhere in these pages alluded to, that all work concealed, or when finished is covered up, runs the risk of being badly done, if not at some parts left wholly undone, by careless, incompetent, or dishonest workmen. We consider it necessary to draw attention to these points, as they may clearly influence practice, and show at least that the valuation of improvements, acknowledged to be such, is not really the easy thing which some seem to think. Before concluding this subject, we would draw attention, as corroborative of the advantages which many insist upon as being derived from proprietorship as opposed to limited tenancies, to the peculiar institution existing in Holland known as the *Becklemming*. This institution constitutes theoretically a species of proprietorship, but practically, actually one over and above the original freehold. It gives the right of working the land in perpetuity at a rental which is fixed and unvarying, and over which the landlord has no control, and in which he can exercise no right to dictate as to any one point connected with the working of the land. Nay, further, he cannot prevent the holder from selling his right to any party he pleases; or he can will it if he chooses, and in no such contracts can the landlord at all interfere. This singular institution originated in the province of Groningen—the only part of Holland where it exists—at an early period in its history, when large tracts of its land were literally deserts. In the graphic language of M. Havard, who describes it: ‘Two men appeared upon the scene, the original proprietor and the cultivator. “The soil is of no value,” said the latter; “it brings you in nothing: give it up to me. By my labour I will fertilize and make it productive. But as it is not just that you alone should profit by my efforts, let us stipulate that all improvements I effect upon your property shall be for my benefit; and for the payment of a fixed rental, which shall never be increased, I alone shall for ever have the right to work your land. This right, at my death, shall be transmissible to my heirs. During my life I must have the right to dispose of it in any way I may think fit,—to sell it, concede it, or give it to whom I please,—without you having the power to interfere, and this on the sole condition that my heir or grantee shall undertake to pay

you the stipulated rental." This institution has had a remarkable influence on the welfare of the province. The second proprietors, as we may term them, or Boers, are very wealthy, and by their exertions, no doubt, through a long course of years, have transformed the once desert lands into a perfect garden of fertility; but not only so, the antagonism which at one time existed between the landed proprietors and the farmers no longer exists, but it has been transferred to the farmer and the labourer. From this some of our present agitators will likely draw the conclusion that, to stop this antagonism, the labourer in his turn should have an interest in the land. On this point remarks will be found in the next chapter. We have thought it right to draw attention to this institution, not merely for the reason already assigned, but because it might possibly afford a hint as to dealing with and bringing into cultivation the large tracts of land in this country which are at present apparently doomed to a perpetual sterility. We conclude this knotty subject by expressing the hope that some means will be found of settling it in such a way as will get rid of the disagreements to which its further and long discussion cannot fail to give rise, and also by reiterating our belief that this can only be effected by friendly and mutual concessions on both sides.

The Agricultural Holdings Act of 1875.—Some of the difficulties connected with the above points are met by the provisions of the 'Agricultural Holdings Act' for England, which was passed in 1875; but this Act has its defects and omissions, and is framed in such a way that, in the opinion of many, in place of satisfactorily deciding the questions we have alluded to, and adapting its provisions to the peculiar circumstances of different districts, it is likely, in course of time, to give rise to difficulties not more easy of solution than those which its professed object is to do away with. On the other hand, it is only right to state that, in the opinion of others,—and these we incline to believe the majority of those who have really studied the question,—its provisions are steps in the right direction. At all events, it indicates a desire on the part of the Legislature to remove difficulties which have long

pressed on the tenant farmers; and if it has done nothing else, it has certainly shown that those are now admitted to exist, which formerly many refused to admit at all. Legislation having once begun, the probability is that it will further be carried on, till, under the pressure of public opinion, it will at last succeed in placing matters on that footing which will be satisfactory alike to landlord and tenants. One immense advantage which the Act unquestionably has yielded, is the alteration of the principle which, previous to its passing, affected all land in England. Thus, to use the words of a paper, the principles of English law 'were against the right of a tenant to any interest in the soil farmed by him, even though created by his own capital, labour, and skill. The presumption was that all things annexed to the soil, or indistinguishable from it, belonged to the landlord.' The only security which the tenant possessed, or rather the only ameliorating influence in his favour, was the establishment, in course of time, of local customs favourable to his interests, and which induced him to lay out manure and to expend labour on the improvement of the soil and its resulting crops. This custom varied with varying localities and influences; the county most noted for its local customs favourable to the tenant being Lincolnshire. The fact that, from this circumstance, the farming of the county became celebrated for its high status, is perhaps as good evidence as can be adduced in favour of the tenants' right to unexhausted improvements. Another ameliorating influence in favour of the tenant was what is known as the 'law of emblements,' which gave him the right, if dispossessed of his land before he could get his crops off the ground, to enter and reap these, etc. Although called the 'law,' it really was not part of the statutes of the realm, but grew up out of decisions and precedents, the English courts being disposed to concede favour to agriculture, as that clearly influenced the public weal. In addition to the value of the Act as having established the principle that the tenant should have an interest in the improvements made by him during his tenancy, it exercises indirect influences upon the progress of agriculture. Thus, in place of vague and too often mere verbal or orally made agreements,—

understandings' which gave rise to too many misunderstandings,—the tendency of the Act is to increase written agreements. This alone will have a most beneficial influence upon the future of English farming. Again, the 'customs' of localities may be expressly excluded by the agreement, otherwise they would have the 'force of law.' Further, landlords are encouraged to give

tenants liberal agreements for unexhausted improvements, as the Act gives them the right to charge their estates with the amount of compensation. The Act is permissive, not compulsory. For a most able paper on 'English Land Law,' see the *Journal of the Royal Agricultural Society of England*, vol. xiv. part 2, No. 28, second series, 1878.

CHAPTER II.

SMALL FARMS—GENERAL CONSIDERATIONS CONNECTED WITH THE SUBJECT—COTTARS, CROFTERS,
OR LABOURERS' SMALL FARMS.

ALTHOUGH the subject of the present chapter is one which, in the opinion of some, is of such minor importance that they will deem it quite unnecessary to have their special attention drawn to it, we trust that we shall be able to show that it is one, nevertheless, which exercises a marked influence on the interests of landed property, so much so that it would be unpardonable to leave its treatment out of the pages of a work treating exclusively upon it. The subject is important no less for the influences it exercises upon the general management and arrangement of the property, than it is for the social influences it has upon those who work upon and are connected with it. This is shown clearly enough, if in no other way than from the large amount of discussion which has been given to it, especially during the last few years. And as this has in many instances been carried on with a too marked disregard of the actual facts and circumstances, it is only right that we should attempt, as briefly as possible, to put the matter in its true light. All the more is this necessary, when we consider that, as popularly discussed, it has a tendency to impress the public mind with notions which are but too well calculated to throw odium upon landlords and farmers alike, who are, we venture to say, wholly undeserving of it. It is certainly a matter greatly to be regretted, that subjects which are truly concerned with social, and what may be called commercial considerations, should be discussed not merely with undue warmth of feeling, for which there may be an excuse offered, but with the introduction of elements almost purely political, for which none can be brought forward. It may be said, however, that these political elements are inseparable

from this subject; but, granting this, even that is no reason why the practical agricultural points should be wholly or nearly ignored. This is certainly, we think, reasonable, seeing that the subject is an agricultural one. On this point we shall have a word or two further to say presently; but we cannot refrain from remarking that it is unfortunate, therefore, for the future progress of the question, if progress will or can be made in this country to the extent which many think desirable, that these foreign elements should have been introduced. It may be impossible to discuss it without those, but we venture to hold that the only element not strictly agricultural which should be taken into account is that bearing on the social condition of the small farmer or agricultural labourer.

While viewing it in this aspect only, it will be found that there are so many points to be considered, and so many difficulties to be overcome, that not a few even of those most anxious to promote the well-being of the labourer fail to see how that can be effected to any great extent by increasing the number of small farms throughout the country. It is easy, for example, to say that a labourer farming his own land is more likely to have that deep interest in the work which is the best guarantee for success, than when he is simply labouring for an employer at stated wages. No doubt the principle is correct, but there are practical facts which will and do come up which very materially affect its working out. Before this can be done, the small farm holder must be put in possession of certain privileges, and have at his command a certain amount of capital, no matter how small the amount of that may be; but it is in the obtaining of these

that the first difficulties to be encountered are met with, and in such a way that, in many instances, some, if not all of them, are found to be beyond his practical reach. Thus, the first of the privileges alluded to which presents itself, and which, in the opinion of all those who have studied the subject practically, is considered essential, namely, that the small farmer shall actually be the possessor of the land he cultivates, is precisely that one which many landed proprietors would be very much indisposed to grant, and this because it would or might materially lessen the value of his larger farms, by materially affecting the laying out or disposition of the same, or by reducing the value of the small farms themselves in consequence of the style of farming adopted on them, and which seems, as a general rule, to be inseparable from the system of small farming adopted in this country,—in some parts of it remarkably so. On this latter point, which has such an important influence on the whole subject, we shall have more to say further on. Closely connected with this essential privilege is another not less so, namely, that the extent of land so sold by the proprietor to the small farmer should be as exactly proportionate as possible to the condition under which he is best calculated to do full justice to its working. This, although not necessarily so insuperable a difficulty to be overcome, or a privilege to be granted, is nevertheless obviously one which presents practical difficulties which all connected with land will at once see.

Taking it, however, as a point admitted, that both of those difficulties are overcome, the next one which presents itself is one which many a small farmer would have a difficulty in dealing with,—we need scarcely say that it is finding the necessary capital. This would obviously represent so large a sum, that many under the ordinary circumstances of the labourer's condition would have a difficulty in finding it. True, he might borrow the amount on the security of the land; but it is not merely for the purchase of this for which capital is required, but he has to have wherewith to work it productively. These two items, before they were realized, would leave the labourer in that condition too often, we fear, where he would find the truth of the proverb,

‘that he who goes a borrowing goes a sorrowing.’ Nor must it be supposed that the amount required to work the land judiciously is small. We shall presently show how this is. Meanwhile, we go on to note another point which has been made very much of, namely, the injustice said to be done to the agriculture of Great Britain by having a system which prevents, as is said, the number of small farms from being increased. It will be seen, from what we have said, that it is very doubtful, to put it in the mildest way, whether the agriculture of the kingdom would be better if this increase actually took place. It is of little practical use to refer to the small farms of the Continent, more especially those of Belgium, because the system there adopted does not exist in this country, nor, so far as present circumstances indicate, is it likely to exist for a long time, if ever. It would be well, indeed, if, for example, the Flemish system, in its general principles, could be introduced among us. But this would necessitate a complete change in our style of farming, and not a little in the way of disposing of its produce. But this system requires, further, a degree of painstaking care, and the exercise of such close and steady habits of industry and order, that we fear it is vain to look for, at least in the present, and we may with safety almost say the succeeding generation, of those who would be likely to devote themselves to the cultivation of small farms. We do not see, therefore, how the difficulties which we have noticed in the way of small farmers having what may be called the best chances of success, can be overcome. This has never been attempted, so far as we know, to be shown by those who advocate the extension *per se* of small farms, without taking into consideration all the circumstances connected with its practical carrying out. They simply content themselves with general statements, which, we are compelled to say, are as a rule somewhat of a vague character, chiefly made up of the assumed advantages to be derived by the nation from the system, while others introduce political considerations which have in reality little or nothing to do with the practical subject. If the writers who have expended so much time in thus descanting on the system, had devoted some portion of it, at least, to

an attempt to explain how the difficulties in the way could be overcome, the nation would have been vastly more indebted to them. It serves little practical purpose to be continually making a certain round of assertions, and appealing more to the sympathies, which tend rather to foster prejudices than to get rid of them. Further, those writers of the class to which we are now specially alluding, assume at once, as a result of the extensive establishment of small farms, that they would be cultivated in the best possible manner. Hence they are mourning so much over the loss sustained by agriculture through the want of a large body of small farmers. This, however, is an assumption which, so far from being correct, is shown, by the actual circumstances of farming as it is, to be the very opposite.

The whole tendency of the improvements in modern agriculture is towards the requiring of such a wide variety of appliances, and the command of such means, as can only be within the reach of well-to-do people; and further, it demands on the part of the farmer such a wide range of knowledge in various branches of science, together with business habits of such a high order, that a special education is now more and more demanded. The keen competition, moreover, with which the farmer has to contend, not merely in this country, but from what is being done by other countries, makes it every day more and more imperative that he shall adopt the newest improvements, and use the most elaborate appliances and materials, best calculated to yield the highest results. In short, the process going on at present in British farming resembles very closely that which went on for a long time in manufactures, and which for many years has been completed. This was the gradual extinction of the hand-loom weavers and spinners by the introduction of improved processes and new machines. As the extension of these increased more and more, the concentration of the work of spinning and weaving into large factories became a necessity, the establishment of which created a new class, which had at its command large capital, commercial knowledge, and business skill and energy. Now, at one stage of this process, which extended

over many years, there were those who raised woful jeremiads over the gradual decay and extinction of small workers who carried on their business in their own houses; and bitter things were said of the large manufacturers, as if they were the men who deliberately ruined the home workers, by preventing their trade being carried on at a profit. But it was found that the new system of concentrated mechanical working on the large scale, instead of decreasing the demand for labour, increased it enormously, while the wages paid were infinitely higher than the amounts earned by the home workers. We have said that the process is completed, but in reality it is not so, for when the mill system was fairly established, many small mills arose; but the tendency of every period of depression in trade, and, indeed, of the whole system of modern business, is the doing away with the existence of those small millowners, and the absorption of the work they do by the large ones, whose works are increasing daily in size and in the perfection of their appliances.

The same course is that which is at present going on in farming,—the same in kind, although, of course, not in degree. Large farms are increasing, but the moderately-sized ones more so; but the remarkable feature of the process of change is what we have already alluded to—namely, the introduction of a system of working infinitely superior to that which has preceded it, demanding, as we have said, a wider range of knowledge on the part of the farmer, the use of a larger number of materials, the employment of machines greater in number and more elaborate and effective in construction and working. All this is clearly beyond the reach of the small farmer; so also the requirements of what is called modern high farming. And, just as we saw in the case of manufactures, the more thoroughly this high farming is carried out, the more complete and complicated the machinery and appliances used, the greater becomes the demand for labour, and the more highly valued is the skilled and intelligent workman, while his work is rendered much more easy than it was under the old system. Neither is there any need to deplore the increased practice of high farming, so far as the wants of the nation are concerned, because the more fully it is carried

out, the more productive does the land become, and the greater the number of live stock that can be kept.

These are facts which cannot be disputed, and they are borne out by an examination of the condition and results of the small farms of the kingdom. It is perhaps in Ireland that the system of small farms can best be studied, because the minor holdings in that country are in greater proportion to the large ones than in England or Scotland, although in these countries they are much more numerous than some writers would lead us to suppose. We shall do the reader a service by briefly directing his attention to some facts given by Professor Baldwin—to whom the progress of agriculture in Ireland is largely indebted—in an article contributed by him to the *Journal of the Royal Agricultural Society of England* (see ‘The Prize System as applied to Small Farmers in Ireland,’ vol. xiii. part ii. No. 26, 1877). These facts are very suggestive, and indeed melancholy, as showing the wretchedly low condition of small farms as a whole. Mr. Baldwin, at the very outset of his article, says that the agricultural practices of most of the small farmers in Ireland are very defective. ‘In some places they are quite primitive. Vast numbers of the occupiers are very poor, while wide areas of land are not yielding a fourth of the produce which could be obtained from them. While many large farmers and graziers partake of the general progress of the kingdom, little or no improvement has been effected in the condition of vast numbers of the small holdings.’ He shows, also, that while they have received lately increased prices for their store cattle and their dairy produce, which have enabled them to pay their way better, their dwellings and social condition have not improved in like proportion. The reader who may be acquainted with the worst of the bad kinds of cottages and small farmhouses in England and Scotland, will find it difficult, we should say impossible, to find a parallel to the class which Mr. Baldwin says he has seen more than once, where the manure-heap was in the middle of the apartment, while very many were found in which the cattle and pigs lived on amicable terms with the families. In every department of farming the defective practices named by Mr. Baldwin are

observed. The grass lands are in the very worst possible condition, little or no attention being paid to them; in all, nearly, but a trifling degree of this would increase their produce largely. Nor is the condition of the land under arable culture a whit more satisfactory. Good, deep, and early tillage, which alone would increase the produce largely, is almost wholly neglected, and the inferior work with which the farmer is contented, even that is done in the most slovenly fashion. Weeds grow apace, and to such an extent that it is no uncommon thing to see ten tons of weeds in a single acre of potato land. We might run through every department as pictured by Mr. Baldwin, and each and all would show the same pitiable state of matters.

From what we have thus said, we do not wish the reader to infer that the condition of the small farms of England and Scotland is similar; but while here and there in every district examples of moderately well cultivated small holdings are met with, it may be accepted as a fact that the small farms, taken as a whole, are far below what may be called the lowest grade or class of high farming; nor need this be wondered at, when one considers the circumstances we have already named. The truth is, that from want simply of means, the small farmer has no chance of doing justice to his land, however willing he may be to do so. But even willingness would not meet the case, inasmuch as we fear that his antecedents and present condition would not admit of his gaining the knowledge necessary to enable him to carry out the improvements which modern science has indicated. We fear, therefore, that however much it might be and, as some hold, is desirable that small farms should increase over the kingdom, as long as farming goes in the same direction as it is now taking, this increase will not take place; and if it did, unless the circumstances of the small farmers themselves are materially changed, the condition of agriculture throughout the kingdom would not by them be materially improved. That we are not singular in this opinion, which, in truth, is that of most practical men, we may cite here the very decided and indeed remarkable expression used by one not at all likely to take an unfavourable view of the interests of the small holders. This expression

is to be found in a paper drawing attention to the statistics of the question, which, he says, goes to prove that, 'if the object be to employ the people in agriculture, and thus produce *dear* food, that object will be accomplished with small holdings with small capitals.' This opinion is certainly very strong, but it is not stronger than the statistics justify. Statistics or figures are said to be capable of that nice adjustment which a writer requires when he wishes to prove, or apparently to prove, any particular view he entertains. But setting aside figures, and appealing to facts, a few of which we have given, and to the general circumstances and tendencies of modern farming to which we have alluded, the above strong statement can be amply justified.

We have already alluded to Flemish farming, or Belgian, as it is better known. Now this system has been again and again appealed to as affording evidence unmistakable that small farming, in place of being the cause of a bad or low condition of agriculture, is, in point of fact, more largely productive than farming conducted on the large scale by men possessed of capital. Now those of our readers who may have done us the favour to read sundry papers of ours published in the *Journal of Agriculture* and the *Transactions of the Highland Society* (republished with large additions in a separate form), will know that we are the last to undervalue 'Flemish farming,' or understate its general agricultural results. We have, indeed, the highest opinion of it as farming *per se*, and it would be well if some even of our advanced farmers were to profit by the lessons which it teaches; but when comparisons are made between it and any other system, and deductions drawn from it, care should be taken that the conditions of the comparisons are correct, and the deductions based upon actual facts, not upon mere assumptions. But this commonsense way of treating the subject has not been generally followed by writers and speakers, who, anxious to show that small farms would be productive of vast service to British agriculture, take us to Belgium, and point to the small farms there as affording indisputable evidence of the correctness of the views.

In a preceding paragraph we have alluded to the principle that if a man has only secure posses-

sion of a small farm, or, in other words, is the owner of it, he is certain to cultivate it in the highest possible style; or, as Mr. J. S. Mill, the great advocate of peasant proprietorship, puts it, as against limited tenancy, 'Give a man a secure possession of a rock, and he will turn it into a garden; give him a nine years' lease of a garden, and he would turn it into a desert.' Now, when we think of all the high-flown sentiments which have been uttered in support of this principle, and the influence which it is said it must have in raising the condition of small holders, and also, on the other hand, the severe and bitter denunciations of the landlords for their preventing its being carried out extensively,—a somewhat striking commentary on all this is the fact that Belgian farming, always brought forward as proving the correctness of the principle, proves the very opposite. Some of our readers will be surprised to learn that the fine, and indeed wonderful results of the small farming of Flanders are produced, not by peasants who are proprietors of the land so highly cultivated, but who, on the contrary, sit under rack-rents, three, in some cases four, times the average value per acre of the English farms. The accuracy of even a name is something in such a discussion, and while the advocates of small farming continually refer us to Belgian agriculture, they ought to know that some of the worst farming in the world is to be met with in the small holdings of certain districts, while it is chiefly if not wholly in the provinces of East and West Flanders that the productive small farms so frequently referred to are to be found, and that even in these provinces there are small farms in certain districts which certainly are not models to be referred to. We say in certain districts. Now this fact and term carries with it elements of no small importance in the consideration of the general subject, which, we fear, have been too much lost sight of by the advocates of small farms cultivated by peasant proprietors.

We refer here to the great influence which the mere position or locality of the small farm has upon the success or non-success of its cultivator. Thus, if the small farm be nearly situated to a market where its produce can be quickly sold, more especially if that be in

a manufacturing town, in which there is always a great demand for the articles small farms best produce, and for which the highest prices are given, it is obvious that the small farmer will have a much better chance of being successful than when located differently. In such a case, as regards the part of his land under arable culture, for which the spade and fork will be the implements almost generally employed, such crops will be raised only as will meet with the readiest demand and bring the highest price. And also as to the raising of food for the live stock he will keep, this will, or ought to be, such as will yield produce which will also be in the greatest demand in the market, such as the milk and butter from a couple of cows—pigs and poultry—the latter fattened for the market as well as for their eggs. For all these there is a never-failing demand in large towns.

The small farmer, therefore, under such circumstances, if a man of energy and possessed of a moderately fair amount of knowledge of his business, would be able to adapt his style of farming to the peculiar and possibly varying circumstances of this market; while the cultivation would obviously—that is to say, if the farmer was at all intelligent—possess more of the characteristics of market gardening than of farming as generally understood and practised. Now we know very well that market gardening, if carried out with even a moderate degree of skill, produces per acre much larger produce than the same land would do even under the highest style of farming. For while in the latter the land bears but one crop in the season, by the successional system in market gardening several crops can be got from the land in the same time; and a further advantage is gained by the market gardening style of cultivating, that its various crops yield in proportion to the land they occupy a much higher money return than ordinary farm crops. This successional system of cropping is, indeed, one of the features of Flenish farming. Change, however, all those conditions of the small farmer into others the opposite or nearly so, and the reader will at once perceive the influence which the circumstances would have upon the chances of the success of the holder. We may safely predict that the results would be very similar to

those we have named as characterising the small-farm system generally.

The reader will now see the bearing of what we have previously said as to comparisons being fairly instituted, so that the small farm cultivated under the most favourable circumstances, such as we have just now named, must not be compared as regards its productive results with a farm cultivated under the ordinary system, but the status of which is only an average, or perhaps below the average. To make the comparison fair, the best of the one class should be set against the best of the other, the average and the worst on the one side against the average and the worst on the other. If the comparison be made in this way between small farms and large farms generally, we have little doubt but that the small-farm results would bear out what we have presented to the reader respecting it. Again, the important influence of climate has been altogether overlooked by those who have taken us to the Continent for evidence of what small farming could do; but climate cannot thus be put out of court when the object is a just comparison. This is so obvious, that more need not be said on this head. Besides, the painstaking industry in working the land, and the careful, almost penurious, personal and household economy of the Continental peasant farmer, is a factor in the general sum, so to say, of the discussion which cannot be left out of account. In an early paragraph of this chapter we hinted that it was not likely that the small farmers of this country would ever as a rule display these Continental habits. It certainly may seem hard to say never, but assuredly all present facts indicate that it will be a long time before they do.

It has been repeatedly stated, that in consequence of the action of the landlords in this country, the number of small holdings are miserably few. Statistics, however, tell a different tale. We have not space to enter into these, but the reader, we trust, will take our statement that England alone has, out of her four hundred and odd thousand holdings, no fewer than one hundred and eleven thousand small farms. If there was any country in which small holdings would preponderate, or at least be very numerous, one would say that the United States of America

would be that country,—the paradise, in fact, of peasant proprietors. Now, how stand the facts? While the average extent of each holding in England is fifty-six acres, in Scotland the same, in Wales forty-six, and in Ireland twenty-six, the average extent of American holdings is actually so high as one hundred and fifty-three. The advocates, therefore, of small holdings cannot go to America for facts in favour of their arguments. The whole conditions of American farming, in fact, are in favour of the system of farms so large that all the modern appliances of machinery, etc. etc., can be applied to their working, this, of course, involving the necessity for large capital; and the success of a large number of the best farmers is owing, as Mr. Moodie points out, 'to the abundant use of animal and mechanical power rather than of human labour. And referring to what we have said as to the increase of large farms in this country as a marked feature in modern British agriculture, the same eminent authority says: 'As this steam-enriched country becomes more and more wealthy, so will the demand for larger farms, or the absorption of numerous smaller ones, continue. We know that many farmers now hold several small farms, the ancient farm-houses being occupied by bailiffs or labourers. We have in our county of Essex a farmer who holds a number of detached farms, and farms them admirably. His total holding exceeds 6000 acres, mostly arable; several others farm 1000 to 3000 acres each.' With this opinion of one so well qualified to give it, and who certainly would be the last to forget the interests of the poor man, we conclude this chapter. What further is to be considered in connection with small farms for those possessed of large means, will be found treated briefly in the chapter on 'Amateur Farms,' already given.

Co-operative Farming.—We can scarcely dismiss the general subject of the letting or disposition of farm land without referring to the working of farms on the co-operative system. This has been applied, as our readers well know, to other industrial callings—mainly, however, that connected with the textile manufacturing districts—with varying success. Where success has been most decided, it is precisely that in which those

who had studied the question deemed success to be most likely secured, namely, in the supply of provisions and household necessities. The reason for this is not far to seek, and will be obvious on consideration. Space, however, does not permit us to enter into a detail of all the points of the system of co-operative working; but to the principal of these we must refer, as they have a very special bearing in considering the application of the system to agriculture. These are—(1) a population concentrated within a comparatively small locality likely to avail themselves of the advantages of the system; (2) a more than normal density or number of people so concentrated; (3) and last, and not least, the possession of such wages by this concentrated and numerous population as enables a large proportion of them to accumulate savings. All these are met with in the manufacturing districts, to which may be added a fourth and obvious reason for success, namely, a desire on the part of this population to use materials which, with those of other callings, would be considered luxuries, and also a tendency to what might be called extravagance in the use even of ordinary articles of household consumption. Finally, the articles sold, and especially when sold in large numbers, yield a profit which, in many cases, is handsome, and, on the average, good and paying. When, therefore, it was proposed to apply the co-operative system to farming, so as to enable the labourer to have a direct interest in the working of the farm by sharing in its profits, we were not of those who believed that it would be so successful as likely to create a revolution in the condition of the labourer. And we had no difficulty in so deciding, when we considered the conditions of success named above, all of which were wanting, or very nearly so, in rural districts and amongst rural labourers. To allude to no other reason than this, it will be seen how small the chances are of the system being successful in such districts. The profits of farming are but small at the best, and are subjected to many contingencies likely to bring about failure in working, and thus to destroy all chances of profit. To many, if not all of these, we have alluded in their proper place. But the difficulties they bring about are so great that they cannot be practically overcome. Even

where the system has been applied in manufacturing districts to the carrying on of working or manufacturing establishments, competing with those carried on by private enterprise, and competing in the ordinary way,—that is, with all the risks of loss, a point too often lost sight of by those so enamoured of the co-operative system,—the co-operative system has not, as a rule, been a success. And it has been found markedly to lack that valuable feature which enables private manufacturers, so to call them, so to arrange their business during times of depression, and even of panic, that they survive them as a rule. But it is just at such times that the co-operative mills fail, and fail often so completely that they are 'wiped out,' and cease to exist. Most melancholy examples of this—and sadly too numerous—are to be met with in the manufacturing districts at the very period in which we write. If these *working* establishments are not successful under the most

favourable circumstances of trade, locality, and capital, it is not at all likely that they will be so in rural districts, and applied to farming, the circumstances of which are so peculiar, that, if not absolutely antagonistic to the co-operative system, their application to it is very difficult. We think we may safely appeal in proof of this to farmers, and to the experience of those who know what farming is. We also appeal to the pregnant fact that in the few, the very few, cases in which the system has been endeavoured to be applied, decided failure—not even, as we believe, the remotest approach to success—has been the result. The failures would have been more destructively complete, and the lessons they taught still more pregnant with meaning, had the labourers been called upon to partake in the chances of loss as well as those of profit. But, in truth, this could not be, as they have had, as a rule, no money to invest.

CHAPTER III.

WAGES OF THE LABOURER—PERQUISITES, ETC.

ON this subject, which is one of the most important in which the farmer is interested, what we have to say will, for the most part, be concerned with circumstances which have only as a rule come recently into existence, and which will exercise an important influence on the future connection of the labourer and his employer. Some of these circumstances have been, and are still apt to be overlooked. Nor is the proprietor less, although not so directly, influenced by these; for whatever ministers to the welfare of his tenants, and enables them to conduct their work more economically and in better style, must of necessity be beneficial, although indirectly, and perhaps remotely, to the landlord. Wages are an important factor in the expenses of working a farm, and must be taken into account by the farmer in making his offer for land. Wages, or rather, to give the more correct name, the amount of remuneration given to the labourer, may be classed under three heads: first, the direct payment in cash to the full amount agreed upon; second, part cash and part perquisites, the principal of which will be presently named; third, part cash and part estimated by the value either of maintenance and lodging in the farmhouse, or lodging in the bothy or a separate cottage, also with board or food. Taking up the first, namely, wages in full in cash, we remark that the notion, held too widely in districts other than rural, that the agricultural labourer as a rule has for a long period been very poorly paid, and therefore to be looked upon as an object of commiseration, as compared with his more so-called fortunate fellow-labourer in towns and manufacturing districts, is to a large extent a popular fallacy, the persistent maintenance of which by the public press and

by platform orators is neither more nor less than a gross injustice done alike to landowners and farmers. We do not deny that there have been too many exceptions to this, but taking an average, our statement is correct. Nor do we refer here to the condition of the labourer now merely, but to that period also in the history of British agriculture anterior to the recent rise in labourers' wages. Comparing, in fact, the general *domestic* condition of the farm labourer and that of the town workman, we have little hesitation in saying that the former is almost in every way the most comfortably situated of the two.

In considering the subject of wages, the recent agitation carried on in agricultural districts, connected as it is with a feature altogether new to farming, namely, the introduction of the trade-union principle, cannot be overlooked. For long, and up to a comparatively recent period, trade unions were confined altogether to towns; and we are of those who cannot but look upon their application to the relationship between farmers and their servants as exceedingly prejudicial to the interests of both, for the principle tends directly and quickly to the total disruption of that kindly interest which, whatever may be said to the contrary by certain parties, has existed to a large extent between the farmers and their labourers. The principles of trade unionism, although they may have apparently for the time been successful in raising the wages of the labourer, will nevertheless ultimately be seen to be an unmixed evil—at least a very grave and potent one—so far, at least, we venture to say, as the farm labourer is concerned. But, in truth, his interests cannot be affected without, in a greater or less degree, affecting those of his master. If the mutuality of interests were more

thoroughly understood and acted upon, it would be much better for the ultimate benefit of the labourer than any rise of wages brought about by such questionable means as that of a trade union, which, beyond a doubt, cripples industry of all kinds; and from the very nature of that of agriculture, its operation is especially inapplicable to farming. The interference of any organized body between master and man would be bad enough if confined only to the question of wages, but it is infinitely worse when it attempts to take away the right of any labourer to work when, where, and how he likes, and upon such wages and to what master he chooses; still more mischievous, and in fact absurd, when it attempts to place all on the same dead level of equality, ranking the idle and the ignorant to be worthy of as high wages as the industrious and intelligent. The marvel is that the labourers should place themselves under the tyranny of a system which demands an absurdity such as this, for the very slightest effort of their intelligence would show that it is an absurdity which any schoolboy could see through at once. But the tyranny of the union does not end with this, for when it insists upon its right to dictate to the labourer whether he shall or shall not work to any master who offers it, it becomes so plain and striking, that the marvel is still more increased that any man should so consent to sell the birth-right of his liberty for so miserable a mess of pottage as the union offers him; nay, no mess of pottage at all, for the union offers him nothing but discord and strife, against which the only set-off is the chance of getting a rise of wages. But this, we venture to say, is indisputable, that if the loss occasioned by strikes be set off against the gain obtained by any rise of wages, one conclusion can only be honestly arrived at, namely, that the labourer would be a loser in the long run. The history of all strikes proves this, and to that history we can safely appeal. If the men were but left to themselves, and not be the dupes of those who really have no connection with or knowledge of farming as it is, they would very speedily see that the contrast between the condition in which the union places them, and that in which they formerly were, would altogether be in favour of the latter.

We have said already that the bond of interest between the master and the servant is of enormous value to both. Not merely from a moral point of view is it so, but also from a material one, as closely affecting the rise in position of the labourer; for whatever tends to increase the work and value of the produce of the farm, tends to increase the value of his labour. Of course this is quite antagonistic to the teachings of trade unionists, but it is nevertheless true that the better the style of farming is, or, to use the term now adopted, the more completely the farmer can carry out 'high farming,' the larger the amount of work to be done on the farm, and, by consequence, the greater the demand for labour. Although contrary to the statements so rashly made by the unionists, farmers as a body are not rich men. Unlike those of other industrial callings, the farmer cannot turn over his capital several times a year, but for the most part he can only do so once, while the capital he has to invest in his working stock is high in proportion to his profits. Moreover, in addition, he has to run a variety of risks unknown to other callings, from causes over which he has no control, such as adverse seasons and the like, losses from diseases in stock, etc. Further, he has to learn at considerable cost the minutæ of his business; and this is to be perpetually carried on, as new methods of working are being continually introduced, and new appliances required. It will be seen, therefore, that a bad season must of necessity demand less labour, just as much so as when the farmer, either from lack of capital or from ignorance of his business, does not carry out the best style of farming. The losses caused by strikes—a new feature, unfortunately, in farming—prevent him, moreover, from carrying on farming up to the highest productive capability of the land. In the case, therefore, of a farmer who knows his business, his prosperity is the measure of the prosperity of the labourer: the better the land is worked, the higher the profits of the farmer; and the greater the amount of work to be done, the higher, therefore, the profits of the labourer. All this has been proved by the history of farming during the past few years. The more advanced its progress has become, the more advanced has become the posi-

tion of the labourer. Not only have his wages increased, and his home and household position improved, but his labour has been materially lessened in intensity by the application of a wide range of mechanical appliances, which have reduced processes, which at one time demanded the heaviest exertion on the part of the labourer, to what may be called the minimum point, and have altogether done away with others which were positively hurtful to the health of the labourer. It has been said by his so-called friends that his position has been injured by the introduction of this same machinery, but the very reverse of this is the truth; for the more it is used, the greater does the necessity for extra and intelligent labour become, for new work and new methods are introduced which necessitate its larger employment.

The position, therefore, of the labourer has been in every way improved by the improvement in farming. This could be easily proved by facts, but it is so obvious and patent to all who look honestly into matters for themselves, that we need not take up any space by going into them. We have said enough to show that the interests of the labourer are thoroughly bound up with those of the farmer, and anything which tends to bring about a rupture between them can only be productive of mischief. So valuable, indeed, is the bond of interest which has so long and so widely existed between the farmer and his servants, that many object to the mode of direct payment in cash in full, simply because it has an inherent tendency to destroy, at least to weaken, that interest. If such be the case, how infinitely greater must their regret be when such a system as that of trade unions has been introduced,—a principle which, we confess, appears to us to give the most melancholy outlook to the future of agriculture which recent times have produced, unless, indeed, it be—as for their own sakes we trust will be the case—that the labourers will see the folly of their present course, and decide upon returning to that of older and better times. Or, if this be not their decision, unless the masters see some way of overcoming the evils which trade unions have brought about. In the wide distress which, as we write, reigns in so many districts in which trade unionism

has had the finest opportunities to show its powers for evil, the farm labourer may see enough, and more than enough, to convince him that the system can ultimately do him no good. One consideration ought to weigh with him, which, unfortunately, has never been thought of by other classes of workmen, that it is not he alone who suffers from the effects of strikes and lock-outs, but those innocent ones, his wife and children.

In connection with the system of paying wages directly in cash, another system of overcoming the difficulties caused by trade unions is to have long engagements entered into, the minimum suggested being six months. In this case, to prevent disputes, it is essential that a proper form of agreement be drawn up and duly signed by both parties, the terms of which could be made to be fulfilled by the ordinary legal course, should any dispute arise; although we should recommend its settlement to be attempted in the first place by compromise, as legal proceedings have a bad tendency in the case of employers and employed alike.

So important and so peculiar is the work of the farm, and it is that in which the nation generally is specially interested, that it is greatly to be wished that some system could be found by which such difficulties as will now frequently arise in practical farming, owing to the action of trade unions, could be neutralized, or at least greatly lessened. We have said that farm work is so peculiar that nearly all its departments are such that only one chance in a year is afforded for their being carried out; further, some work,—that of harvesting, for example, or haymaking,—if not done at the exact time when it ought to be, a whole season's produce may be, if not lost entirely, at least partly lost or injured to a great extent. Now, if a trade union in any district should at such times issue an order for its members to demand some extravagant price, and on not receiving it to strike, some idea may be formed of the loss sustained,—a loss sustained by the farmer in the first place, but which must also be shared in by the general public. Such facts as these are not recognised by many, who, if they do not advocate the introduction of trade unionism into

rural districts, are certainly very indifferent on the subject, as if it in no way concerned them.

We now come to the second system, of paying the labourer by cash and partly by perquisites. These vary in different parts of the country, for details of which we have not space here; but the reader, by turning to vol. ii. of our work, *Outlines of Modern Farming* (Crosby Lockwood & Co., London), will find them there given on page 257. By referring to this, they will find that, while goods in kind, valuable in the household, and such equally valuable perquisites as cottage gardens, potato ground, and the like, are given pretty generally, beer and cider allowances figure pretty freely. Now, whatever may be said in favour of the system of remunerating farm labour partly by perquisites, certainly much cannot be said in favour of a part of these perquisites being in the shape of drink allowances. The giving of these is, from almost every point of view, essentially wrong in principle, and productive in practice of a large amount of evil; for not only do they encourage those who have acquired the habit of drinking in a continuance of it, but not seldom act as an incentive to some, who have not the habit, unfortunately to form it. If refreshments are required, as they certainly are at certain seasons and classes of work, there is abundance of materials of an innocent character, such as coffee or tea, to choose from, better calculated to support the labourer than beer is. We say this, not that we hold extreme views, and object to beer *per se*, but if given in moderation we would not object to the custom. But we confess to seeing a practical difficulty of enforcing this moderation, so that we, on the whole, conclude that such encouragement to do extra work, which the beer is supposed to yield, would be infinitely better given in the form either of cash payment to the labourer, or, what we think would be better still, as being likelier to do more good, the giving to the wife of some present, either of food or some article useful in the household. Some labourers would object to this, but not all, for by no means do all care for drink, and even the objectors would, by the second or third season, we believe, fall pleasantly into the arrangement.

To the bestowal of perquisites of a useful character, such as 'giving in kind,' as the term

is, of allowances of food of a certain kind, fuel in the shape both of coals and firewood, or one or other of the many forms in which this may be done, the same objection cannot be made as in the case of drink, above noticed. Indeed, a great deal can be said in favour of the former system as carried out, as it must tend in greater or less degree to the establishment and the keeping up of the kindly interest between master and servant, to the value of which we have already alluded to. Another valuable and highly esteemed perquisite, as it would be sure to be considered by the labourer and his family, would be the giving of a *cottage rent free*. In this case it would be necessary to have some form of agreement, as elsewhere alluded to in this chapter, the labourer being hired for a certain period to do certain duties, one of the terms being that at its expiry, or on the labourer leaving his employment, the cottage would be given up. Of course, it need scarcely be said that the cottage should be a good one, and its occupancy by a valuable servant would be all the more esteemed if a good garden was attached to it.

Of course, the system of perquisites is not applicable to unmarried men, who must therefore be paid directly in wages, or by the third system stated at the commencement of this chapter, namely, part wages and part board. When the board is given in the kitchen of the farm-house, one can easily conceive how true may be the objections raised as to its demoralizing effect, both on the male labourers and the female servants of the house. This would have but comparatively small place in olden times, characterised by so much simplicity of manners and style of living, that the farmer and his family, as a rule, lived chiefly in the kitchen, and presided at the meals; for in this case a supervision over the conduct of the servants, farm and house, could obviously be so exercised as to prevent demoralizing influences exercising much evil. But now things are so much altered as regards the farmer's style of living, that the system, with all its obvious advantages, cannot be carried out so that these can be secured. Not the least of these advantages were such as the establishment not only of a kindly intercourse between

master and labourer, but also, as was very often the case, a direct teaching or inculcation on the part of the master and mistress of advice and example calculated to be of service to the young men. In brief, the family tie, so to say, in many, probably the majority of cases, had then so decided an existence, that the labourers may be said to have formed part of the farmhouse establishment, in the welfare of which all were interested. In some districts the plan may yet be carried out, but we conceive these will be few, and certainly not amongst the class of farmers holding even comparatively small farms. That part of the third system of remuneration now under consideration, in which the accommodation of the board allowed is given in a separate building,—often, indeed, the stable loft, but in the majority of cases in what is called the bothy,—finds more objectors than praisers. No doubt the bothy, which obtains chiefly in the northern districts of Scotland, has been so much improved of late as to get rid of the many objections which have been raised to it. Nevertheless, it has to the minds of many so much of the soldier barrack system connected with it, that they cannot see how it can be carried out without certain moral deterioration being incurred on the part of the young men. But the whole system of dealing with the unmarried young men of the farm is so surrounded with difficulties, that it is hard to condemn off-hand any one plan by which it is proposed to meet them.

In view of the evils connected with the introduction of trade unionism into farming districts, more attention is being given to the importance of introducing the system of piece or task work on the farm. This system is by no means new, for it has been advocated for years as the best possible for farming work, as it has been maintained by many, and proved by not a few, to be the best for other branches of industry. By far the best statement of its advantages which we have met with in published form is a paper read before the Central Farmers' Club by Mr. James Howard, the senior partner of the celebrated firm of agricultural engineers, J. & F. Howard, Bedford. At first sight, the system appears to be based on the thoroughly common-sense principle of paying a man accord-

ing to the amount and efficient value of the work done by him, a standard or rate of cash value for a certain amount being fixed on and agreed to by master and servant. The system, in short, puts a man on his mettle, so to say, and he takes his place in the rank of workmen by a rule which may be said to be his own making; if a good workman, it enables him to make more money than he otherwise would do, while the larger amount of work also is likely to be done just at the time wanted—two conditions evidently to the benefit likewise of the farmer. There is this, however, to be said, that the system demands close supervision, either on the part of the farmer himself or a trustworthy overseer; for it is plain that if a man be tempted to do as much work as he can in order to increase his pay, he is in proportion tempted to hurry the work over and do it more or less carelessly. It is therefore essential, in the interest of the employer, to see that he has not succumbed to the temptation, and that the work he does, if increased in quantity, be of as good quality as it ought to be. On some of the points connected with piece-work, the reader will not be surprised to learn that there is a diversity of opinion; and as it is a good motto to follow, in considering any subject, 'Hear the other side,' we give the following remarks by a well-known writer on agricultural subjects, who has taken the labourer under his wing specially:—'This ought, as far as possible, to consist of piece-work. I say as far as possible, because I am well aware of the difficulty there is in bringing many agricultural operations under the denomination of piece-work. Nevertheless, many of those difficulties may by perseverance be overcome, and for his own sake, as well as in the interest of those who work for him, it is well worth the farmer's while to overcome them; for, until human nature is very much changed from what it is now, labourers will be found, even without reference to age, to differ very widely from each other. Physical strength and power of endurance, skill, industry, a desire to do an honest day's work, and many other particulars, are points in which there is sure to be an immense amount of difference. Yet, unless the amount of a man's earnings depend upon the work done, it is difficult to see

how to avoid paying all those various characters of labourers exactly the same amount of wages, and so inflicting on the farmer both a present and prospective loss, by getting now a less amount of work than he ought for his money, and discouraging improvement in the class for the time to come. It is very important, also, for all parties, that in every case in which a system of day-work is adopted, the number of hours constituting a day's work should be definitely settled and understood, and that an account of all after-time employment should be accurately kept and paid for, not by beer or cider or other refreshments, except perhaps in time of harvest, but in money, and in the proportion it bears to a day's work. Now that thrashing is almost entirely done by machinery, it is very difficult to provide wet-weather work for agricultural labourers. Yet, when the immense loss of income which, in the changeable climate of Great Britain, and specially in the western counties, accrues to the labourer from bad weather, unless paid by the week with no deduction for wet days, and the difficulty in which the loss involves him, are considered, it will be obvious that a farmer who wishes his labourers to have well-nourished, powerful bodies, and minds free from anxiety, will do his best to secure them against the possibility of many days' forced idleness in the course of a year, involving, of course, short commons for themselves and families.

A practice obtains in some districts of allowing at certain parts of the season, such as harvesting, when it is important to do the farm work in a short space of time, a higher rate per week than is allowed during other parts of the season. This practice, however it may appear to suit the farmer, is, to say the least of it, of questionable utility as regards the labourer. But, in truth, this system of extra payment at extra seasons is

no gain to the farmer, for, as a rule, while the rate of wages is increased in a high proportion, the amount of work done is considerably below this; in some cases the difference between the wages given and the work done is as much as one-third. In view of this, the above statement that the system is of questionable utility to the labourer seems of doubtful accuracy, as the labourer is clearly the gainer of 6s. 8d. in the pound: of doubtful accuracy, therefore, at first sight, as regards cash; not so, however, as regards its moral influence. Labourers accustomed to receive a comparatively low rate of wage during the greater part of the year, receiving at another a very much larger amount, are greatly tempted to spend the extra sum in a foolish if not in a vicious way; and it tends also, in many instances, to be the first cause of lowering his *morale*, which becomes permanent with some. Now thus reducing, as it does, his value as a workman,—for all vicious habits have this tendency,—he cannot be said in any way to be a gainer by the system which is the cause of this. On the whole, therefore, we consider that in districts where it is at present carried out, it would be much better for both parties if it were done away with, and a rate of wage uniform throughout the year substituted. Further, another objection to the system is, that being applied, as it is in many districts, to harvesting and summer work alone, the labourer receives the heavy flush of money at a season when it is much less useful to himself and family than it would be during the severe months of winter. Such considerations as these may appear to some to possess little practical value in connection with the work of the farm, but to the thinking man nothing is unimportant which influences in any degree the moral and social status of the labourer, as that must have a reflex influence upon his working capabilities.

CHAPTER IV.

THE RECREATION OF THE LABOURER—VILLAGE CLUBS, READING ROOMS, ETC.

SOME may think that if the labourer be supplied with allotment plots or gardens, as advocated in the preceding chapter, enough will have been done in the way of providing for recreation for the farm labourer; while others may think that recreation is a matter which did not concern those connected with the improvement of landed property. As regards the last of these objections, it should be remembered that, just as one would advocate the employment of good buildings, machines, etc., as important helps towards this improvement, so in like manner it may be held that good and well-conducted labourers—'living tools,' as some one has called them—are great helps also. Anything, therefore, which tends to raise the status of the workman, and maintain him in good working condition,—this involving his moral as well as his physical qualities,—is of importance to our general subject. From this point of view—and it will be somewhat difficult to prove that it is not correct—it is, we think, very obvious that those interested in the right working of the property must or should be interested in the well-being of those who, after all that may be said, constitute the 'power,' so to call it, by which that working is carried on; the better and higher, therefore, their condition in every respect, the better for the property with which they are connected. And as regards the first of the objections above named, it should not be overlooked that men cannot be always working in their gardens during their spare hours; for if they wished to do so, the seasons and the weather would in turn prevent them. Besides, a love of change seems to be an essential part of the human constitution, and men cannot always be doing the same thing, even although that be amusement. The necessity,

therefore, of supplying them with healthy-toned recreation is evident.

This may take many forms, but we concern ourselves only with that of clubs or reading rooms. We confess that there is more difficulty attendant upon the establishment of these than in that of allotments or gardens, and this mainly on account of certain peculiarities which arise from a variety of causes. In the allotment system, each man, having his own plot, meets with no interference from his neighbour, or, if he does, it is of that kind which is very easily dealt with; but in the case of clubs and reading rooms, numbers of men meeting together, have more or less to do with their organization and management, according to the system on which they are established, and, as a necessary result apparently in all such undertakings, jealousies more or less decided arise, which interfere materially with the harmonious working of the institutions. These may be organized upon a variety of systems,—they may be established by the proprietor of the estate, or by a number of individuals interested in the social progress of the labourer, the expense of establishing and maintaining the institution being wholly provided by them. In this case the management, as a rule, is carried out by those who have established them, the labourer simply having the free use of the rooms, books, etc. On another system, the institution may be partly supported by subscriptions from the well-to-do, and partly by the payment of a small fee exacted from the members. The management in this case may be made up from the general subscribers, the members, as in the preceding case, having no concern with it; or, as in some cases, a joint committee of the two bodies may undertake the conduct of the institution.

Of the two systems, the 'club' with its reading room and other recreative attractions, and the 'reading room' pure and simple, we prefer the club, and this on the ground that, just as we have said a man cannot always be gardening or cultivating his allotment plot, so he cannot always be reading by way of amusement in his spare hours. In fact, reading is to labouring men generally not very attractive; really hard work is it to them; partly, indeed, mechanical, as they do not take in at a glance the subjects treated of in the ready, almost intuitive way of educated people accustomed to reading much. The working man has too often to spell out his reading, and many of the words and phrases convey no meaning to him; the result, therefore, is the soporific tendency not wholly unknown even to educated people. When to the labour of intellectual conception of what is being read, is added the mechanical labour, so to call it, of—in many cases painfully—spelling out the words and sentences which convey it, this soporific tendency is so enormously increased, that we need not feel surprised at working men not showing a very keen interest in what some call the 'pure and never wearying pleasures of the reading room.' We fear those who so use this expression have not taken into account the circumstances we have named. But in the case of the club, in the diversity of attractions which it offers, changes can be made according to the taste and inclination of the members. They may read, may have a game at draughts or chess, or, if judiciously organized and managed, may go to the smoking room to sit and rest, or chat with a neighbour, or, as in the case of some clubs, may have their glass of beer the while. Some, probably many, of our readers may object to our supposing that a club can be judiciously managed where either tobacco or beer is allowed, especially the latter. But where the management in such cases is judicious, we strongly incline to the belief that no fear need be entertained of any evil results arising from these indulgences. The whole point lies in the words judicious management. Indeed, very little knowledge of human nature is required to show that the withholding of such privileges is the very reason why so many clubs have been either partial or total failures.

At the same time, another cause of this failure arises from the members being too much kept in leading-strings, so to say, having little or nothing to do with the management of the club; and when they have this entirely to themselves, jealousies are apt to arise, and quarrels result, which are highly prejudicial. This state of matters is, however, gradually mending itself, and this mainly in consequence of the growing intelligence of the labourers as a body throughout the country,—an intelligence arising from the various means put in operation during the last two or three decades to raise the social and moral status of the class. Hence they are beginning now to see, not merely the great material, but the moral advantages obtained from education and study, and also how much these can be aided, and other agencies for good established, through the operation of conjoined efforts in managing their own concerns, by the application of common sense, kindness, and consideration for one another. Much has been done in this direction, but still more remains to be done; and it is gratifying to know that progress is steady in the right direction.

A very good and striking example of what can be done in the way of overcoming difficulties of the kind just noted, and the removal of the prejudices of the better classes as to the establishment of clubs with certain privileges as we have described, is furnished by the 'Allotment Club,' established at Rothamstead by the well-known J. Bennett Lawes, F.R.S., who has carried on the series of long-conducted and costly agricultural experiments which have made his name and reputation world-wide. The experiment now to be briefly noticed has had a twenty years' successful career. When first started this was not anticipated, judging from the strictures passed upon it by friends, who feared the use of tobacco and beer would be simply a nuisance; but Mr. Lawes,—being one of those valuable practical men of the world who do not wait to follow the work of others, but begin the work themselves, allowing others to follow them,—not heeding the strictures of his friends, simply erected a building consisting of one lofty room, with skylight and two side windows, a thatched roof to be cool in summer,

a roofed verandah going all round the building, provided with seats, for the open-air enjoyment of the men during the same season. For the winter warmth, the large room had both an open fire-place and a stove. Having thus provided for the house comfort of the club members,—an essential point in such undertakings,—Mr. Lawes placed a barrel or two of beer in the large room, and invited the members of the 'Allotment Club' to meet him there on a certain evening. A large meeting was the result, to which he explained the object of the club, to which all those having a garden would have free admission; and stating that for the first year, under simple rules, he would manage it himself for them, after which it would be handed over to the members, to make the best of it they could. The beer was to be sold to the members, and although he had been advised to restrict them in its use, this he would not do; merely observing that if they indulged in it to excess, the consequent disgrace would extend to him as well as to themselves. Having thus, as a conclusion to his brief address, enlisted their manly feelings, he left them to discuss the matter over their beer and pipes, and for the rest of the year rarely, if ever, went near the club. The place, as we have said, was a success, but not at first; for, as explained by Mr. Lawes, some jealousies arose, but these gradually disappeared. The following brief history of these *contretemps* and subsequent success is given by Mr. Lawes, in some remarks so pregnant with meaning that we give them here, as being likely to afford a good guide to those of our readers who may be disposed to try a similar plan:—

'Labouring men are rather apt to imagine that if any one does them a kindness, his motives are not altogether disinterested. If they had thought one of my objects was to know more about their ideas and acts—if, in fact, they had fancied that they did not possess entire freedom of action, they would not have abandoned the public-house for the club. At the end of the year a dinner took place, and by universal suffrage twelve committee-men from amongst the members were elected to manage the club and make rules for the ensuing year. At first, some little jealousy existed between the agricultural

labourers and the owners of gardens, who were somewhat above them in social position; and as the day-labourers were necessarily in a large majority, the committee was entirely composed of that class. The result of this was mismanagement, and generally a clean sweep of the whole of the committee-men at the end of the year. The day-labourer is somewhat of a politician, and is fond of making laws, so that at one time the club was rather overloaded with rules. But, having made those laws, he is by no means anxious to enforce them, and on one or two occasions I had to point out how important it was that the rules should be strictly enforced. In the course of time the jealousy referred to passed off, for it was found that the man whose social or pecuniary position was somewhat above that of the agricultural labourer, possessed more intelligence than he, and was better able to conduct the affairs of the club. After this, instead of a complete change of ministry, the elections would pass off with comparatively small changes; the present chairman, to whom, more than any one else, the success of the club is due, having held this post for about seventeen years. From time to time the rules have been altered, as circumstances required. Shortly after the club was established, the late Mr. Austin, with whom I was associated on a commission "to inquire into the sewage of towns," requested permission to bring down his brother-in-law, Mr. Charles Dickens, to see the club. This visit is described in an article, entitled "The Poor Man and his Beer," published in the first number of *All the Year Round*, April 1859.

'It may be mentioned here, that neither the reading-room nor the store club proved of any use, education being at a very low ebb in Harpenden twenty years ago. The club books were therefore transferred to a general parish library. At the present time, however, the reports of Her Majesty's inspectors show a very high state of efficiency in the education of this parish. It need hardly be said that a club-house receiving barrels of beer direct from the brewer did not meet the approval of the publicans, so that an attempt was made to compel me to take out a licence. When I first established the club, I pointed out clearly to the members that any

attempt to sell beer to non-members would destroy the private character of the building, and, to the best of my knowledge, no attempt of the kind has been made. At all events, I was successful in establishing the character of the club before the magistrates.'

In the same number of the *Journal of the English Agricultural Society*, there is another paper on the subject of village clubs by Sir E. C. Kerrison, Bart., to which we now draw brief attention. After noticing the fact that for various reasons village clubs in Suffolk have not been very successful, Sir Edward says an attempt was made to obviate the difficulties met with; and this attempt has been so successful, that he believes it will slowly spread over other counties in England. The principle adopted is the same as that carried out so successfully in Yorkshire in connection with the Mechanics' Institutes, being simply a joint effort or organization of the various clubs, so that they can help and mutually encourage one another in the work. The following rules and remarks given by Sir Edward will explain the principles of what is called the 'Suffolk County Club Association':—

'1. To assist existing clubs and reading rooms, and to aid in the formation of new institutions of the kind throughout the country.

'2. To supply members thereof with the rules of successful clubs.

'3. To facilitate the exchange of books.

'4. To provide, as far as possible, for lectures on questions of general interest, neither political nor theological.

'5. To give information on the subject of provident societies, savings banks, and other kindred institutions.

'6. To assist in any plan clearly shown to this association to afford to the labouring population of the towns and villages of the county increased facilities for intellectual and social recreation.

'This County Society has so far been successful that it has been in communication with some fifty clubs in Suffolk, has started eighteen clubs, and been the means of assisting a great many others, and of supplying information to most of the counties in England, to Ireland, and even to America, besides obtaining

for the use of the clubs books to the value of £100. And this has been done with a very small outlay, very little fuss or public notoriety, quietly and unobtrusively, as all such useful works should be done, gradually, by their real worth finding favour amongst the people. No central society can for a moment pretend entirely to work local institutions like village clubs, but it may give good counsel, suggest rules, lend books, and provide lectures and magic lanterns. Such work has already been done in Suffolk.'

The advantages of co-operation are so obvious, they need not here be dilated upon, and we trust that Sir Edward's paper will be the means of extending the plan now explained over the whole of the kingdom; for, as Sir Edward remarks, there are few villages in which a room cannot be hired, and a few subscriptions obtained to buy books, etc., and provide the necessary light and fire. We are not sure, however, but that in the case of such clubs it would not be good policy to make the members pay something towards the expenses, for it seems a principle in human nature, which we may as well take advantage of as not, that what men pay for they estimate more highly, no matter how small the sum may be which they give. In the clubs connected with the Suffolk Association, smoking is permitted, but beer is not. We doubt the policy of this, for reasons we have already given; to which we may here add another—namely, that such a prohibition has a tendency to make the members feel as if they were not trusted, and this is sure to act prejudicially on their minds: there are few men who, if trusted, but would feel as if bound in honour to put and keep themselves on their best behaviour. Indeed, Sir Edward himself remarks that it is a question whether beer in small quantities might not be allowed in the reading rooms, although he states that at first there is no need to supply refreshments. This, however, along with other points, should be left for other members to decide, as we hold, as may be gathered from what we have already said, with Sir Edward, that the members should principally manage their own clubs, being guided, as occasion requires, by the counsel of those who can practically help them with their experience. The expense of maintaining such clubs may be reduced by having

them, as in the case of the County Association, opened, as a rule, only in the winter months, the members having occupation and amusement enough in their gardens and allotment plots and summer games. We conclude this chapter by briefly alluding to other ways in which the principle of union may be applied—as, for example, in the establishment of ‘medical clubs.’ The benefit of these may be said to be already provided by existing friendly and benefit societies and orders, such as the Oddfellows, etc. But these, as a rule, apply only to males, whereas it is obvious that they are as necessary, sometimes more so, in the case of women and children. We need say nothing of the advantages derivable from such clubs, but refer the reader to Sir Edward’s paper ‘On the Suffolk County Medical Club,’ for some practically useful remarks and rules on their establishment; only giving here those few words of Sir Edward’s, which might form an excellent motto for all such institutions:

‘The first stepping-stone to pauperism is an application for the doctor’ (see *Journal of the Royal Agricultural Society of England*, second series, vol. xiii. part 2, No. 26).

We have now touched upon the leading points connected with the subject of the chapter, and we trust we have been able to impress in some measure upon those of our readers who may not have given attention to it, and may therefore be prejudiced against the establishment of the institutions we have advocated, that they really form useful and, if wisely organized and properly managed, powerful aids to the raising of the social and moral status of the labourer. Anything which does this must, we consider, have the practical effect of helping forward the prosperity of the property with which the labourers are connected. And although this may not be the highest of motives, it is at least such a practical one that it will commend itself to those who might not be moved by other considerations.

CHAPTER V.

THE ALLOTMENT QUESTION.

IN close connection with the general subject of the labourer and his position on the property, is that named above, about which a vast deal has been written and said, showing, what is usual with nearly all subjects connected with agriculture, a great diversity of opinion thereupon. But, in reality, comparatively little is required to decide the matter, whether it is or is not wise policy on the part of the proprietor or farmer to allow his labourers to fill up their spare time by cultivating a small piece of ground,—at least to give them the option of doing so,—or to occupy it by one or other of the too often bad ways in which it is filled up when men have nothing to do in a useful direction. If the farmer goes in with the objection which has been so often made to labourers having work of their own to do, no matter what it be,—namely, that it takes off so much of what may be called the available stock of his working capability, which he believes should be given entirely to his employment,—there appears nothing more to be said, save that he (the farmer) must simply for himself strike the balance between the presumed advantages of having, as it were, his labourers' working abilities kept entirely to himself, and those disadvantages which are likely to or may arise from throwing the labourer on his own resources as regards his spare time. What these disadvantages are, little space may be occupied in naming. They are, unfortunately, too obvious—if any observation be used—in every village or hamlet in which there happens to be a beer-shop or a public-house. The misfortune of the thing is, that this observation on the part of the employers in too many cases is wanting, otherwise it might happen that the farmer might find that the advantages he deemed he was deriving from the system of

allowing—some would perhaps use a harsher word, and say forcing—the labourer to spend his spare time in doing anything he chose, save that of employing it in useful labour, existed only in imagination. And the point might then strike him as one bearing very practically upon his own interests. Thus he might see that the 'available stock of working capability' we have already alluded to, might be much more quickly exhausted or wasted by a night's debauch at the beer-shop, than the same time given to the working of a garden or the plot of allotment ground. In fair justice to many an agricultural labourer, we by no means wish to infer that labourers as a body, if debarred from giving their spare time, which they might wish to give, to the cultivation of allotment ground, would of necessity fly to the beer-shop; still, in view of all the complaints which have been made of what may be called the private habits of the labourer, it is worthy at least of some consideration, whether it would not be advisable to prevent as much as possible temptation being thrown in his way calculated to induce and cultivate the habits complained of. Nor should the circumstances connected with his home, and to which we have already alluded in a preceding chapter, be lost sight of in the consideration of this important question; those circumstances being, as is too well known, anything but attractive, or likely to induce the labourer to remain during a long evening surrounded by all the discomforts which cottages so often present, when set against the counter influences of the beer-shop, supplied with those attractions, ministering at least to his physical comfort, which their proprietors know so well to provide.

On the other side of the question there is

much more to be said of a more attractive and useful character, than has yet been admitted by those who oppose the introduction of the allotment system into farming districts. The question being viewed in these two aspects, the majority of the objections raised to it would, we think, disappear. We need under the head of attractiveness say but little, as that opens up considerations which scarcely come within the province of our work; but we may say this much, that if by any means you can infuse the taste for gardening or allotment-working into the mind of any labourer who has not hitherto possessed it, or who unfortunately has vicious habits, you arm him with a power to overcome these, the force of which one can scarcely exaggerate. Many a man has been saved from the destructive effects of the habit of going to the public-house by simply setting him to cultivate what no one can deny is the higher-toned habit of attending to—if but only a few—flowers in the tiniest of garden plots. But, powerful as a reforming agent as the pleasures are to be derived from work of this kind, it is obvious that a higher inducement, at least a more powerful one, is added when utility comes into view. Now the cultivation of an allotment plot gives this higher inducement. Although the money payments of the labourer have risen considerably above what they have formerly been, they are not yet so high but that the labourer, especially with a family, would be very glad to have them supplemented from one source or another. Now, any one who is at all acquainted with domestic economy must know what an amount of saving is effected in the food department when a well-stocked garden can be drawn upon for produce. Even a small plot of allotment ground can be made to produce a wonderfully large amount of garden stuff, which, well managed in the house, goes far to obviate the necessity for the purchase of other food costing more money. Nor should the fact be lost sight of, that, as the labourer gets interested in the cultivation of his plot, he begins to make it a study to get as much produce from it as he can. Hence arises another source of what may be called mere amusement by some, but which, we take leave to think, is a positive source of

intellectual pleasure. The more, therefore, one gives inducements for the cultivation of this, the higher must be the status to which we raise the labourer; and this being so, it is, we think, incontrovertible that the better servant he will make to his master. At a recent discussion in connection with the subject of the improvement of the status of agricultural labourers at one of our Farmers' Clubs, this point at least was conceded, and it is difficult to see what arguments can be brought to controvert it.

As a mere moral agent, therefore, tending in every way to the advantage of the farmer, we confess to having a difficulty to see how, when it is duly considered by him, he can raise objections to the allotment system. To allude again to the objection raised against it, that it unfits him for his daily labour to the extent that, in so far as he works much at his allotment, in so far as he is fatigued, we believe also that this is groundless. So far, doubtless, we must admit that his garden demands labour, and labour necessitates fatigue; but fatigue, it should be remembered, is of different kinds; and if we admit the truth of the well-known statement, 'that mere change in the character of the work is relaxation,' and therefore, to a certain extent, rest, to the overworked man in a higher grade of society, we fail to see why its truth should be denied in the case of a lower one. Again, we know that where one is strongly interested in work which even may be admitted to be actually hard, the fatigue incurred is of a totally different kind from that brought about by doing work in which no interest is felt. The fatigue, therefore, of the labourer incurred by working on his allotment ground, in which he is greatly interested as to making the most of it, becomes so light that it may be said of it, that it need not be taken into account as antagonistic to the interests of his master. We believe it to have quite the contrary effect; and certainly it is not at all to be compared with the fatigue which arises from the labourer having to walk a considerable distance, morning and evening, to and from his work. This is the case on too many estates throughout the country, from the fact that no proper or indeed any cottage accommodation is provided for him on or near the scene of his labours. This is, in point of fact,

work of the hardest kind, inasmuch as it possesses none of the interest to which we have alluded; on the contrary, so long as human nature is constituted as it is, the labourer will feel the work to be a grievance, as being forced upon him through a system which deprives him of advantages which he knows full well he ought to possess. Moreover, after the light labour of the allotment plot, he has his night's rest, whereas after the hard walk to his work on the farm, he has to begin to that at once, and that under the pressure of fatigue. And yet this system is not so much opposed as that of the allotment, now under consideration. Indeed, so far from being opposed, if not quietly and tacitly acquiesced in as right, it is assuredly in very rare cases denounced as utterly wrong. Consistency, therefore, demands that the lighter labour of the two should not be held up as constituting a grievance and causing a loss to the farmer, when the heavier one, which beyond all doubt does so, is passed over and deemed a matter of no moment. It is circumstances such as this which, conned over by the workman, becomes one of the grievances of which he complains, and tends to prevent the formation of that bond of sympathy between his employer and him, to the great value of which we have more than once alluded in this work.

The only point where we think that danger lies is, that the allotments may be allowed to be too large; and this we object to, not only because the labourer may really incur fatigue by having too much to cultivate, but because we think that it is better that he should cultivate a small plot well, rather than a larger plot not thoroughly. Moreover, we believe that it would be better for the labourer himself that he should not feel as if overburdened with the extent he has to cultivate, and the interest which he will feel in planning out and making the most of a small plot will be greater. Now the cultivation of this interest in the mind of the labourer we look upon as not the least valuable feature of the system, as affording a moral agency which cannot fail to be powerful for good. Nor does this influence rest only with the labourer. Where he has a family, some members of which are growing up, they also will become interested in the work, and the more they show of this the greater will be the

interest of their father, and thus another motive for good will arise.

We have said nothing as yet as to the paying point—that is, how far the landlord or the farmer will be recouped for such outlay as the carrying out the system may involve. But all experience goes to prove that the rent willingly paid by labourers for their allotment plots is not only sufficient to repay the proprietor, but actually yields such an income that the investment, so far as it goes, is a good one. An acre of land, divided into plots of 50 feet square, will give a plot each to sixteen labourers; so that, charging a rent only of £1 a year for each plot, a very fair return—some would think it more than this—is thus yielded. And referring to the point briefly alluded to, of cultivating a small plot well in place of a large one indifferently, it is surprising how large a bulk as well as how great a variety of produce such a plot yields, if the fullest amount of justice is done to it.

If, however, the allotment system cannot be carried out for one reason or another, we certainly would strongly recommend that each labourer's cottage should be provided with a garden of fair extent, and for precisely the same reasons as we have already stated in connection with allotments. And if this garden does not yield the same amount and variety of produce as an allotment which can be turned to direct use in the family, still some can be raised, while by a judicious culture, especially if the cottage be near a town or large village, flowers can be raised and bees kept, by which a fair amount of money can be realized in the season; and if a pig be added, this of itself will greatly increase the economical resources of the family. But we should suppose that there are few farms on which the allotment system could not be carried out; and if difficulties did exist, the probability is that a little effort would overcome them; and in view of the advantages derivable from the system, which we trust we have shown that it possesses, we think that it would be worth while for the effort to be made. There can be no doubt, judging from such experience as has been gathered from extensive trials of the system, that, in the words of one who has some authority to give an opinion, 'so far as we can see, and we have seen it working

in many parts of the country, good must result from it, harm cannot.' And as regards the value of the work done, the same authority states that at all the shows he has attended as judge, and they have been very numerous, 'the cottagers' and allotment-holders' produce equalled and often surpassed those of the gentlemen gardeners; and

when men once take to gardening, they appear to us to become more enthusiastic and more successful every year.' With such pregnant words we conclude the subject of allotments, leaving it for the consideration and decision of the proprietors and farmers whether they shall or shall not form part of the features of the property.

DIVISION SIXTH.

NOTES ON THE TREATMENT OF DIFFERENT SOILS UNDER ARABLE CULTURE—HEAVY LANDS—LIGHT SOILS—GRASS LANDS—EXTENSION OF SYSTEMS OF CROPPING IN RELATION TO LIVE-STOCK FARMING—WEEDS AND WEEDING.

CHAPTER I.

SOME POINTS CONNECTED WITH THE TREATMENT OF HEAVY OR CLAY LANDS.

THIS class of farms, although possessed of soil the richest in manurial constituents, and capable of producing the heaviest crops, may be said, as a rule, to be the least desired by the majority of farmers. But this apparent contradiction is easily enough explained, when we consider the great mechanical difficulties which lie in the way of effecting that degree of high farming which at least those who are ambitious of being considered advanced agriculturists aim at. But the realization of this demanding as it does skill and knowledge of no ordinary kind, great and almost continuous labour, and the use of mechanical appliances more or less costly, and in the aggregate requiring a considerable amount of capital, it is not to be wondered at that perhaps the worst specimens of farming in the country are to be met with amongst the heavy clay-land ones. 'Talpa,' in his wonderfully clever book, *The Chronicles of a Clay Farm*, gives a graphic account of what the conditions of too many farms of this class are, although he usefully explains how this condition may be changed from their waste and unproductive to the productive state. But difficult as the cultivation of clay land has hitherto been, it is satisfactory to know that there is a future before it, by which it will be rendered much easier; a future which, by opening up its hitherto locked up stores of highly enriched manurial constituents, will add enormously to its productive powers. This future lies in the application of steam power to an altogether new system of working—a system destined, we

believe, to bring about an absolute revolution in this department of farming. Before noticing the peculiarities of this system on which the hopes of advanced farmers are founded, it will be well to trace briefly the system by which, under ordinary circumstances and by the use of ordinary mechanical appliances, clay-land farms may be cultivated with a prospect of success far in advance of that which characterises the efforts of too many of our heavy clay-land farmers.

If it be asked what are the main or principal points to be attended to in bringing these desirable results about, we may state briefly that they are—first, deep and thorough drainage; second, deep culture or stirring of the soil; third, early or autumnal doing of the last-named work; fourth, the employment of proper manures; and fifth, of crops best suited to the soil, and to aid the processes above named. Taking these in their order, a few remarks on each will now be given; and first as to drainage. As we have in another part of this work gone somewhat fully into the details of this important part of farm labour, we have little to say upon it here, save that, if the best results are desired, the drainage must be deep and thorough. We are aware that it is the opinion of many that it is useless to put down deep drains on close, retentive clay, as the drains will not 'draw,' as the term is. This, however, proceeds on a mistaken notion of what drainage is, and the work it is capable of doing. Drains from 4 feet 6 in. to 5 feet in depth, we have, in the closest possible quality of clay, seen to act

almost immediately on being opened. It is scarcely necessary to say, that the precautions in forming the drains we have pointed out in the chapter in which the subject of drainage is discussed, must be closely followed if the best results are desired.

Deep Culture of the Soil.—Assuming, therefore, that drainage is properly and efficiently carried out, we proceed next to some of the considerations connected with the next point, namely, the deep culture of the soil. And here we have to point out certain fallacies which exist in the minds of many on this subject. Thus, in view of the evils, or assumed evils, of bringing the lower strata of crude and sour uncultivated soil of the lower depth to the surface, and mixing it with the soil which has for a long time been under the influence of cultivation, and is therefore of quality more or less good, some strenuously object to deep culture, as bringing about a state or condition of upper soil the very reverse of that which is desirable. This, however, proceeds upon the assumption that deep culture involves this as a result, which, in common with many others, we are quite disposed to admit is prejudicial to the old upper surface of cultivated soil; although, at the same time, we are inclined to believe that more is made of the difficulty than the circumstances of actual practice warrant. But deep culture does not of necessity involve the bringing up of the lower strata of soil, which may be called crude and sour from its hitherto having been out of the range of the ameliorating influences of the atmosphere; on the contrary, much of the prejudice existing against the system would at once be got rid of, were the truth known that it consists more, or rather wholly, in its modern and more recent phases, of the stirring of the lower layers in such a way that, while they still retain the same relative position they have hitherto done to the upper layer of cultivated soil, they are not brought up at once to mix with it, but are nevertheless opened up to the beneficial action of the atmospheric influences. These in time, and with a rapidity much greater than is generally supposed, so act upon the crude lower layer as to bring it into such a condition that it may safely, by appropriate mechanical means, be brought up to mix with the top layer of older and

cultivated soil, adding to its manurial richness, and reviving it, so to say. This, then, is what we mean by deep culture, and it is here that the system of steam cultivation is destined to play that part in the working of clay soils which we have already designated as being, in point of fact, a complete revolution in the art. It is impossible to overestimate the importance of this deep stirring of the soil, here but in a general way described; for it is the only way by which the under strata, which have lain for untold years, with all their rich supply of manurial constituents wholly unavailable, can be opened up and brought under the action of the atmosphere. This, in its ever changing peculiarities, and more especially in the hard and severe frosts of winter, which aid their operation wonderfully, acts upon the soil in a way much more beneficial than is generally supposed, and reduces the otherwise hard and unyielding clods to the tilth or pulverized condition, which makes the most obdurate clays fit to bear those crops which we shall presently notice. This system, then, gives the farmer the power of modifying the method of working heavy clay lands so completely that he can dispense with what has always been one of the greatest drawbacks attendant upon their cultivation, namely, the necessity of bare or summer fallowing. But this is not the only advantage obtained by deep culture, great and valuable as it is; but another point must not be overlooked, namely, the positive manurial influence of the atmosphere. So marked is the atmospheric influence on the soil in this way, not merely as carrying down to the lower strata of the soil, stirred in the way we have alluded to, the manurial constituents present in the air itself, but it brings into active operation those stores present in the soil itself; and the process is wonderfully aided by deep drainage, and this in the way explained in the chapter on that subject, which should be read in conjunction with the present matter. So marked, indeed, is the action of the atmosphere on our soils in a beneficial way, that some of our advanced farmers actually go the length of maintaining, that where the soil is deeply stirred, so as to admit of its operation thereon, little or no extra manure is required, all that is necessary being supplied by the air, and by

the stores naturally present in the soil itself, which the air sets into active operation.

This in a great measure, if not wholly, has been proved by certain systems of cultivation, in which manure has taken no part, but constant stirring and pulverizing of the soil have alone been the means employed. Some conception of the manurial constituents which heavy soils are possessed of may be shown by the experiments conducted with such painstaking care by the celebrated Mr. Lawes. Taking even an average loamy soil, Mr. Lawes showed that an acre of one foot in depth only, contains about three and a half tons of ammonia. The best guano contains about seventeen pounds to the hundredweight, while other artificial manures, even of the best qualities, contain much less than this, and yet their application to soils produces most successful results. Yet we have, as here shown, present in the soil itself an amount of the most valuable fertilizing material, far, infinitely far, in excess of that which even the most lavish use of artificial manures can yield. Now if a few pounds, speaking relatively,—for it is only small weights comparatively which are applied artificially to the soil,—produce such results, some conception may be formed of the gain to the farmer which lies before him by adopting this system of deep culture, which opens up the sources of manure which otherwise remain dormant in the soil. Hence the value of that repeated and systematic stirring of it which we have here advocated, and without which no heavy clay land can ever show fully its productive powers.

Autumnal Working of the Soil.—But in close connection with, and, indeed, as forming an essential part of the system of working clay lands, comes to be considered that of autumnal culture—that is, getting the land ploughed, or otherwise stirred, as early as possible after the crop has been taken off the land. It is impossible to get this work done too early, so that advantage may be taken of fitting weather for the work. We here use the words ‘fitting weather,’ as conveying a vast deal of practical importance. For it is impossible to overrate the importance of working the land when it is in good order, no matter what the form of the implement may be which is used. To send implements into a field either during

wet weather, which is bad enough, or after a long continuance of it, when the soil is in what may be called a ‘bird-limey’ condition, which is worse, is simply time and labour thrown away; nay, even more prejudicial results follow this procedure, for the soil is put into such a bad condition that it will be long before it can be brought into a good one. For it is not only the effect of the implements themselves on soils saturated with wet, but the injury done by the poaching and pressing of the horses’ feet with which we have to contend. This latter evil is, of course, got rid of where steam apparatus is employed, but we are at present only considering the ordinary modes of working. We have for a long course of years availed ourselves of many opportunities to point out the importance of working the land only when in good condition. There is more harm done to it, and, of course, greater loss sustained in the succeeding crops taken from such land, than those who practise the system are disposed to admit; but, as before in other cases, so now we would say, try the two systems honestly and fairly worked out, and as honestly record the results, and we have little fear as to what these will be.

One advantage obtained by commencing early in the autumn to work the land, is that opportunities will be offered of repeated workings being done; for it may be taken as an axiom in this department, that the more frequently the land is stirred before the winter sets in, the better will be the results. There are, however, exceptions to this rule, for some lands are none the better, but much the worse, by too much ploughing. What these exceptions are, the farmer, if he be one who observes, will soon find out for himself. One hint only do we give,—it is *not* light land which can do with much ploughing and stirring; the roller rather than the plough, or the grubber or the harrow, is the implement for some soils of this class. But ‘circumspice,’ say we to the farmer; and when the thing is found, ‘Take a note on’t,’ says sage Captain Cuttle. Those frequent workings, either by cross ploughing or grubbing, not only tend to produce the fine tilth which every true farmer aims at having, but the soil is more effectually opened up to the action of the atmospheric influences. Of the two implements used

for working the land, the plough and the grubber, we confess to giving the latter the first place for efficiency, at least at certain parts of the work. As an implement for getting rid of the weeds, we believe it to be unsurpassed, and we might almost say the same of its power for effectively stirring the lower layers of the soil without bringing them to the surface and mixing them with the upper and the older cultivated soil. Of all the weeds which infest and afflict heavy clay lands, that known as the couch grass, or popularly as 'twitch,' is the worst to contend with and get rid of; and it is an unfortunate peculiarity of this, that the more you divide the long and far-spreading roots, the more you multiply the scourge, as each division forms the nucleus, so to say, of a fresh congeries of vigorous plants. Now the plough, with its share, coulter, and sharp-edged mould-board, cuts the plants up, and tends to bury rather than to bring them to the surface; whereas the grubber has much less of this cutting power, and more of that which brings them to the surface, leaving them to be got rid of by subsequent harrowings. We are aware, however, of the fact, that some authorities, whose practice entitles them to more than a mere passing consideration, prefer the plough, holding that it does not cut the couch so much as the grubber, and brings it better to the surface; but in common with many others, we have always noticed that the cleanest fields were those which had been grubbed; at the same time, there is no doubt that most excellent results have been obtained by a combination of the two implements. Thus, after the use of the grubber or the drag and the light harrow, according to the condition of the soil, the fields may be finished off for the winter by a cross ploughing, and then finally by splitting the ridges by the double mould-board or turnip plough, so as to throw the land into very deep ridges. It should never be forgotten that the deeper and rougher the surface is left at the end of the autumn working, the better will be the condition of the soil the following spring. Many farmers adopt precisely the opposite mode of procedure, being desirous to see their land with a surface smooth, and finished off in what they call a 'workman-like way.' But we have merely to point out what is the practice of gardeners who know their

business, who take care to have the surface of their soil left as roughly as they can;—although, be it noted, some gardeners, and those able ones, do not always adopt *deep* or very deep cultivation;—and we all know that the more closely we can bring the condition of our farming soil to that of our gardens, the higher is the class or style of cultivation. This is a point which surely does not require naming at this advanced period, but the misfortune of the thing is that in the practice of so many it is strangely overlooked, to their great pecuniary loss.

Working of Fallows.—For a long time, and still over a large breadth of clay soils, as an established part of the system of working them, the fallow plays an important part. Fallows are of different kinds, but the oldest of all is that known as the 'summer,' 'bare,' or 'naked' fallow, in which the soil is left during the whole of a season or summer unoccupied by any crop, so that an opportunity is afforded of working the land by successive ploughings and harrowings, so that the weeds may be got thoroughly rid of, and the soil brought into as fine a tilth as possible for the seed put in in autumn. This system is only now, as a rule, pursued on the very heaviest and most retentive of clay soils; although some farmers, who can scarcely be said to belong to the advanced school, still pursue it under all circumstances. But by the progress of agriculture, and the use of improved machinery, clay-land farms, which formerly were put under naked fallow, are so cultivated that, while all, and indeed more than the advantages of the old system are secured, green crops are taken from the land which in value of produce are frequently little behind, and often before, the crops obtained from land of a class better adapted for their growth. This system of working is that known as 'green-crop fallow working.' Still there are considerable breadths of clay land so retentive and obdurate, that the bare or fallow system, admitting as it does of continuous working and cleaning, is almost a matter of necessity. Here again the caution we have before given must be attended to, where the best and most economical results are desired, namely, to work the land only when in good condition, never during or immediately after a long spell of wet weather. This caution

carries with it, we believe, the whole secret of success in the working of fallow lands. It may appear to some to be a waste of time to wait; but the truth is, that waiting at such times is the truest policy, and its value may be exemplified by the Italian proverb, which says, 'that success comes to the man who *can* wait.'

We shall now glance briefly at the modern system of fallow working, by which, while obtaining all the advantages of the complete bare or summer fallow, we can also produce green crops, and gradually bring even the most obdurate clays to the condition of a fine tilth. The first working should be begun, as already stated, as soon as possible after the removal of the crop; and the object of this should be to produce, not a deep, but rather a quickly-formed surface of shallow mould, so as to induce a rapid growth of the annual weeds. These, by subsequent harrowings and scarifyings, are brought to the surface and removed to the compost-heap or the manure-pit; while at the same time this upper layer of soil receives the benefit of the atmospheric influences, not the least valuable part of which may, *for aught we know* to the contrary, at this season of the year be enriched, to some extent at least, by the gaseous emanations proceeding from the decay of such a large accumulation of organic matter with which the surface of the fields, ditches, etc. are at this period of the year charged. This preliminary operation prepares also the soil for the next stage of working, in which it is stirred and worked to as great a depth as possible. This in turn acts upon the perennial weeds, as the 'twitch' or couch grass, bringing them to the surface, from which they are removed by subsequent harrowings and scarifyings, placing them in heaps so that they can be dried and burned, the ashes being added to the compost-heap. We recommend this burning decidedly in preference to the plan generally adopted of taking them to the manure-pit, inasmuch as those perennial weeds are possessed of such vitality, that when the season comes round for removing the contents of the manure-pit to the field, they will be as fresh almost as when taken from the field, so that they will start again with renewed vigour. The great point to be aimed at in the after proceedings is, by a succession of repeated workings,

done by the aid of the plough or the grubber, or by a combination of working of those two implements, to get the soil as deeply stirred as possible, and to have it cleaned from all weeds and rubbish. As long as the good weather continues must this working and cleaning of the land be carried on without intermission, one mode of procedure following the other in continual succession, so as to bring every clod or piece of soil under the action of the atmospheric influences, and this to the full depth of the stratum which has been worked. But this must be done in such a way as to preserve the integrity, so to say, of the rough condition, by which interstices or tubes, if they may be so called, are left, by which air, rain, etc. will be able to descend to the lowest part of the stratum of soil under working. It will be a great mistake so to prepare the soil that it will run together, and thus prevent the very object aimed at from being secured.

Steam Working of the Soil.—All this points to labour of no easy kind, which it would be difficult on many farms to secure, where the horse-power is under rather than over the mark. Still, if the fallow working is to be effective, it must be done; and if power cannot be obtained to do it over a certain breadth, it will be infinitely better to reduce the extent of that, and work the smaller portion thoroughly, than to take in hand the more extensive portion, and to neglect or be incapable of doing well what is absolutely essential. This, we may remark in passing, is a principle applicable to all departments of farming, and is, we believe, the key to the reason why there is so much of it that is had throughout the kingdom. The maxim, 'Better little well done than much half done,' is important to be remembered. Clay-land farms of limited extent, say under 150, or at most a maximum of 200 acres, with a judicious system of management, so arranging the work beforehand that the full power of the horses can be put on to do the field work which we have described, may be worked economically so as to produce a good green crop in the succeeding season. But on farms exceeding the maximum we have named, the system can hardly be carried out to advantage without supplementing the horse-power by that of steam; and on very large farms paying

can only be secured by doing the field work wholly by that power. In any case, implements of the best kind must be used. We believe that a large percentage of the loss sustained in working clay-land farms arises from neglect of this department.

Where steam cultivating appliances of a complete kind are used, we would draw special attention to the system introduced by the Messrs. Fowler, the well-known steam-plough manufacturers of Leeds. This firm has introduced a system of working admirably adapted for clay land, the implements used in which bring the soil into the condition of a fine loam or turnip land in a remarkably short space of time. The implement named by them their 'patent knifer,' stirs the soil to the astonishing depth of 24 inches, effectually opening it up, so as to admit of the atmospheric influences reaching the very lowest portion of the worked stratum, but without bringing any of it up to be mixed with the older and cultivated soil, until, by the process of weathering, it is brought into the condition in which it can be so mixed, thus forming, and in a remarkably short space of time, a stratum of fine loamy soil of the depth of two feet. Another implement is also used by the same firm, in which the tines of their knifer are combined with ordinary plough breasts or bodies. In this the knifers or grubbers, as they may be called, operate on the soil first, effectually stirring it as above described, while the plough bodies follow and turn over the land in the usual form of furrows. The plough bodies, having no sole or slade, do not form the hard crust or pan which is the great objection to the ordinary plough; and, of course, all poaching of the horses' feet is avoided,—an enormous advantage, as every farmer must know. We believe, as we have already said, that the adoption of steam-power, in conjunction with implements constructed and worked on somewhat the same system as that of the Messrs. Fowler, will introduce a new era in the working of clay lands,—an era so marked by its successful results, that it may be said to bring about what we have already called a complete revolution in this department of farming, and add enormously to their food-producing capabilities. Some idea of the pecuniary value of such

a system may be formed, if we consider even the roughest calculation of the acreage of clay land throughout the kingdom. To obtain, however, the fullest advantages of the improved system of working, it may be found necessary so to arrange the cropping that some portion of the land shall be free from crop, to enable the working to be carried on continuously.

New Methods of Working and Cropping Clay Soils.—On clay-land farms of small extent, where steam cultivation cannot be carried out, the following system has been recommended for horse labour, and which is equally applicable for the cultivation of corn and green crops. The authority who recommends it states that the proper cultivation of the fallow course can easily be carried on in a dry March or April, where the land is not wanted for beetroot or mangold, so as to place the farmer in a fair position without any extra outlay. The system is applicable to the cultivation of green crops on the flat as well as on the ridge and furrow, and is as simple as effective:—'Let the first crossing be a double ploughing, the second plough following with the breast off, with two horses out at length, breaking up the pan of the subsoil about four to five inches, leaving—it where it is, the next furrow of the surface soil turning over and lying upon it. Certain particles of the mould will run among the dead soil and form air-tubes, which will admit the sun, and assist the percolation of water after a heavy rain. And if you can serve that portion of the land required for mangolds early in the autumn, in the course of four years you can have all your farm virtually steam cultivated without any extra outlay.' The same authority insists strongly upon a proper rotation, and also upon the liberty to alter that according to circumstances. His plan is, one-fourth wheat, one-fourth barley, one-fourth clover and beans; and as to the fallow shift, that portion which he does not require for either roots or green crops for his horses, instead of the old system of a long or bare fallow, he puts down either with beans or peas, and consumes both the corn and straw on the farm. He can then grow, with the application of 3 cwt. of barley manure, a greater yield of barley than on any of the root lands. The wheat stubble must, however, be broken up

and turned in as early as possible, and the pea stubble must also be broken up before the harvest or during it. Of course, in this system the wheat crop is heavily manured, so as to leave the land in good heart for the production of a heavy crop of beans or peas. The following is another system of working heavy soils with horse labour, dispensing with the bare fallow, and substituting a green-crop fallow. Immediately after the year's crop is taken off the land, and weather being favourable, it is all gone over, and all perennial weeds, such as the dock, thistle, and twitch, are got rid of as completely as possible. The land is then ploughed up deeply (8 or 9 inches) into 27-inch ridges. At a convenient opportunity, when the land *is dry enough to be worked*, and better, when slightly frosted, a simple subsoil plough is run between the ridges, stirring the subsoil to a depth of 8 or 9 inches, but not bringing any of it up to mix with the surface soil, when the whole is left for the winter. When a fallow or green crop is to be taken, the furrows are manured and the ridges cast over or split in spring, affording at the same time another opportunity of getting rid of such perennial weeds as may have escaped the autumn forking. If the turnips are preferred to be grown on the flat in districts where the climate is specially dry, the land in the following spring may be levelled by the grubber, the manure laid on and covered with a light furrow. When the turnip crop has been 'folded' or carted off, by simply cross-grubbing the furrows (when the land has been finished in autumn as above), it will be ready and in capital condition for harrowing and then seeding.

Opinions differ as to the relative advantages of sowing turnips on the 'ridge' and on the 'flat,' even where the climate may be exceptionally wet or dry, apparently necessitating the use of the ridge for the wet and the flat for the dry. One great advantage of the ridge is, that if the seed misses, or if it comes up or 'brairds' well and is afterwards destroyed by the fly, the seed can be re-sown with comparative ease even a fourth time, for the top of the ridge indicates at once the position of the manure, which will be still undisturbed; whereas by drilling on the flat, as the whole surface is uniform, it is a difficult thing,

and in many cases impracticable, to hit the exact line for the drilling machine to follow up, at which the first seed was sown, and so another disadvantage arises from the flat system of cultivating turnips. If rain follows the sowing, the surface is apt to get so soddened together and hardened, that a second ploughing or at least stirring is required; and this disturbs the manure to such an extent, it being thrown up on the surface, that it is apt to get wasted, besides being thrown out of the line of the drill. The flat system is, of course, adopted, as a rule, only in districts where the climate is dry; but, in view of the above-named facts, it may be the better plan to ridge in all cases. The experience of leading farmers goes to prove that heavier crops are obtained from the ridge than from the flat system of cultivation, especially where weeding and cleaning of the crop are carried out, as they ought to be, and are in good systems of working.

Live-Stock Farming on Clay Soils.—Many heavy clay-land farmers have great difficulty in so cultivating and arranging their system of working as to enable them to keep *live stock*. Mr. Mechi, whose opinion on this department is certainly worth having, seeing what he has done in this way with perhaps the most intractable clay land of a county somewhat celebrated for soils of this character, in asking the question, which many a clay-land farmer asks with not a little of the feeling of despair at ever receiving a satisfactory answer, 'Why our clay lands are not stock farms?' replies: 'Certainly not because they cannot produce enough to produce stock; for if heavy land be thoroughly drained, deeply cultivated, and heavily manured, it will produce ample crops of mangold-wurzel and other roots, clover, tares, rape, beans, and other feeding-stuffs, and certainly more straw than can be grown on lighter soils.' Mr. Mechi's system is based on the principle which for years, in the pages of our leading agricultural journals, we have advocated whenever an opportunity presented itself, of protecting the animals from the effects of cold and wet,—a system as satisfactory for its paying results as it is for its humanity. This may be done in a variety of ways, but Mr. Mechi, as is probably well known to the majority of our readers, is an advocate for the covered-yard

system, the absence of which on a heavy-land farm is the cause of much loss and damage. In conjunction with this, he adopts the feeding system of pulped roots and cut straw, steamed and mixed with rape-cake, malt coombs or cummins and bran. The strong stems of the beans are also cut up, steamed, and used as food, the nutritive value of which chemical analysis shows to be nearly equal to hay. In brief, to use his own pithy style of putting things, he uses 'straw largely as food, instead of wasting it to mop up water,'—an office which it very largely performs in the great majority of the uncovered yards so frequently met with not only on heavy but also on light-land farms. Mr. Mechi, as we have elsewhere stated, is an advocate for warm food, which he has found to pay well.

On the point now under consideration,—the conversion of heavy clay lands into stock farms,—Mr. Mechi says that the time will come when the value of straw as a feeding material will be better understood; and states, what will doubtless surprise many of our readers, that, with the sparred floors of the cattle-lair or stall, burned-clay ashes may be used as a bedding material in place of straw. And he quotes the case of a well-known farmer, who has long adopted this plan with success and profit, a barrowful of brick-dust or dry ashes being sufficient to keep twenty sheep dry and comfortable, the saturated ashes forming a capital manure for the turnips, containing as they do such a large percentage of alkalis. And he goes on to say that 'miserably unprofitable stiff clay farms, now difficult to let, would be cheaply converted into paying stock farms by an annual summer burning of 1000 cubic yards of stiff clay or brick-dust ashes to each 100 acres, at a cost of £25, for we can raise clay and burn it into ashes at 6d. per cubic yard. The straw would then be available as food, instead of being wasted in sopping up rain.' Estimated cost per acre:

Burned ashes,	£0	5	0
Interest at 7 per cent. on covered yards sufficient for 20 bullocks and 100 sheep,		0	3
Interest on drainage of land per acre,	0	7	0
	<hr/>		
	£0	15	0

Such an arrangement on the part of the 'landlords and tenants would convert our miserable and profitless plastic clays into holdings creditable and advantageous alike to tenant and landlord.'

Of course, in cases like the present, there are always differences of opinion; but it certainly does appear that the chances of success in any particular branch will be more likely to be increased when all the details form part of a system in which care is exercised as to the disposal of the materials used, than when the reverse is adopted; and as an authority well puts it, one cannot 'throw the want of pecuniary success upon a system, because in some instances that system might be followed with better success, and in certain instances some details might be better attended to.' Nor should it be forgotten that influences of a very powerful kind might be at work in one instance, which would have no existence in another, such as differences in climate, locality, etc. etc.; for it cannot be too strongly impressed on those connected with farming, that it is not a fixed science, but one subjected to various and ever varying influences, more or less antagonistic to the successful carrying out of any system. Hence the necessity for each farmer doing what is not always done,—thinking for himself, and weighing maturely all his circumstances modifying or likely to modify any system which he may wish to adopt.

Manuring of Clay Soils—Farm-yard Dung.—As regards manures for the class of land now under consideration, by far the best, and that which is most generally used, is good farm-yard dung. But unfortunately, on too many clay lands, this is of the poorest, from the system adopted, on which we now offer a few remarks. We have said that heavy clay lands are *par excellence* wheat-growing soils. This, where the following system especially is carried out, throws upon the hands of the farmer a large bulk of straw. In order to form this into manure, cattle are kept; generally in open yards exposed to rain, with the exception of the part occupied by the shed,—a convenience, however, not always supplied. The straw in this system is supplied most liberally, and this, in conjunction with

the rain with which it is so generally soddened and saturated, after being trodden down and ultimately taken out as manure, is of wretchedly poor quality; and all the more so, that, as the animals are almost wholly fed upon the straw, few turnips or roots being grown upon such farms, sometimes indeed none, the voidings of the cattle contain but a very small percentage of fertilizing constituents. But poor as the manure just formed is, it is frequently made poorer, not merely by the careless way in which it is treated, alike in the yards and in the dung-heaps, but by the method adopted of applying it to the land. A remark or two will be found farther on as to the evils arising from the exposed open yards as a system of sheltering cattle and producing manure, and, even where the system is thought the best, through the defective way in which the yards themselves are arranged and constructed. Then, again, as to the treatment of the manure after being taken from the yards and added to the dung-heap, it is too often the case that this is quite antagonistic to right principles. The reader is referred to the chapters in which the construction of yards and manure-pits, etc., is discussed.

As to the way in which the manure made as just described should be applied to the land, great diversity of opinion exists. Some maintain that it should be spread on the surface in autumn, and allowed to lie exposed all the winter, and not ploughed in till spring. This plan we consider a bad one in the case of manure of such poverty as that now under consideration, and this will be evident enough especially in open and dry weather, as the manure will be in reality little better than, and have all the appearance of, straw pure and simple. The better way, according to some authorities, to make the most of it, and to conserve or get the advantage of such fertilizing constituents as it may possess, is to plough it in in autumn. If it does but little good to the heavy soil as a manure treated in this way, it will at all events possess some value as opening it up, allowing the atmospheric influences to act upon it during winter. Others, however, are quite against autumn applications of poor strawy manure, preferring to apply it in spring to the turnip or root land, to which it is

generally given. Others, again, hold that the best way to use it is to apply it to the lea land, and not to the stubble. Much, however, will depend upon circumstances, as soil, climate, etc.

Feeding of Stock as Producers of Farm-yard Manure.—But by far the best way, on such farms as we are now considering, of making the most of the large bulk of straw, not only into excellent manure, but adding greatly to the value of the cattle, is to feed them in boxes or in covered yards. Still more valuable would the manure be if the cattle were supplied with at least a small modicum daily of oilcake, or other nitrogenous food, and the straw cut or made into chaff, as it is generally termed. Under the ordinary system, or at least that which is very largely followed, and which we have described above, the cattle are kept chiefly to produce manure from the large bulk of straw, the farmer seldom looking for profit from his cattle; but by box, or at least sheltered feeding, such as by hammels, straw, chaff, and extra food, the farmer will be delighted to find that he has not only cattle worth having, but, in addition, a very large stock of rich manure. For further remarks on this improved system, the reader is referred to the concluding part of this chapter, and also to that in which the live stock of the farm, considered as the improvers of landed property, are passed under review.

Cropping of Clay Soils.—We now come to the cropping of heavy soils, upon which we have already incidentally given a remark or two. The systems adopted by various farmers are, as may be anticipated, very different—a very common one being the ordinary four-course.

The following is one which has been very successful, in which flax, a crop by no means a favourite with farmers, is a leading feature. First year, flax, wheat, and peas; second year, mangold, rape, and beans; third year, wheat; fourth, Swedes and vetches, followed by common turnips; fifth, oats and barley; sixth, clover. To this rotation it may be objected that the peas and flax ought to be classed with the beans in the second year rather than with the wheat in the first; but this is met by the statement that beans ought not to follow grass, as the crop prevents the land being worked deep enough for

drilling the beans. And further, the flax and peas are better grown in case of heavy land on clover ley or lay, as peas require to be sown very early before the winter's fallow is dry, and because flax requires a surface soil of very fine tilth, which is absolutely necessary to enable the seeds to grow away together; and this fine condition of soil is obtained by the early winter ploughing allowing the atmospheric influences to act upon it. Objection has been taken to the flax crop on the ground that it is a very exhausting one, but if properly cultivated it is not more so than any other crop. Every crop exhausts the land; no doubt some more than others. But it is the work of the good farmer so to cultivate it, that what is taken from the land is restored to it by manuring, and having a proper succession of crops. One great advantage possessed by the flax crop is, that, to get a good one, the very highest style of cultivation is necessary. It compels, so to say, good farming. The real difficulty connected with the crop is preparing the produce for the market, as this necessitates a series of operations, some of them so purely mechanical that they can scarcely be said to come within the range of farm work. If this difficulty could be overcome, it would be a great boon to the farming community. A very good crop for certain stiff clays is rape, the roots of which have a tendency to lighten the land. The crop also has this good feature, that sheep can be folded on it at a time when there is no fear of injuring the soil by treading, and it also forms an excellent preparatory crop for the wheat. Drilled at 18 inches apart in the early part of May, and with superphosphate at the rate of two and a half to three hundredweights per acre, it is ready for folding with sheep in July; and by a proper adjustment of hurdling, a second feed will be ready in about six weeks. Winter vetches are also good for clay land, generally lightening it as rape does. They should be sown as early as possible, and a breadth should be put down manured with dung, so as to obtain an early cutting for stall feeding, the remainder being folded with sheep.

In connection with the manuring and the weeding or cleaning of heavy soils, we may here note that salt has an excellent effect on them generally in getting rid of the twitch or couch grass.

It has succeeded in this when all other applications have failed, and it is obviously a much less expensive way than forking or grubbing it up. It is, indeed, one of the worst features of the ordinary system of summer or bare fallowing, that the repeated ploughings, in place of getting rid of the couch, in many instances actually increase the growth of this pest, inasmuch as the plough cuts up the long roots of the weeds into parts, each part or joint starting as a fresh plant. The quantity of salt to be used as a top-dressing will vary according to circumstances, from two and a half up to as much as five hundredweights per acre. Some use lime in conjunction with the salt, the two being well mixed together; and when sufficiently dry, the mixture is broadcasted over the land. It may be made to serve a double purpose, by using it as a top-dressing in spring for the wheat crop, being afterwards harrowed in. Some would think this harrowing wholly destructive to the crop, but the reverse is the case as a rule; the plants, which may often be in a sickly condition, taking quite a new start, and this chiefly from the stirring of the soil admitting the air to its generally clodded and closed lumps.

Turnip-growing on Tenacious Clay Soils.—Use of Burnt Clay in Heavy Soils.—It is too often supposed that turnips cannot be grown on stiff, tenacious clays, such as the well-known Wealden clay of Sussex. We have already explained one method of raising an excellent crop from clay land. But in cultivating turnips on it, two points are absolutely essential to be attended to, always assuming that the land is thoroughly and deeply drained. The first essential is—never under any circumstances, however tempting to the farmer it appears to be, to plough or work the land when it is wet. We have, in another part of this chapter, shown the necessity for this, and that time devoted to ploughing wet clay land is worse than lost, for it does mischief to the soil, which it is almost impossible in the heaviest of clays to undo by any amount of harrowing or rolling or clod-crushing, the soil in such cases turning up in huge lumps, which become almost as hard as stone. The second essential is autumn or early winter ploughing. As soon, therefore, as the white crop is off the land, the soil being in

proper condition for working, the stubbles should be turned over with the plough, or turned up with the grubber (see remarks in a foregoing paragraph).

The practice of using *burned clay* for the lightening of heavy clay soils is one which is happily greatly on the increase. To some it will appear an odd way to use clay for clay soils, but the nodules or small nuts, as they may be called, of clay burned, or the clay ashes (see a preceding chapter on clay-burning), are very different from clay in its natural condition. These nodules or ashes, when spread over the surface and ploughed into the seed-bed soil, act at first chiefly mechanically, lightening and opening up the clay by preventing, as it were, its adhesive lumps from lying closely together. But afterwards, as the nodules change in their character through the action of the atmospheric influences, they seem to have a chemical effect in enriching the soil as a manure does. Thus, for example, tares or vetches are especially benefited by the action of burned clay. And as the nodules have the effect of making the soil of a darker hue, it consequently absorbs the heat from the sun's rays and the atmosphere more readily; so that, in conjunction with the other cultural processes, clays which are generally described and thoroughly deserve the name of 'cold clay lands,' become quite changed in character. The great mistake made in using burned clay is, as a rule, giving too small a dose of it. An eminent authority on the cultivation of soils of this character says that at least from eighty to a hundred one-horse cart-loads should be given to the acre. Taking the burning, carting, and spreading of the burnt clay into account, it is by no means a cheap application, but the effect of it lasts over several years, and, as we have stated, is highly beneficial.

Ashes as a Manure for Clay Soils.—Many clay lands—as, for example, those of the Wealden already alluded to—grow timber to a large extent. The oaks are numerous, and the elm seems specially suited to the retentive, tena-

cious clays. Many trees, however, are often allowed to grow on clay-land fields, and these greatly deteriorate the quality and lessen the quantity of the crops; so also do the huge, old-fashioned, timbered or hedgerow fences, in which large trees are often interspersed here and there. In getting rid of these, as also in putting lands under cultivation which have been wooded, a great number of roots and parts of timber, which cannot be disposed of, are left on the hands of the farmer, to whom they are generally quite a nuisance. They can, however, be turned to excellent account as a manure by burning them and saving the ashes. Where they are produced in very large numbers, they may be used to great advantage for heating kilns for burning drain-tubes, etc. (see a preceding chapter on certain methods of economically using waste timber). When used as a manure, the ashes will best be treated when spread on the floor of stalls, etc., or in the dung stances, in the same way as dried soil, described in another paragraph. When the roots are made into charcoal, this has been found to be an excellent top-dressing for some soils in the cultivation of beets (see the above-named paragraph).

On heavy clay land, such as has been occupied by timber and brought under cultivation, lime is found to have an excellent effect in getting rid of certain prejudicial constituents and qualities in the soil, and in new land it is essential. The quantity per acre will vary according to circumstances; for old timber land, a hundred bushels per acre will be a good dressing. Lime, however, requires to be used with judgment on clay land which has long been under cultivation. It is quite a mistake to use it, as some do, wholly as a substitute for farm-yard dung and other manures. For remarks on lime, its value as a manure, and for cautions to be taken in using it, the reader is referred to a succeeding chapter on the 'Compost-heap' and the sources from which its materials may be derived.

CHAPTER II.

SOME POINTS CONNECTED WITH THE GENERAL MANAGEMENT OF LIGHT LAND.

Varieties and Mechanical and Chemical Properties of Light Soils.—The varieties of light land met with throughout the kingdom are so numerous that it is impossible for us to attempt to classify them here; indeed, this classification is anything but easy to do, inasmuch as in some instances varieties so run into one another, while between this one and that one there is the merest shade of difference. The generic term, therefore, of light land is the best to use here, its chief characteristics being the converse of those of clay land; thus, while clay is in its mechanical texture close and compact, light land is open. Clay is difficult to work with implements, light land easy; while the one requires tedious and generally costly operations to make it friable and to bring it into the condition of what is known as fine tilth, light land is easily brought into this state, and in many cases may be said to be naturally in it. While clay is retentive of water, light land, from its porosity, permits water to descend freely. So much for the mechanical differences between the two classes of land. Chemically considered, heavy land is generally rich in those constituents which crops require to make them fertile. Light land is more or less deficient in these, and in some instances they are wholly absent, their place being supplied by others which are either positively and permanently injurious, or are temporarily so until they are corrected and rendered useful to plants by certain cultural systems. There is not, as those unacquainted with agriculture might suppose, a line of demarcation between the two classes, making one district with its farms clay land, and the other light, although to a certain extent this peculiarity is met with; but, on the contrary, a single farm,—nay, even, and that not so seldom as some might think, a single

field,—not to say a district, will have examples of both kinds, or of a class which may be said to combine the characteristics of the two. The operations of farming long continued, moreover, can change to a great extent the character of a soil, making it that of the opposite kind: thus, for example, a heavy clay soil, by long-continued judicious farming, can be made open, loose, and friable in its texture; while a light soil, by sheep-folding, etc., can have its mechanical condition changed into that in which the soil is compressed and compact. In such cases, the crops which, generally speaking, are considered as confined to one class of soil, may by this change be successfully cultivated on land which was originally of an opposite character. In the chapter on 'Soils' the reader will find other peculiarities of light and heavy land fully described; we therefore go on to note a few of the leading points connected with the management of certain classes of light lands, leaving the minuter details of cultivation of these and of other classes to be gathered from one or other of the many works published which treat of farming generally.

In some cases light lands possess very marked peculiarities, which are sometimes supposed to be thoroughly prejudicial to the crops which may be grown upon them. To get rid, then, of these, and to make the land more suited for the presumed requirements of the crops, is the first work done by some. Careful consideration should, however, be given in such cases as to what should be done, and not to carry out operations of the very opposite character to that which are required. The temptation to make certain changes in farming is perhaps greatest in the case of one accustomed to the practices of one district. Going to another and a distant one, in

which the practices are different, the new-comer is naturally inclined to believe that the style of farming which was so successful with him before in his old, will be equally so in his new undertaking. But he forgets the lesson, which indeed his own farming must have taught him, that the practice, generally considered, of any district is brought about by certain peculiarities of locality, climate, and soil; and it is worth his while to observe for himself the peculiarities of his new district, and to inquire from neighbours if he does not see the reason for their adoption. Thus we have heard of a farmer, who left a district where stony land was considered a monstrosity, going to another where the land was not only light, but filled with, so to say, and covered by stones, numberless in multitude. Determined to show what could be done by him, and to teach the benighted farmers of his new district a lesson, he began at once to denude the surface of his fields of what, as he deemed, were unsightly and dangerous excrescences. He was warned, but warned in vain; and the result was, in the case of one field thoroughly cleared, that he found that he must either restore the stones or be content to keep a field greatly reduced in value. Now on certain light and poor lands these stones are of great service, not only as, in exposed localities, acting mechanically as shelter to the young plants, but also chemically, so to say, by the action of the atmospheric influences, because, disintegrating and crumbling away,—as in the case of some stones rapidly,—they add greatly to the fertility of the soil. Even in the case of implements used on light lands, one requires to be guarded and to take note of the practice of the district, for grievous mistakes are often made, which can be avoided by observation and inquiry.

We have said that the classes or varieties of light soil are exceedingly numerous, but the principal are the gravelly, chalky, sandy, and peaty, between which come in a wide range, making up the varieties above alluded to; some of which may be said to be combined soils, comprising the characteristics of two different kinds; while some, forming the upper soil, have a subsoil of a different character, which by deep cultivation and stirring may be brought up to mix with and change its character. We shall

glance chiefly at the leading features of the cultivation of light land, and give also a brief *resumé* of the general management of one or two of the leading classes. The light soils of the best class are, taking all things into consideration, the most useful, and, being adapted to a very wide range of cropping, and further, being much more easily worked than clay lands, are more in request. True, they do not possess what may be called such a natural store of fertilizing constituents, as our clay lands have to a practically inexhaustible degree when under deep culture, but by judicious cropping and liberal manuring, their fertility can be maintained to a very high point. They are essentially the lands for root and forage crops, and are made to play a most important part in the keeping of live stock, especially where the soiling system is carried out, or at least forms a part of the general routine of the farm.

General Management of Light Lands.—The crops best suited for good light land are the different varieties of roots,—turnips being *par excellence* the favourite and principally cultivated crop,—forage plants of all kinds, and the cereals barley, oats, and rye. Light lands are not true wheat and bean land, the clay soils playing this role in agriculture; still, when improved with the system of admixture elsewhere referred to, as by the addition of clay and marl, they may be made to bear good crops of these. In a word, while light soils may not yield the crops which bring the highest prices in proportion to the acreage they occupy, they produce, on the other hand, the greatest variety of useful produce when of the best class. Grass or 'seeds,' as the technical term is, form also part of the cropping of good light lands, poor classes being almost quite unfitted for grass crops till improved. The grasses, indeed, form, when part of the rotation, a useful means of improving the character of all light lands. This is more marked in the case of the lighter or sandy soils, as the roots, remaining and decomposing in the soil, not merely add to its productiveness chemically, but, by rendering it more cohesive and firmer, improve it mechanically, the clover being especially valuable in this way. 'Green manuring'—on which more presently—is based on this principle;

and for the conversion of almost worthless, light, sandy, poor soils into those which bear excellent crops, it takes the highest place in the practice of the most advanced of our farmers, although its value is generally greatly and singularly overlooked.

The manuring of light lands is a part of their management which has given rise to much discussion, which chiefly relates to the time at which and the way in which it should be applied, the manure here referred to being farm-yard or dung. But in taking an impartial review of all that has been said on the subject, it seems to be pretty conclusive that the manure is best in condition when old or short, that is, well rotted; and in order to retain the moisture as much as possible, especially in turnip cultivation, it should be turned in or covered over as soon after it is applied as possible, and the seed sown immediately. Many a good crop of turnips has been lost by neglect of these precautions—light land, by exposure, when roughly ploughed, losing more moisture than is generally supposed. The quicker the various operations of sowing time are gone through and succeed each other the better, and the lighter the soil the greater the necessity for this. *The ploughing or working of light lands* is also a department of their treatment on which there is much diversity of opinion. From what has been said above as to the retention of moisture, it will be obvious that too much ploughing will not be beneficial. Then, again, with reference to the system of autumn or early winter ploughing or grubbing, some maintain that it is highly injurious, while others hold the converse; but we believe that in light lands, more especially those which have a tendency to become dry, the autumn culture is decidedly the best, inasmuch as it reduces the workings in spring-time, thus getting rid to a great extent of the evils of undue exposure. Another element in the general management of light land improvement is the *folding of sheep on the turnip fields*. This, considered as a part of the system of turnip culture, without which root it could not, of course, be carried out, has done more than anything else to improve—has, indeed, in reality been the actual means of improving light lands. Without turnip cropping and sheep-folding, enormous tracts of

light land, now in a high state of fertility, would have remained in the condition of almost absolute unproductiveness, which was their original and normal characteristic. It is, indeed, impossible to overestimate the value to light lands of turnip sheep-folding in at once consolidating and enriching the land, the firmness of texture which it naturally lacks being so given in precisely the best way, by the uniform treading of the sheep, that they are said to have 'golden feet,' as marking their value as land improvers. Nor should the other characteristics which turnip cropping has introduced into light-land farming, such as the use of a wide range of artificial manures, and the necessity of careful mechanical treatment, be overlooked in estimating the causes of this remarkable change. Other methods, such as green manuring, which supplies organic or nitrogenous constituents, and marling and claying, have also had greater or less influence in the same direction. Such may be taken as a brief *resumé* of the general treatment of light lands of what may be called the ordinary or normal class. In one sentence, it may be said that the nearer, whatever be the mode of treatment adopted, the soil is brought by it to the condition of a clayey loam, the better will be the results and the higher its ultimate value, for this may be said to be the best and most generally useful of all our soils, and that adapted to the system of mixed husbandry, as to the value of which we have elsewhere given a remark or two.

Certain soils require the use of certain implements, without which no good can be done in their cultivation. Thus, in the case of sandy soils, the roller may be considered the chief anchor of the farmer. These soils are eminently deficient in compactness of mechanical texture, admitting, therefore, the rapid passing away of moisture which the plants require, while at the same time they do not afford that firm seed-bed which is necessary in order to enable the seeds to germinate properly. Without compression, the soil lies so loosely that it does not come in contact sufficiently with the seeds, so that many miss, and a poor braird is the result; hence the value of rolling and of sheep-folding, already alluded to.

Admixture of Soils as a Means of Improving Light Lands.—From the nature of the soil, it is of

course nearly, if not wholly, deficient in alumina. The system of admixture of soils, to which we have alluded in another chapter, may be carried out by applying marl, which has a highly beneficial influence on sandy soils; where marl is not to be had within easy distance, clay, if that alone can be obtained, may be used, and if this be somewhat deficient in lime, this may be added, the lime being slaked in small heaps over the surface of the land, as elsewhere described. Although marl under certain conditions is the best and richest mixing for sandy soils, the clay may be what is called a marly clay, this being the next best. When there is much alumina present in the clay, it will give considerable firmness, and will increase its retentive properties to a greater degree than when alumina is present in small proportion. As a general rule, which may be safely followed in choosing a clay for the consolidation of light lands, when the clay is plastic or capable of being moulded or worked by the hand, and has more or less of an oily or greasy character, if the term may be used, the clay may be pronounced good. But where the clay is sandy, destroying more or less this plasticity, and of light colour, its good effects will be proportionately lessened; but if the clay be red in colour and has iron in its composition, or if it be what is called ochreous, its influence on the soil will be decidedly injurious. The quantity or weight of clay applied per acre will obviously depend upon the character of the soil; the poorer this is, the heavier the dressing—it may range from sixty cartloads per acre up to double the number. The improvement of light soils by the use of clay will be gone into more fully farther on.

Green Manuring and other Systems as Improvers of Light Soils.—Another method, we have already noticed as of high value, of improving light lands and preparing them for cropping, is the growing of certain green crops and then ploughing them in at the period when they are about to flower. When the soil is sufficiently good to furnish light loam,—say to produce a crop of clover, which, however, will require the soil to be heavily manured,—this may be pastured in the spring, and when eaten moderately well down, it should be allowed to grow again. When the growth is pretty good, say about Martinmas, the crop should

be ploughed deeply in, and the land allowed to rest for five or six weeks, then well harrowed and cross-harrowed about a fortnight after, when a green crop suited to the soil may be taken. But when the soil is poorer than above noticed, better results will be obtained by abstaining from pasturing, and ploughing in the clover when the plants are in full flower. When the soil is so poor as not to be capable of producing clover, then such crops should be taken as it will bear, as rape, white mustard, spurry, and leafy, stalky plants, and these should be ploughed in. This green manuring may have to be repeated before the soil is fit to produce clover, which may be said to be the turning-point in the improvement of the poorest class of light soils. The first crop of this is also to be ploughed in, after which regular cropping may, with fair certainty of good results, be proceeded with. Of the mineral manures useful for sandy soils which have to grow grains as well as green crops, phosphates, gypsum, salt, and artificial manure containing phosphates are required. Of what may be called the vegetable manures, we need scarcely say that farm-yard dung is the best for light, sandy soils, and this is the most valuable when obtained from live stock fed upon a mixed food, of which grains and oilcakes form a part.

As regards the cropping, attention should be paid, especially when first bringing sandy soils into cultivation, to the choosing of plants which will tend to consolidate the land, while at the same time they are in themselves capable of best withstanding the natural dryness of the soil. Of this class, red clover is perhaps the best to use. By the system now described, poor light soils, which are generally considered hopelessly sterile, can be changed into those with all the characteristics of fertile ones; and just as heavy clay lands have been given up for want of a good system, so also has many a tract of light land, but which under proper cultivation has afterwards been made a source of wealth to a succeeding farmer. In the chapter on 'Reclamation of Waste Land,' the reader will find descriptions of the methods of treatment for other classes of light land of the poorest character; and should he wish to come across practical examples, and learn some lessons of practical value, of what

can be done in the conversion of sandy land of the extremest character of poverty, he cannot do better than visit certain districts of the Continent, of which, perhaps, the best is that known as the Campinès in Belgium.

Where *sandy land is covered with heath*, the first process in its improvement or reclamation is paring and burning the heath and other plants. This is essential; ploughing them in should never or rarely be resorted to. The best crop to take after the land has been ploughed with a shallow furrow is oats, which should be ploughed in green; or, if the crop be got in early enough, it may be allowed to die off naturally, and then the land cross ploughed, and allowed to remain till the following spring, when turnips may be folded off with sheep in October, after which the land is again ploughed and allowed to lie till spring. Lime in a light dressing is then applied, when a second crop of turnips is again taken, and again folded. If for permanent pasture (see succeeding chapter on 'Grass Lands'), the land after ploughing is sown down, but without a corn crop; and if a little rape is added to the grass seed, the pasture is improved.

Clay Top-dressings as Improvers of Light Soils.

—In cultivating light land of what may be called the extreme sort, such as that which most would call sandy waste land, growing heather, worthless weeds, and in its best parts gorse, furze, or whins, clay top-dressings, as have been already noticed, have been used in some instances with remarkable success. A good example may be here noticed, which occurred in Devonshire. The extent of land was about sixty acres, which was enclosed, and eleven acres were first taken in hand. The surface was pared and burned, and a crop of turnips taken, followed by one of oats, after which the land was well manured; then a second crop of turnips was taken, followed by a second one of oats, with which clover and artificial grasses were sown, but the grass crop from these was a failure. The employment of clay in the after cultivation of the land was the result purely of an accident, so to call it, but which was observed in its effects, and a valuable lesson learned. We name it here as showing the value of the habit of observing. Light sandy soil very frequently is underlaid by a stratum of clay or

marly clay, the depth from the surface of which varies very much; the indication of this is in some cases met with by the clay cropping out at some particular part, often at a natural depression of the land. When a well, therefore, had been sunk on the farm now under notice, the soil taken from it was found to be of a clayey or marly character. This was ultimately carted on the field, there unloaded, and spread over a certain part in a very irregular manner, the object being simply to relieve the roadside from a substance *considered to be of no value*. The crop succeeding this chance application of the clay was oats; when this was taken off, Mr. Gould noticed that the part of the field on which the clay had been spread, or rather thrown down, was nearly double in produce as compared with the rest of the field, being as fifty to thirty bushels per acre. The next crop of grass seeds showed a still more remarkable improvement; while on the part of the field destitute of the clay not a single plant had come up, on those parts on which the clay had been unloaded an excellent crop of clover and other grasses was obtained. The farmer, Mr. Gould, being now convinced of the value of the clay, had it applied at the rate of forty loads per acre twice in sixteen years, and ever since he has not failed in obtaining good crops of oats and turnips, nor has he experienced a single failure in the grasses. We may here remark in passing, that this case affords an admirably striking example of the value of what so many despise, namely, what they somewhat sneeringly call 'book farming' or 'learning.' For had even the most elementary of books on farming—one, of course, written by one who knew his subject—been consulted, the value of a mixture of heavy with light soils would have been seen at once. So that in place of the clay being considered as of 'no value,' it would have been treated as a discovery of 'great value,' and an instance of what would often be met with if looked for,—that the very substance required to improve bad land is to be had under or near it.

Where the soil is of the very lightest character, opposite, however, to that named in the last paragraph, such as *peaty reclaimed land*, clay may also be used with remarkably good effect. A very good example of its use is met with in the

bog land of Whittlesea Mere. Here the soil consists mainly of lumps of fibrous and nearly wholly vegetable peat, having no sand in it. This dry, fibrous, 'towey'-looking material, is underlaid with two strata, differing greatly in character; the one immediately under the surface stratum consists of a dry, hard, red peat, known as 'moor,' through which the roots of plants appear incapable of penetrating; the third or lowest stratum becomes of a soft, dark, and greasy clayey character, which is fairly fertile when brought up and put under cultivation. The depth of the first stratum is about twelve inches, that of the second, ten to eighteen inches. In cultivating this land, this hard stratum of 'moor' deep subsoil is sought to be got rid of by ploughing; and, repeated at intervals, the hard moor is brought gradually to the surface, where it is burned after being raked into heaps, till, finally, the stratum is broken up, and the roots of the crops which are afterwards grown are able to penetrate to the third and richer stratum below. The clay spread over the surface, to a depth of three and a half to four inches, readily amalgamates with the top soil, and firms in time a rich and fertile mould. When the land has been clayed, the breaking up of the moor or second stratum must be done gradually, for extra deep ploughings following too quickly upon one another are apt to result in the loss of the clay. We should consider that the use of Fowler's steam-dragged grubber, known as the 'patent knifer,' would be of remarkable service in land of this description, for it would break up the most obdurate subsoil to the depth of actually twenty-four inches, without bringing any of it to the surface, and consequently without disturbing the clay top-dressing. After the clayed land has been under cultural treatment for some time, the best crop to be taken is found to be cole seed, this being sown early in July. This is eaten off with sheep, which have, in addition, a supply of oilcake; the land is then ploughed in winter as the weather permits, the succeeding crop being oats, which should, however, not be sown too early in the spring, as they are apt on such soil to be injured by frosts. In May the land is sown down with grass seeds, red and white clover, timothy, parsley, trifolium, Pacey, and Italian rye-grass. The seeds should be down

only for a year, as it is found that, if kept for a second, the crop not only deteriorates, but the land loses from want of the regular cultivation and the consequent mixing of the soil. Artificial manures are only used to advantage after the land has been brought into fairly good heart. Such may be taken as a system of treating land of this description in which sand is not present.

In the *ordinary or general classes of light land*, the five-course system of cropping is generally adopted. One which is largely practised in northern districts, where the climate is moist and the normal temperature comparatively low, is—first, turnips; second, barley and wheat; third, grass, partly mown; fourth, grass pastured; fifth, oats. A four-course system for light land in a drier and warmer climate is—first, turnips; second, barley; third, clover; fourth, wheat. In light peaty soils the rotation is a six-course, a good one being—first, turnips; second, rye; third, fourth, and fifth years, grass, all pastured; and the sixth, oats. One of our best authorities in light land cultivation, for rich, black, boggy soil recommends a modification of the last-named rotation, consisting in allowing the grass to lie two years only in place of three; and he has found, contrary to general opinion, that this soil yields increased produce in the grain crops where farm-yard manure is applied. For light, flint, chalky soils, the same authority recommends this rotation—first, clover; second, wheat; third, turnips; fourth, oats; fifth, vetches and rye—successional crops fed off; sixth, barley or oats; seventh, mangold.

Culture of Root Crops on Light Lands.—It does not come within the scope of the present work to enter into minute cultural details; but a notice of the following points, which sometimes are not attended to sufficiently, may be of some service here, and our remarks will apply in a great measure to root crops generally. What we have elsewhere stated as to the working of the land only when in proper condition, valuable as it is for cereal crops, is even more so, if that be possible, for the root crops of spring, it being absolutely essential for these that the soil should be of the finest possible tilth, and as deeply stirred as possible. This is obvious if one considers the habits of the plants, especially in the

case of those crops which have long tapering roots, such as mangold-wurzel, the parsnip, and the carrot. Nor is it less necessary in the case of the turnip, which, although taking its bulk more in a lateral direction than those above-named roots, is nevertheless wonderfully influenced in its development by the state of the soil in which it grows. When roots are not free to develop themselves or to grow in the natural direction in which they can best add to their bulk, abnormal growth is induced, such as contorted, twisted, or bulging parts. Now when growth of this kind occurs, it will be found that the character of the flesh, so to say, is changed more or less for the worse, it having a tendency to get hard and woody; or, as in the case of the turnip more especially, soft and rotten, closely resembling that state which the root assumes when affected by the disease known as the anbury; or the same root will show both of those conditions. Indeed, we have more than once, as the result of repeated observation, and direct experiments made to prove the point, directed attention to the conjecture that the latter disease, as well as that of finger-and-toe, is not seldom caused by the mechanical condition of the soil in which the roots grow. The conjecture may possess value, but at all events it is worth while for those who grow the root to pay some attention to the matter, to see whether it be so or not. Certainly, the common-sense view of the case cannot be disputed, that, while the roots have a natural growth, it is more likely that their ultimate produce will be more in its natural or sound healthy condition, than when this natural growth is by any means prevented. These are not the times for farmers to lose anything—they lose enough by causes over which they have no control; it is well that they should try to prevent loss by those which they may in a degree more or less avoid. Another point connected with the preparation of the land for root crops is the condition of the manure. Long or strawy or fresh manure should not be used, when short, well rotted, or old can be obtained. The caution here given is obvious, and for the reasons named above, as to the mechanical condition of the soil, and the influence it has upon the roots growing.

Turnip Soils.—A soil, then, easily worked into a good tilth, having considerable depth, free in its particles, well drained so as to carry off superfluous moisture, yet such as to retain a fair amount of it in order to give (on the first sowing) the plants a good start, and to maintain them in full vigour till the critical time when they are liable to be attacked by ‘the fly’ be passed, are the chief characteristics of a turnip soil. All this betokens the outlay of no small degree of care in the working of the soil; and the nearer its condition approaches to that of a stiff one, the higher must that degree of care be. Freedom from weeds is also essential, and to secure this, workings, repeated in number and efficiency according to the nature of the soil and its foulness, will require to be made. So particular are some farmers to procure a clean, well-worked, and deep soil, that they will go through a series of operations which others would and do think a waste of time; but it is not, as the produce of their fields afterwards shows. In moderately free land, tolerably clean, a good plan is to give it a good deep grubbing as soon as the preceding crop has been taken off, and the sooner this is done the better; then a cross grubbing, thereafter throwing up the soil into ridges, and spreading the manure. It is, however, a disputed point whether the winter is better than spring manuring. And, finally, covering up the manure with the double mould-board plough, and leaving it there in ridges for the winter. The higher or deeper those are left the better. In the spring the ridges are well harrowed down, and the seed sown on either the ‘flat’ or the ‘drill’ system. This is the practice of those who do not approve of autumn manuring for the root crop; it would be modified by applying the manure in the spring, in the ordinary way in root cultivation. We have thus run over a few points of some importance in connection with the cultivation of light lands, and have, we trust, shown how by systematic efforts not only may the lands of this class now under culture be greatly improved, but considerable tracts, which are at present lying useless or nearly so, may be brought to bear crops of increasing value, and thus add to the revenue of the property on which they are situated.

CHAPTER III.

A FEW SUGGESTIONS ON THE IMPROVEMENT OF OLD AND THE LAYING DOWN OF NEW GRASS LANDS, THE CONVERSION OF OLD GRASS INTO ARABLE LAND, AND THE CONVERSION OF PASTURE INTO ARABLE.

General Considerations.—There is no subject, scarcely, in the wide range of agricultural topics which has been so much discussed of late years as the question of grass lands as against arable. Some maintain that the best interests of the farmer are consulted by devoting the most of his attention to arable culture, getting rid actually to a large extent of such old grass lands as he may have, putting them under crops; preserving only the minimum area of grass land for sheep, or for an occasional exercise ground for cattle, which, under this system, he maintains, of course, on the soiling method, or in yards, boxes, or hammels. Others hold quite the converse of this, and believe that, as the future progress of British agriculture depends upon the increase of live stock, and that increase as they say on that of grass land, the farmer should add to the extent of this as largely as possible. A third class adopts the medium course, and advocates a system in which there is a due balance maintained between the grass lands and the arable, which balance is regulated by the circumstances of locality, style of farming adopted, etc. This appears to be what one might call the common-sense system; at all events, it possesses the advantages which a middle course between two extreme ones generally has. But whether this be so or not, or which of the three systems is the best, we do not now stop to inquire; all, we think, will be agreed upon this, that whoever has good old grass lands, it is a wise plan to have them in the best of possible order; or if he changes his arable fields into pasture, he should do this in the best and most economical way. This way of stating the matter may appear to some superfluous, but it will scarcely be considered so if one looks, on the one hand,

on the bad condition in which too many of our pastures are, or, on the other, on the careless, hap-hazard way in which arable is changed into grass land. Common-sense rules are not always dealt with or attended to in a common-sense way.

Defective Systems of Treating and Using Grass Lands, Pasture and Meadow.—Intended to grow grasses,—we are now considering permanent pasture land,—it would seem as if many thought that the real object is to produce weeds, at least as part of the crop; and even where weeds are not allowed, to give undue prominence to the grasses which are not of the kind required, or useless varieties of natural grasses. And even in cases where, from some influence or another, good varieties are put down at some time, these are not maintained up to their full productive capabilities by proper attention afterwards. Left to grow as they list, they gradually deteriorate and die out; whilst the useless natural grasses once more resume their old places, so that the condition is just as bad as before. Further, little or no attention is paid in too many instances to what might be called the system of utilizing the products of grass lands. Many, indeed, seem to have no notion whatever, in the case of permanent pastures, that there is a right and a wrong way of stocking them. But this point is one, nevertheless, of great importance, for by a judicious system of feeding the stock which are put into the fields, the grasses not only go farther as food, but they have the best, or at least a better, chance of being more productive. Thus pasture lands are, as a rule, overstocked, the plants being cropped too closely, while few opportunities are given to them of resting, so as to permit their recupera-

tive powers to come into play. But even in cases where there is a desire to improve permanent grass land by manuring, for example, with 'artificial,' this is done in such a haphazard way, without special reference to the soil, climate, and varieties grown, that these, in place of being made more productive, are injured to a greater or a less extent. Taking now the case of meadow grass lands, we find, although, of course, in different directions, the same indifference as to productive results too often displayed. Few or no attempts are made to get rid of weeds; or, if these be occasionally made, the work is done in such a perfunctory way that there is little good effected. The result is, that in not a few instances the weeds obtain such a mastery over the grasses, that it is difficult to say which of the two is really the crop which the land is designed to bear. We have seen meadows with the whole surface absolutely red with the ripened seeds of the dock; or, like the garden of the 'sluggard,' choked with thistles. Again, the grasses sown from time to time where renovation is attempted, are so carelessly selected as regards their relation to the soil, that the crops are of the poorest, while the varieties themselves are not those which yield the most nutritious hay. Still further, the grasses are allowed to remain too long on the land, so that their nutritive qualities are greatly deteriorated, while the soil itself has much of its fertilizing constituents uselessly taken from it. All these and other points, to which reference will presently be made, will suffice to show that the subject is one in connection with which a vast deal remains to be done before it is put on a proper, practically sound basis. And it is rendered of still greater moment when we consider that the practice of extending the acreage of land under grass has increased of late, is still increasing, and is likely from all appearances to increase even more in the future. It is difficult, indeed, to understand, seeing the great importance of the subject, how it has been and is so much neglected in so many districts and by so many farmers. We hear daily of the difficulties which a farmer meets with in procuring food for his stock, which stock many are desirous to increase, in view of the larger demand for butchers' meat throughout the

kingdom, and the low prices obtained from wheat; and yet the marvel is, that so many farmers are met with who find it a difficult matter not only to name the distinction between the good and the bad grasses, and their relative feeding properties, but to describe, if asked to do so, the best method of treating and making the most of them.

Importance of a Knowledge of Grasses.—No doubt this may be said to be of the high order of knowledge, which is not possessed even by those who, from their position in the scientific world, should be able to distinguish between the different kinds. But, in truth, so far as the practical farmer is concerned, this knowledge is of comparatively easy attainment, inasmuch as, out of the immense variety of grasses grown, or which grow in our island, the number of those which are really useful is very limited indeed. This fact ought to weigh with those who are specially interested in increasing the supply of food obtainable from grass lands, in endeavouring to gain some precise information, even if that did not extend to all points bearing upon the subject. A good deal can be learned by mere observation in the farmer's own locality. By exercising this habit, he could soon be able to distinguish the varieties, and to know which of them would be best calculated to suit his soil, climate, etc.; and even by noticing examples of bad farming, he might learn much as to 'how not to do it.' On the other hand, we conceive that the farmers of the kingdom would be greatly benefited if one or other, if not all, of our leading agricultural societies would take up this subject, and have a *vidimus* of all its points drawn up. Another good movement would be to devote a small space in farmers' club-rooms, which would suffice to display actual specimens of the grasses best to be grown to suit the soils and climates of the special localities.

Practical Improvement of Grass Lands.—But whether or not the farmer interested in making the most of his grass lands should elect, or think it worth his while, to make the points we have alluded to the objects of his special study, he certainly has it in his power vastly to improve their condition, by means which come clearly within the range of his practical work. Some men are so afraid of being theorists,

that nothing will induce them to go beyond the lines of their daily practice, forgetting, however, what theory has done for them. In this practice there are a variety of points to be considered, in all of which he can, as we have said, do much,—by keeping the land clean and free from weeds; by the judicious use of proper manures; and, in the case of putting down arable land to grass, or in the renovation of old fields, by the exercise of extreme carefulness in the previous cropping and preparation of the land. In the department of keeping the land clean and free from weeds, there is much to be done, which, if done thoroughly, would of itself alone raise the condition of large tracts of grass land, now in every sense a disgrace to British farming, and the cause of enormous loss to farmers, to a higher and more productive position.

In connection with this discussion, recent statistics and inquiries have produced facts pregnant with meaning; and, indeed, give rise to the most painful surmises regarding the future progress, or rather condition, of British agriculture. While year after year more land is converted from arable into pasture, during the last three years, notwithstanding, our herds of cattle and flocks of sheep have steadily decreased. This, with lessened and lessening corn crops, with other circumstances obvious more or less to our practical readers, has made the employment of labour much less than it was. To some, therefore, this unfortunate conjunction of circumstances seems to foreshadow the time when British agriculture, compared with what it has been and now is, will be but a mere name, and, in the dreary prophecy of a writer, 'must slowly die out.' Surely brighter things are in store for us; and the explanation of the above-quoted writer cannot be the correct one—namely, that it 'must be either the ignorance and unskilfulness of our farmers, or special disadvantages of some kind, such as dear labour, excessive rents, or unwise restrictions. The matter is of the very highest moment to the nation, for the soil on which we live is the endowment of nature; and if we fail to turn it to the best account, we are wasting the national resources, and squandering abroad the wealth that ought to enrich ourselves.' Since writing the above, the 'Agricultural Returns' for the present

year (1878) have been issued, and the facts and figures they furnish tend very materially to modify the conclusions come to by the writer above quoted. Not only, under the influence of a season specially favourable for the grass and hay crops, and a much lessened amount of cattle disease, has the decrease in the number of cattle of the kingdom above referred to ceased, but, better still, there is an actual increase to the extent of one per cent., chiefly in the young cattle—that is, under two years old. Horses have also slightly increased; as also lambs, although the number of sheep is less. This, however, is satisfactorily accounted for by the fact that the season was so favourable that they were got ready for market earlier than usual. Wheat, although under the average, shows, however, an increase over last, and a still greater over the preceding year. The conversion of arable land into grass land still continues, and its necessity is maintained by eminent authorities. Notwithstanding the gradual increase of stock-keeping and of consequent pasturage, the proportion of arable to grass land shows so high in Scotland—considered *par excellence* the land of good and high farming—as three of the arable to one of the pasture; in England it is lower, being as thirteen and a half million acres arable to eleven of pasturage. The gloomy anticipations of the author we have quoted are, however, shared in still by many. Some of our highest authorities point out that not for a long time, if ever, have so many farms been offered as now, and that, moreover, in the best cultivated districts. Some go the length of saying that a complete revolution in the economics of farming must be brought about before things mend—that we live in transition times. We may in a succeeding paragraph or two further follow up this train of suggestion and thought, meanwhile leaving it to be illustrated by what we have already stated.

Drainage of Grass Lands.—In further considering the subject in the general way we propose to do, we shall take up first that department which concerns itself with the improvement of grass lands, which from one cause or another have been allowed to deteriorate. This evidently assumes that the lands at one period or another have been in good condi-

tion. And in connection with this there is perhaps no fact more surrounded with obscure points than this—that of lands, as far as one is able to judge, of the same degree of fertility, and situated equally favourably in point of locality and climate, the one goes on increasing in, or at least keeping up, its productiveness, while the other shows the very opposite results. We know, however, sufficient to enable us to decide as to what should be done under what we may call average circumstances, and these are not of such difficult attainment as to make farmers fear to do it. We presume that in the two cases above alluded to the land has been primarily drained; but if this has not been done, it will be idle to expect that other improving operations will yield their best results. Drainage, then, on all classes of soil is the first essential; although, if any can be left undrained, heavy clay soils, or, indeed, clayey soils of all varieties, do not come within this category, drainage being with them imperative. But we maintain, nevertheless, that it is so in all soils, although the drainage differs in detail, as regards distances between the drains and their respective depths. In the absence of plans of the fields in which the drains would be indicated, it is a matter of comparative ease to decide whether grass lands have or have not been drained. Want of drainage is generally shown by the presence of coarse and rank herbage, and of aquatic plants such as rushes. The depth of, and the distances between, drains must be decided by circumstances, and the farmer may on these points gain a hint or two by observation in his own locality. An authority gives the following, which may be taken as the basis of a guide to the farmer draining his land:—‘The distances or intervals between the drains in feet of the following soils is shown by the letters *int.* following the figures, and the depths, in inches, by the letter *d.* 1. Gravelly and sandy soils, 50 to 75 (*int.*), 5 to 7 (*d.*); 2. Clayey land with porous subsoil, 30 to 36 (*int.*), 46 (*d.*); 3. Strong clay, 24 to 30 (*int.*), 54 (*d.*); 4. Very stiff clay, 18 to 21 (*int.*), 42 (*d.*).’ The stronger the soil, the more numerous should the drains be, the object being the opening up and making porous the soil by the action of the air, carried down to and through it by the drains, and the

drainage water passing through these. In other chapters we have pointed out the great benefits accruing to the soil by admitting atmospheric influences to operate upon it. This, in the case of arable land, is done by stirring and opening up the soil in addition to the action of the drains; but in land under grass it is effected through the agency of the latter alone, hence the necessity for having it done thoroughly well.

Weeding and Manuring of Grass Lands.—The drainage, then, is the most important, as it is the first of the improving operations; being carried out, we glance at the next to follow. These will vary in kind and character according to the condition in which the grass lands are. If they be much infested with a thick undergrowth of thick, coarse, and innutritious grasses and fog, an excellent plan to get rid of this is by mowing it off as closely as possible. Some get rid of this and open up the upper soil to the beneficial action of the air, exposing much soil to this which has long been deprived of it, by running one or more turns of a scarifier or light grubber over the land. The stuff loosened, some allow to remain on the surface and to act as a manure. We by no means, however, recommend this plan, as the rough grasses and weeds do not so readily decay, but, on the contrary, much more easily take root again, more or less extensively. The better way is to clear them all off the land and burn them, taking the ashes to the compost-heap. This is the only true method of getting rid of weeds, which have an extraordinary vitality. When the land has been thus mown down, scarified, or grubbed up, it should be top-dressed with a manure. As to manures used for grass lands, a vast deal has been written and a wide variety of opinions given; but on all hands nearly it is admitted that there is one which possesses nearly all the qualities desired, that is, crushed or ground bones. This is applied in several ways. When used in the ‘raw’ or natural condition, it is only crushed or broken into small fragments, or ground into a coarse powder, and when thus applied as a top-dressing, at the rate of 6 to 8 cwt. per acre, will last for several years. Some prefer the bones to be made into a fine powder, or a true superphosphate, by

the application of sulphuric acid. The results of the above application are, in the great majority of cases of old deteriorated land, simply remarkable; they must be seen to be believed by those who have had no experience of their use.

Other manures are used, such as farm-yard dung and artificial manures; but in the use of the latter, such as nitrate of soda, great caution must be observed, for although nitrogenous manures have a wonderful effect at first, and even for a year or two, in increasing the weight of grass, still that effect is in the long run injurious. One effect, however, of some of those nitrogenous manures is, that they have a tendency to rid the land of weeds. Nitrate of soda, for example, seems to exercise a very striking influence in this way. We have applied it to land infested to a fearful extent with the dock weed, the soil being a pretty heavy clay; one application at the rate of about 3 cwts. to the acre nearly cleared the land of the weeds, and they almost wholly disappeared by the second season. As considerable uncertainty exists as to the action of various artificial manures on certain soils and under certain conditions of climate and locality, and as it is therefore not easy to predicate results, so as even to expect the same in one season from trials which have been carried out in precisely the same way as a preceding one, it will not be lost time to make some experiments or to institute investigations into the character and action of artificial manures before they are used on the large scale systematically. For it is not with them always as in the case of bones, of which there need not be any fear as to their action being prejudicial, no matter what the climate or soil may be. This, however, must be taken with a reservation, inasmuch as bones, while still good for all soils, are best for heavy ones, those of a light character experiencing the least benefit; much, however, will depend upon circumstances influencing their relative value.

Of what may be called ordinary or natural manures, farm-yard dung is the best known and most generally employed. At the rate of 12 to 15 or even 20 loads per acre, applied every five years, the results obtained will be good. The manure made in compost-heaps is also valuable as a top-dressing, but care must be taken not to use in their material anything likely to be

infested with weeds. The soil from old hedge bottoms will, as well as that taken from the outer edge nearest ditches of the 'headlands,' form a most valuable manurial material for mixing with composts, or even as a top-dressing for lands. But these soils are generally much infested with weeds. These are generally attempted to be destroyed by lime and salt, but such is their vitality that this is not always effectual. The true way is to get rid of them by burning them. The ashes form a valuable addition to the compost-heap. Used alone, indeed, ashes of vegetable matter, timber, etc., act very beneficially as a top-dressing for soils. Lime is an essential in top-dressings, especially where the land is wet, and the herbage coarse and rough. The quantity applied will vary, but from 3 to 4 tons per acre, with 3 to 4 cwts. of salt, the whole mixed up from the compost-heap, will form a good top-dressing.

Sheep Folding or Feeding on Grass Lands.—The folding of sheep on grass land is, however, the best of all the methods adopted of obtaining a top-dressing of a very valuable character; but this depends altogether upon the way in which the sheep are fed. If the half-starving system, as alluded to in another chapter, be the one adopted, assuredly the folding will not yield the highest results. If, as some think, the herbage on the field is sufficient for their feed, they have quite an erroneous view of what constitutes the real value of the method. Little feeding, surely, can be obtained from the herbage of land so deteriorated that the sheep are folded on it for the very purpose of improving it. This common-sense view of the method is too often quite overlooked. But where the sheep are liberally fed upon roots, hay, cake, etc., as explained in another chapter, then results almost equal to those obtained by the use of bones may be reasonably expected. Valuable, however, as a sheep top-dressing is, it should be remembered that it fails in that uniformity of application which can be secured by other methods of top-dressing; but by careful placing of the feeding stuffs so that all parts of the surface are visited by the sheep, this difficulty may be overcome. The manurial action of 'folding' is, however, not the only benefit received from it; for, just as in

the case of light soils in arable culture described in the preceding chapter, so in those under grass, the treading of the surface in certain conditions of it will be of the greatest benefit in consolidating the soil, and giving the roots of the grasses a firm hold of it. Folding, in such cases, may thus be considered as combining the benefits of rolling and manuring in one operation. Before leaving the subject of manures, it should be noted that it is a matter requiring special attention, their action varying, as already hinted at, in different soils. Thus, while we have spoken of bones as highly beneficial, the reader might suppose it was so in all cases; but there are certain soils in which this beneficial action is less marked, and, indeed, in some cases bones are absolutely useless applied to permanent pasture. This fact points to the necessity of carefully considering the application of manures, and still more clearly to the importance of having a scientific opinion as to their constituents, so that one may not be groping in the dark, so to say; a position very likely to be that of a farmer who trusts or holds to his own knowledge, or rather lack of it, in a matter so intricate and complicated. Nor can there be any excuse on his part for neglecting this obvious duty to himself, seeing that the two National Agricultural Societies in England and Scotland offer him every facility for ascertaining the nature and value of manures, and at the cheapest rate. Even if the expense were much greater than it is, the outlay would be as nothing when set against the heavy loss which would be incurred in using manures which were really not required, or which would be prejudicial. In referring to the use of farm-yard manure or dung, it may seem, from the brief remarks we made on it as a permanent top-dressing for grass lands, that it occupied but a second place in the rank of manures employed for this purpose. This, however, is not so; on the contrary, it occupies the very first rank, and is in every way entitled to be called a universal manure, containing, as it does, all the constituents which our cultivated crops of whatever kind require. There is scarcely any soil occupied by permanent grass, the subject now under consideration, to which occasional dressings of dung may not be applied with marked benefit. We refer

to a preceding paragraph for the quantities which may be applied. As to time, it may be put on either in autumn or spring. If in autumn, the dung should be new or long, that is, strawy; for, independently of the value of the manurial constituents, the straws act mechanically in a valuable way, affording shelter to the plants in a way very remarkable in its results. This feature of shelter should not be lost sight of. The dung, whether applied in autumn or spring, should, as we have said, be bush or chain harrowed in spring.

Before concluding this subject, we may state that we are inclined to think that changes in the manures applied will be beneficial. The late Professor Anderson pointed out, indeed, the probability of the time coming when a 'rotation of manures' would be as systematically carried out in farming as a rotation of crops. And there is every reason to believe this, when we consider why we have a rotation of crops. The same reasons may be safely assumed to exist in the case of manures, especially in permanent grass lands; for, the plants always drawing the same class or classes of constituents, the manure will leave those in the soil which are not demanded by the plants, and if the same manure be used, the result will be the accumulation in the soil of certain constituents. These are obviously not only lost, but the probability is that they injure the plants more or less; indeed, this is shown by the fact, well known to some observing practical farmers, that pasture land, fed regularly and continuously off, receives from the manure of the stock an accumulation of those constituents which the plants do not require. A gradual decline in the value of the herbage is the result. This, however, is not known to many, who attribute the decline to other causes. Doubtless these may exist also, but the influence of a manure continually applied is beyond a doubt prejudicial. Here the cure would evidently be to hit on some artificial manure which would so change the character of the accumulated constituents in the soil that they could be assimilated by the plants. Whether this could be done it is not within our province to say, but the circumstance now stated adds another to the many we have alluded to throughout this work, in proof of our state-

ment that farming is not quite the easy thing which some hold that it is, but that it closely demands the exercise of great skill and observation, and of a wide range of practical and theoretical knowledge.

Top-dressing Grass Lands with Soil.—In concluding these remarks on manuring of grass lands, we may notice the benefit often derived by *top-dressings of different soils* (see remarks on 'Admixture of Soils'). This has been singularly overlooked in this department of farming, but there is no question that they are no less valuable to pasture lands than they are to those under arable culture. The soil used for a top-dressing should have some definite relation to the soil of the pasture land—as, for example, if this be light, the dressing will be a heavy soil; still almost any kind of soil of good quality may be used with good effect on all pastures. If the dressing be clay or loamy clay, perhaps the best time for its application is either the late autumn or the early spring, and this in view of the additional advantage obtained by the shelter which the lumps or pieces of soil will give to the young plants,—a point of great importance, much overlooked, however. We should prefer the autumn application, inasmuch as the heavy-soil top-dressing will be reduced or will melt away, so that it can be spread over the surface when the bush harrowing is performed in spring. Light-soil dressings may be applied in early spring, and indeed at any period, when the pastures are getting what they ought to have occasionally—a rest from eating off. When once adopted, this method of treating pastures will not be given up, as its influence in producing rich and nutritious grasses is very marked.

Scarifying and Rolling Grass Lands.—We have referred to the scarifying of old lands as being very beneficial before the application of top-dressings,—so beneficial, indeed, that some recommend that the land should be well harrowed or gone over with a grass weed extirpator twice a year. Another cultural process of great value to grass lands is, we scarcely need to say, rolling. And still another, and what is a more radical one than scarifying or harrowing, is that of turning over the land with a somewhat shallow furrow, and taking thereafter one or two suitable crops pro-

perly manured, finally seeding the land with a mixture of seeds suited to the soil. This furrow process is, however, only done when the soil and the herbage it bears are of a poor character, such as hungry clay, the grass of which has been greatly neglected. Where the soil is of an opposite character, such as a poor sandy one, before ploughing it up a good heavy dressing of marl, or, failing the easy obtaining of this, a marly clay, or even clay, should be applied, and ploughed in. This will be found very beneficial.

Turning over of Grass Lands.—One point in connection with the turning over of grass land with the plough, as above noticed, cannot be overlooked, and that is, that the tenant under covenant is as a rule, with few exceptions, not allowed to turn over land under grass. At first sight one would say that the object in view, namely, the renovation of the grass, would preclude the possibility of any objection being taken to the land being turned over, seeing that it was only to be two or three years under cropping. But although some landlords have such an objection to old grass land being touched at all with the plough, still we think that there are few who would object in a case like this, more especially where the process unmistakably would result in the improvement, not the deterioration, of the land. It should be remembered that in some cases grass land is dreadfully infested with weeds of such a kind that no other process but ploughing serves to eradicate them. There is yet another case demanding this thorough process—namely, fields which have been laid down as permanent grass lands, but with seeds of such a kind as to be quite unsuitable,—as, for example, grasses which only remain productive for a short term of years; these grasses, therefore, dying out, their place can only be taken by natural grasses and weeds,—grasses, very likely, chiefly of an un-nutritious kind. Some soils, again, although well seeded down, seem for some reason, generally very obscure, to lose their power of producing grasses, or at least of keeping them, even with good management, up to their productive power. Now in these cases ploughing is absolutely essential, unless the grass lands are to be allowed to remain unimproved. The case, so far

as ploughing, etc. is concerned, assumes a different aspect when

Grass Land is to be converted into Arable, which has formed the subject of many a long and warm discussion in agricultural circles, and on which, like all other farming topics, there has been and is great diversity of opinion. At present, however, the tendency of farming is chiefly in the opposite direction to this—namely, the conversion of arable into grass land. The fact is, however, that the two sway to and fro, as it were, in the farming mind—at one period one system kicking the beam, at another the opposite weighing most with farmers. This is easily to be accounted for, as it depends not upon any meaningless uncertainty as to which of the two systems is the best, but upon the fact that at one of the periods there happens to be a demand chiefly for corn, for example, live stock being at a discount, or *vice versa*. Now at present, and for some years back, live stock have taken the precedence of corn, cattle coming to the front, corn, to use a sporting phrase, being ‘nowhere.’ Much, therefore, as the farmers have been sneered at for not knowing their own mind in the matter, they seem to have known, and know it pretty well. They have done, in fact, what manufacturers have been and are in the habit of doing regularly; for when the fashion for one fabric has died out, they have turned their attention to another, and yet no one seems to have thought it necessary, desirable, or in good taste, to jeer at them for not having known what they were or are about. All changes, as a rule, in the then habitual course of proceeding, require to be brought about with due caution, and after consideration of the existing or likely circumstances of the case. And although changes are and can be made much more rapidly in manufacturing, there is something in the very nature of farming which, in view of changes, demands a slowness which seems at times to be the result of unnecessary timidity. There is a good deal to be said in favour of farmers for this, inasmuch as past experience has shown that fluctuations in the demand for farm produce are very frequent, and, indeed, constitute a regular feature of British agriculture; and it is therefore to be expected that some may think twice before carrying a change out, on the

ground that before the change is effected, and better paying results attained, the demand for the produce may have slackened, and another taken precedence.

On the whole, however, we should think the middle course the safest, and this involves the principle of a fair adjustment between the different systems. And one thing should never be forgotten, that the peculiarities of soils and climate must be taken into consideration. In some farms, for example, nay, indeed, in districts, and those large ones, nature, so to say, indicates what the leading features of the system should be; hence we find some are clearly designed for arable culture, while others are just as much so for grass lands; but in a large majority of cases the mixed husbandry system can be adopted. And this seems, when all things are considered, to be in the long run the safest for the farmer—that is, if there be any truth in the warning which the proverb gives us as to the danger of sending ‘all one’s cargo in a single ship,’ or ‘carrying the whole of our eggs in one basket.’

The conversion of grass land into arable, the subject at present under special consideration, is a change much more quickly carried out than the converse, which will presently engage our attention. And although the system would at first sight seem to be that quite opposed to the increase of live stock, and consequent demand for grass lands, which at present seems to be the tendency of British farming, it by no means follows that it is so. For, in considering the converse plan of turning arable land into grass for the production of food for live stock, one thing seems to have been greatly overlooked, if not ignored, in the majority of the discussions which have been carried on in a very lively way during the last few years. This point so overlooked is the ‘soiling system.’ In this the cattle are almost wholly housed. There is little need for us to say much on the subject of changing grass land into arable, as the process, comparatively a simple one, is known to most farmers. Some, of course, think the first crop ought to be of one kind, some another; some holding that the crop should be taken immediately after the land is ploughed up, others holding that a bare fallow should be first taken, in order to

give the soil all the benefit of those atmospheric influences which, being so long under grass, it has been largely deprived of, while at the same time the opportunity is afforded to get rid of the weeds. All these details will, of course, vary according to circumstances of soil, etc., heavy land obviously requiring different treatment to that which is very light. We pass on, therefore, to the

Conversion of Arable into Permanent Grass Land.

—On this there is much more which could be said, but we shall confine ourselves to the leading and most suggestive points.

In the remarks already made in this chapter, we have only incidentally alluded to grass lands which have been artificially made, so to say,—that is, seeded down according to a certain system upon a soil previously prepared,—and have chiefly confined them to the natural grass lands, which are the most justly entitled to the term ‘permanent,’ and which may be said to be the first class of grass lands. To the second class the term ‘made’ may be applied, being that now to be considered—namely, the *conversion of arable fields into permanent pastures*; and which term, if not absolutely correct, is more convenient to use in discussing the subject than the words we have just italicized. This term ‘made’ is also used to distinguish it and ‘permanent’ from what we may rank as the third class, and to which the term ‘artificial’ is generally applied—that is, those lands in the mixed husbandry system which come in the due course of its cropping to be seeded down for grass, which only occupies the land for a very limited period, according to the rotation adopted. These three distinctions or classes should be borne in mind by our non-practical readers. The natural grasses, which cover a very large percentage of the acreage of grass land in the kingdom, afford the farmer and grazier, in many instances, some of their best feeding-grounds. From a careful study of the characteristics of these, and, indeed, even of inferior classes of natural grass lands, a good many hints can be derived, which will be of practical value to the farmer about to convert arable into grass land. It is not always, of course, that these natural grasses yield information as to what should be done; they perhaps as frequently give the converse, as what should not be followed,

—as valuable in its way, be it noted, to the observant mind as the other.

Natural Selection in Grass Lands.—One lesson which can be learned from this observation of the ‘behaviour’ (to use a scientific technical term) of natural grasses is, that out of the wide range of varieties met in them, each particular class of soil selects, so to say, that variety best adapted to it. So also as regards locality and climate, thus indicating that in the laying down of ‘made’ grass lands, attention must be paid to those two points before the system to be adopted is decided upon. It is generally customary to consider the soil only, in selecting grasses, although in too many cases not even this solitary precaution is taken; but it is clear that climate and locality must be held as important factors in the problem to be solved. This is practically exemplified in the wide difference there is between the grasses which make up the herbage of one district as compared with another. A close observation of these different qualities of grass lands shows that the particular period of the year exercises a decided influence, if not actually in all cases in changing the varieties which appear,—although it does this,—at least in materially influencing their feeding value. In other words, there is a certain time at which each grass, or class of grasses, is at its best. Here, again, differences in soil and of locality come in to exert an influence, causing a wide diversity in this peculiarity. Again, while each soil and district has its own peculiar and most suitable varieties, certain kinds are to be met with in every district, thus giving a certain normal and similar feature to all the British grass lands, while at the same time each soil and district has its own distinguishing characteristic varieties. Still further, while this characteristic is observable, it is to be noted that the selection made, so to say, by the soil and locality, does not end when certain grasses known and considered to be beneficial as food are produced, for other plants, generally of an opposite character, are present in the field. These are generally considered more in the light of useless rather than useful plants, and to be got rid of. But closer investigations seem to point to this, that those so-called weeds form an important element in the economy of the herbage,

as enabling the useful grasses to perform all the functions necessary to make them in the highest degree productive. Moreover, it seems to be beyond a doubt that many of those extraneous plants or 'weeds'—so called generally—when taken off by stock, exercise an important influence on the health of these, each plant having its own dietetic or physiological value.

Value of so-called 'Weeds' present in Grass Lands.
—Indeed, some of our most advanced observers and scientists hold that it is to the presence of these very plants or 'weeds' that much of the peculiar and valuable feeding properties of the natural grazing lands of the kingdom is owing. Some writers in this view designate them as the 'condimental' plants of natural herbage. Others give them a double character, 'condimental and medicinal.' There seems to be no doubt that a large number of those extraneous plants are mere 'weeds,' which go far to deteriorate the feeding qualities of the herbage; but, on the other hand, there is as little doubt that several of them really possess the valuable qualities above claimed for them. Many facts discovered by patient observers go to prove this; and we all know that different animals have different likings, one class of live stock taking those which another class rejects. A very familiar illustration of the fact that some grasses are medicinal is found in the case of the dog, who is well known to go to the twitch or couch grass when he feels that he requires a 'dose to set himself to rights.' The whole subject is, indeed, one full of great scientific interest, and its investigation would well repay the patient scientist, and which would result in much that would possess high value to the practical feeder. There are several other points in connection with the subject; but we have said enough to show that it is one which demands, on the part of the farmer, a special knowledge and the exercise of habits of the closest observation, before he can be said to be master of it, or able to decide as to the best system to be pursued in converting arable into permanent grass land. Beyond a doubt, there are many points which have never been dreamt of as possessed of any value, but which are nevertheless of the highest practical importance. To some of these we have above directly alluded, while we

have, at the same time, indirectly alluded to the way in which others may be observed, and which are probably not less valuable. We have much to learn on the whole subject, although few will go quite the length of a high authority, who says 'that, in view of what is yet to be known and practised, we know nothing about grasses and their attendant plants; what to grow, and how to grow them, and their dietetic and physiological qualities.'

Condition of Land necessary for 'made' Pastures.
—In laying down arable land to permanent grasses, it should be taken as an axiom, that soils which have produced inferior crops when under arable, will yield the same when under grass land culture, other things being equal. This evidently involves, as a direct lesson, that land must be in the highest condition, capable of producing the best crops suitable to the soil, before conversion into permanent grass; and secondly, that it is of no use to put down to grass, lands which are poor as arable, in the hope that the mere conversion will effect the desired improvement. The one lesson, indeed, is a corollary to the other. Again, in the selection of the seeds, it is essential that these be not only suitable to the soil, the climate, and locality (on which point see preceding remarks), but that they be true to their kind, sound, and free from weed seeds, etc. These points are of such a commonplace character, that some readers may think that mention of them might be dispensed with; but commonplace as they are, they are so frequently and completely overlooked or neglected, that it may be safely said that to this alone is due the existence of such a wide acreage of miserably poor grass land throughout the kingdom. On the point of seed alone, to save a few shillings or a little extra trouble, the most trashy mixtures are bought and used. Good soils, thorough preparation and cleaning of them during the previous cropping, and the best quality and variety of seeds, are the three primary essentials in the conversion of arable into permanent grass land. These three being conceded, all the other points of detail should follow naturally. Indeed, many of them are, so to say, bound up or comprised within them.

Thus, for example, drainage, which is an

essential point to be attended to in grass land culture, will or should have been previously done while the land was under arable culture. Of course, there are instances in which land is *de novo* laid down for permanent pasture; and in such, drainage is the first operation. On this we have given remarks while treating of the improvement of inferior lands, to which we refer the reader. But on this point there is considerable diversity of opinion,—some maintaining that drainage cannot be too thoroughly carried out, and for reasons we have already explained; while others hold, if not quite the converse, at least something approaching to it—at all events that grass land requires much less thorough drainage than arable. We believe, however, that the extent to which drainage should be carried out will depend upon the soil, climate, &c. Thorough cleanliness of the land—that is, freedom from weeds—is another essential condition. This, so far as arable land is concerned, is involved in the first lesson which we pointed out in the beginning of the last paragraph but one; for weedy land is not compatible with first-class crops. But in the case of lands laid down *de novo* to permanent pasture, this cleaning of the land will be dependent, as to the method to be pursued, on the nature of the soil; so also will the cropping to which the land is subjected previous to laying down the grasses; but with the details of this cropping we do not here concern ourselves, referring the reader to works specially devoted to the cultural and other details of farming. The after management of the grass land, when once fairly established, will, like the cropping, depend upon circumstances; but much of what we have already said under the head of renovation of old pasture will apply here.

From what we have said at the commencement of our treatment of this subject, it will be seen that the conversion of land into permanent pasture is a work demanding the exercise of no small amount of special knowledge and skill on the part of the farmer undertaking it. More than this, slow as at the quickest all cultural processes are when compared with the rapid ones of other industrial callings, and patient, therefore, as the farmer must be before their

results can be known, there is no department of his labours by which his patience will be so much tried. For, before the results of the complicated and costly labours which the work demands can be known in their highest and most productive condition, years must elapse, if not indeed, as in some instances, the best part of his working lifetime. The few lines which now remain to us will be usefully filled by some notes on

The Management of Hill Pastures.—As our readers know, there are large tracts of uplands bearing herbage more or less nutritious in character, which from situation, &c., can only be devoted to the pasturing of sheep; and in the lower parts, where these join the lower levels, and circumstances are favourable, for the feeding of cattle. While a considerable proportion of these lands afford a pretty good supply of productive grasses, still a large acreage is in a condition capable of very great improvement. Drainage of the higher parts of such land is of a much more simple character than that of soils in lowland districts, simply consisting of a series of open channels cut in the surface soil, leading in various directions across the face of the hills to a proper outlet at its base, where, in some instances, the water may be utilized for irrigation, &c. The dimensions of these open channels, and the direction in which they are led, vary according to circumstances of locality, &c. Where the climate is humid, and especially where subjected to sudden, heavy rainfalls, their number and size will require to be greater than in districts of an opposite character. It is difficult to name an average for distances and dimensions; but with a distance between 25 to 30 feet apart, the depth may be from 16 to 24 inches. The sectional form may vary according to soil; the stiffer it is, the nearer the approach to the perpendicular. There is one thing, however, in favour of keeping the sides, in whatever soil, with a pretty good slope,—that is, the safety of the sheep; for where the sides are perpendicular, and the width of drain not great, the grass in process of time grows in such a way as to cover up and conceal the cutting more or less, so that they act as a series of pitfalls to the sheep, from which they are hidden.

It is scarcely necessary to say, although nevertheless the rule is too frequently broken through, that the drains should be kept open, being cleaned out regularly at intervals as required. On the lower levels, and this, again, according to situation, drainage on the ordinary plan will be carried out, so that hilly pasture land may thus present examples of the two systems.

Liming of Hill Pastures.—That a considerable increase to the revenue of an estate may be made by the improvement of such lands, in many districts, is beyond a doubt; and it is a matter of surprise that this is not more extensively carried out. In many cases, the soil, although bearing herbage, poor and coarse in quality, and small in quantity, nevertheless contains a large amount of vegetable matter, which, by proper treatment, can be brought from its inert to that active condition which will rapidly and certainly change alike the quantity and quality of the herbage. In soils of this character, therefore, liming is the thing to be done after the drainage has been completed; and wherever adopted, the change from poor to comparatively rich herbage has been as quick as it has been satisfactory. Indeed, we are understating the case, the reality being that, under favourable circumstances, and the work being thoroughly well done, rich pasture lands are obtained capable of feeding all classes of live stock; and one feature favourable to the carrying out of the improvement, and which should act as an inducement for landowners to do it, is that when the liming is properly done, its beneficial effects extend over a great number of years, in some instances considerably over thirty. Of course, this is dependent upon certain circumstances. The same may be said as to the quantity of lime to be given per acre, this varying with varying circumstances of soil, the heavier land requiring more than the light. The heavier soils may have as much as from 9 to 10 tons per acre, the lighter 6 or 7 tons given to them. As the expense is considerable, in consequence in many instances of the large area over which such lands run, and the difficulties of access to them, it will frequently be the case that the tenant may not be able to find the necessary capital; or, from the circumstances of his tenancy,—as, for example,

the near approach of its expiry,—he would not consider it a prudent thing to expend it if he had it. It has therefore been suggested by one who has had large experience in the improvement of such lands, that this improvement might be carried out in such a way as to be made comparatively easy to both landlord and tenant; this being based on the assumption that the benefit of the liming extends to fifteen years, and that the tenant is about to enter, or has just entered, upon a lease of fifteen years, during the whole of which he has the benefit of the application.

The Management of Lawns of Farm-houses, and of Mansions on the Building Lands of the Property.—We might perhaps be expected by some readers to give a few remarks on the subject of lawns. This is, however, connected with the province of the gardener, and it can only come within ours in so far as the appearance of good grass on the lawns of *buildings on the property* adds so much to their value, or at least to that attractiveness which is likely to raise it, and to which we have referred in the chapter on that special subject. In this view of the matter we give the following few sentences. Assuming that the soil is of good quality, and has been thoroughly well prepared and drained, the first thing to be attended to is the selection of the grass seeds to be sown. This is of vital importance, and to the indifference with which it is treated by some, and the almost total neglect which it meets with at the hands of others, may be traced that wretchedly scrubby and tufty appearance which so many lawns present, to say nothing of the coarseness of the grasses themselves. An excellent statement of the qualifications which the grasses selected should possess is that given by Professor Buckman—namely, fineness of herbage, as contrasted with the coarseness we have referred to; next, a capability of amalgamating or mixing well and uniformly together, so as to produce the close, matted, springy, or elastic floor surface, if we might so call it, of turf, so well known and admired by those who know what a good lawn is; lastly, a constitution fitted to resist the influence which repeated mowing or clipping has upon the plants, processes which have the

tendency to cause them to die out. This last qualification is essential, inasmuch as this mowing must be carried out regularly and repeatedly, in order to get the closeness and fineness of grass desired. Special care must be taken to extirpate all plants which have a tendency to grow bunchy or separately, or long and lanky. Flowering and seeding plants, or rather weeds, such as the buttercup, the daisy, and the plantain, must be ruthlessly got rid of. Another qualification named by Professor Buckman is, that the species chosen should 'delight in poverty.' This is necessary, he says, when we 'consider the constant drain there is upon the soil by the oft-repeated mowings,' which we have shown to be necessary to the making of a good lawn surface. The following grasses will, as Professor Buckman says, bear great vicissitudes in the above respect—namely, *Lolium perenne*, *Poa pratensis*, *Festuca ovina*, *Var. dariuscula*, *Cynosurus cristatus*. The two first are smaller in poor than rich soils, and the latter very small with constant clipping. Of course, the reader will understand that the mowing is only carried on during the growing season. The repeated cuttings, however, may weaken the grasses too much, so that some judgment will have to be displayed in regulating them. This is also necessary, as the colour of the grass is likely to be injured if cutting be carried to excess. A safe rule to be followed in the mowing and dressing of lawns is to mow them once a week during the growing season; the only exception to this being the hottest season, especially if this be very 'forcing'—that is, occasional, or even repeated light showers, alternated with warm sunshine,—when two mowings may be taken. In the interval between the mowings, the lawn should be cleaned and weeded; the

daisy weed being the easiest got rid of, the stronger rooted weeds being got out by a small spud or dock spade.

Worms on Grass Lawns.—Nothing is more vexatious to the possessor of a lawn, which he has got into first-rate order, than to find the worms coming to destroy it. We do not mean to say that they do not put in an appearance before, but their unsightly ravages are not so noticeable during the process of making as they are when the lawn is finished. The reason for this is obvious enough, *their* work being more easily seen on the smooth, finished surface. All sorts of cures for the worm disease of lawns have been proposed; frequent rolling is the one most trusted to, however, but some rely upon liquid dressings, the latest proposed being a very weak solution of corrosive sublimate. This brings the worms to the surface, where they speedily die. They should be swept off immediately, care being taken to put them in the dung-heap in such a way that they cannot be got at by poultry, etc., to which partaking of them would be certain death, the sublimate being, we need scarcely say, one of our deadliest poisons. We confess to have no liking for such deadly poisons coming upon the premises; we would therefore advise the plan to be adopted recommended by the authority we have so largely in this section quoted, namely, giving a dressing at winter-time of guano and soot well mixed and pulverized, one part of guano to five of soot. This dressing has the further advantage of strengthening the grasses, if they have been weakened by excessive cutting, and also of improving their colour. We have ourselves found that a dressing of salt and soot has proved beneficial for worm-infested lawns, and also in improving and thickening the grasses.

CHAPTER IV.

COMPOST-HEAPS, AND THE SOURCES FROM WHICH THEIR MATERIALS MAY BE DERIVED.

IN various parts of our work we have alluded more or less definitely to the important subject of manures, and to the best methods of collecting and saving them. These remarks, however, have had reference more particularly to the manure obtained from the live stock of the farm.

We have now to direct attention to a source too much neglected, but from which a large amount of manurial matter can be obtained, valuable in a variety of ways and to different crops, namely, the compost-heap. It is only those who have devoted their attention to this, who can have any real conception of the great number of materials which, on the farm and its immediate neighbourhood, are ready for the service of the farmer in the making up of compost-heaps, while there are many special sources yielding materials which are more than usually abundant, readily available, and rich in manurial constituents. The mere waste and rubbish of the premises afford alone a vast variety of material useful for the heap. Nor is it the least advantage arising from the collection of this, that it tends to keep the premises in that cleanly and orderly condition so desirable in a well-regulated farm.

Formation of Compost-heaps.—There are various ways of making up a compost-heap, each authority having his own particular views as to the best method; but what may be called the main principle is greatly influenced by the character of the soil, not only to which the compost material is applied as a manure, but which is used in the formation of the compost-heap itself. This arises from the fact that, in the majority of instances, soil of one kind or another is used as the basis of the heap, with which the various manurial matters are mixed. Other materials, however, such as peats, boggy

soil, pond mud, ashes, etc., all of which will be shortly noticed as we proceed, are used when available.

The materials are, in the first instance, placed in the heap in layers, and then mixed together so as to form a uniform mass, this being turned over at certain intervals. It is in the way in which the layers are placed in relation to one another, the intervals between the times at which they are turned over, and the number of times that this is done, on which the diversities of opinion we have alluded to arise. These are so numerous that we can do no more than glance at one or two of the most important of them, premising this by a general statement of the ordinary method of forming the heap, with remarks on what we consider to be essential features in all methods.

Site of the Heap.—The first essential is a foundation as close, firm, and water-tight as it can be made. The reason for this is obvious; for, seeing that the object in view is the saving of the manurial constituents of the heap, it is but folly, so to term it, that those which are liquid should simply be allowed to drain away uselessly to the surrounding soil. The best foundation to prevent this is obviously a close, adhesive clay; and where this is the natural soil, it will be very easily formed. But even with such it will not be amiss to well ram or consolidate the site of the heap and for some distance beyond it, so as to fill up any interstices which may happen to exist. In this consolidation of the site, it requires to be all the more carefully done in proportion as it is loose, light, and open, so that the interstitial spaces be thoroughly closed. It is a good plan to have the site—which should in all cases be of considerably larger area than

the base of the heap—dug out for some depth, as this forms a species of small tank or receptacle, in which the liquid manurial constituents draining from the heap may be collected and afterwards mixed up with the general heap at the periods when its contents are turned over. Exterior to this excavated part, and surrounding it, an open drain should be cut in the soil and inclined on all sides towards one point, at which a main drain should be cut leading to the nearest ditch or field drain. The object of this exterior drain is to carry off the water from the soil at the base of the heap, in order to keep it as free from moisture as possible, as well as to carry rapidly off all rain-water falling upon the surface of the field.

Filling or Building up of the Heap.—The site of the compost-heap being thus prepared, the next thing to do is the filling or building of it up. If peat, and specially peat-charcoal or calcined peat, can be procured, this will be the best material to spread over the surface of the excavated or hollow base, as it is at once an admirable deodorizer and absorbent. Failing this, ordinary soil or ashes—especially wood ashes, which are very valuable—should be used, this varying with the character of the soil or land to which the compost is proposed to be applied: if heavy clay, for example, sand will be good to use, or a sandy loam, according to circumstances; if a light land, clay or clayey loam, or the nodules of burnt clay, which in time will absorb the liquid constituents. Above the bottom layer or foundation soil, the vegetable refuse gathered from various sources, together with all decaying solid matters, even those of the household, are placed in alternate layers with the soil of qualities as above named. Liquid manure may be thrown over each layer with advantage; indeed, some keep a hollow place in the centre of the heap, into which liquid refuse from the house, or from the liquid-manure tank of the steading, is thrown from time to time.

The best, at least the usual, time for commencing the formation of the compost-heap is the autumn; but seeing that decaying matters useful in its formation are continually accumulating in and around the steading, the time can never be wrong for collecting these and putting them up on the compost-heap. They are

infinitely better there than littering about the place, adding to its disorder, and losing by exposure much of their manurial value. When the compost-heap is finished according to the height desired, it is covered over with soil, the thickness of this varying according to circumstances. Two constituents should never be omitted in the formation of compost-heaps, lime and salt. The lime aids the decomposition of the various matters of which it is formed, and it is useful in all soils to which it is applied as a manure, with the exception only of those already rich in lime, as chalky or calcareous soil. The salt is valuable in more ways than one; in clay or heavy soils, infested with the couch or twitch grass, it is specially valuable in killing it or helping to do so. (In fact, special heavy dressings to such soils so infested with this great plague, say from $2\frac{1}{2}$ to 3 cwt. per acre, are worth applying, and will well repay their cost.) The salt is also valuable in destroying worms and various insects with which the land may be infested. Soot, also, as a component part of the compost-heap, is useful not only in this latter way, but as possessing valuable manurial properties.

After-treatment of the Heap.—The heap being made up and covered with soil, say in the autumn, is allowed to remain quiet till the early spring, the only additions made to it being supplies of liquid manure in cases where special means are made to apply this, as already noticed. The whole is then turned over, thoroughly mixed, and allowed to stand a day or two in the rough condition, and then made carefully up as originally constructed. Some, however, prefer to make it up at once as soon as thoroughly mixed. The heap is then allowed to remain quiescent for six or eight weeks, when it is again turned over, thoroughly mixed, and again made up as before. Some allow it to remain quiescent until the period arrives when its contents are wanted, only turning it well over and thoroughly mixing it before using it for the crops. Others, again, turn it over and mix it for the third time before finally using it, allowing an interval of four to six weeks' rest between this period and the last mixing. There are many, however, who object strongly to repeated turnings over and mixings, contenting themselves with only one, and that just before the period of

using it for the crops; contending that, if the materials be well adjusted as regards their nature and qualities and position in the heap, the contents become not only better pulverized, so to say, than if mixed, while, at the same time, the great advantage is gained of none of the volatile or gaseous constituents being lost by their 'flying off,' which is the case, they say, when the heap is often mixed. The frequent turning over of the heap also tends, they maintain, to stop the fermentation of the materials, by which they are reduced to a homogeneous mass. This, however, may be kept up to the proper point by the addition of dressings of liquid manure, applied to the heap by means of the hollow space formerly alluded to, or holes may be made at intervals by means of a sharp-pointed and stout piece of wood, provided with a cross-handle, into which the liquid may be poured. The cross-handle will give a leverage to the workman, and enable him very easily to make the holes wider at the top—an obvious advantage. There is much force in the above opinion as to evils of frequent turning over, but a great deal depends upon the way in which the constituents are originally placed in the heap, and of what they are composed. If of such a nature as not to decompose quickly, mixing is absolutely essential. However treated, if the result be that the materials are fairly pulverized when ready for use, and if their constituents be rich manurially, the contents can scarcely be surpassed in value, especially for the root crops, which require finely-mixed manures.

Materials available for the Heap.—The great value of the compost-heap is that every material (organic) which decays can be added to it with greater or less advantage, animal matter as well as vegetable, thus bringing it into a condition resembling that 'universal manure,' farm-yard dung, which, as we have already said, is applicable to every crop which the farmer cultivates—to pasture lands and meadows as well as to the wide variety put under arable culture. To the vegetable components of the heap, the weeds collected at various parts of the farm will form an excellent addition; although this source of supply should certainly not be depended upon, as in good farming weeds should be 'conspicuous by their absence.' There are differences of

opinion as to how these should be used; some simply put them into the heap in their natural condition. This may do in the case of annual weeds, the seeds of which do not possess such vitality as those of the perennial varieties. But in all cases it is safer to burn the weeds and add the ashes to the heap. We have elsewhere pointed out the value of pond mud as a manure; for compost-heaps it is invaluable; and, of course, the older the mud the richer it is, as vegetable refuse and leaves of trees, etc., have been added to it during a course of years. But this source of supply, like that of weeds, on well-cultivated and well-conducted farms, will soon cease, or at least be gradually and greatly reduced. More must be looked for from other sources than the horse-ponds, etc. on the farm, although, of course, the regular cleanings out of these, which under good management will take place, will always yield a fair amount, as well as the mud obtained from the ditches, etc. One of these extra sources will be tidal rivers; and if towns be situated on their banks, the materials will not only be greater in quantity, but richer in quality. Large deposits of mud are to be met with in these, formed by certain actions of the current, and the removal of which, in place of doing harm, will rather benefit the water-way. Leaves themselves form a valuable material for the heaps, but these should be allowed to lie in a heap by themselves for a considerable period—two years at least—to allow them time to decay; and when much vegetable matter is placed in it, lime, already alluded to, is an essential constituent of the heap, and, if added to the leaf heap, will hasten the decay of their contents. Old turf is also valuable; indeed, it is difficult to name any organic substance which cannot be made useful in the compost-heap.

Different Methods of forming Compost-heaps.—Having given several hints as to the materials, etc. of the compost-heap, we are now prepared to detail one or two of the methods of forming heaps according to the systems advocated and used by various practical authorities. The first we shall notice is the plan given by Mr. Charles Lawrence in his *Handy Book for Young Farmers* (Longmans)—(a 'little' book, but one so 'great' in the number and value of the hints which it contains, that all farmers should possess and read it).

He gives some excellent hints on the treatment of spring manures, which, although not strictly compost-heaps, still come so closely under the category, that we begin by giving a brief *resumé* of what he says. He is a great advocate for collecting all the vegetable rubbish of the farm, grassy earth from roadside parings, ditch cleanings, together with weeds, and waste roots of all kinds. The hedge trimmings are also set aside, but separate from the other rubbish. As near the centre of the cultivated land as possible, a site is selected and a heap is made of the various materials collected, and the whole set on fire, the heaps being covered over with the sods, the soil side downwards. Mr. Lawrence gives full instructions as to the management of those burning heaps, which provide, as he says, a much larger accumulation of ashes than the majority of farmers would suppose. Where pigs are kept, these ashes are mixed with their manure, with occasional loads of night-soil. 'A rich heap of manure, about the consistence of spit dung, the ashes having absorbed all the moisture. This is mixed intimately with the great bulk of the ashes remaining in the burned heaps, as follows, when there is no pressing work for the hands. One man casts this mixture with a shovel on the adjoining ground, cleared for the permanent heap; another divides and scatters this with a fork; while a third wheels the dry ashes to be thrown over the scattered manure, thus gradually forming the permanent heap, about 15 feet wide at the base, and as high as it will stand together, until all the dry ashes are disposed of. The heap thus formed and neatly trimmed, so that heavy rains would run off, remains several months. When convenient, in dry frosty weather, this should be turned back at one end and re-formed, in order that the ashes and manure should be again thoroughly mixed. This is accomplished by cutting away the old heap in thin slices with a spade, and throwing the debris back on the new heap.' Mr. Lawrence keeps his pigs on a sparred floor and in boxes, the pit below being 14 inches deep; the spars are placed with an interval of $\frac{3}{4}$ of an inch between each. A layer of the ashes is placed at the bottom of the pit before the pigs are put into the boxes, and every three or four weeks a layer is placed

on the spars and brushed into the pit below, sufficient to cover the surface to the depth of an inch or two. A series of deposits of rich manurial matter is thus formed of alternate layers of ashes and pig manure. When the deposits in the boxes are to be removed, a species of tank consisting of the dried ashes is formed, into which the semi-liquid manure is placed. The mass is then covered with ashes, which absorb the liquid, and constitute the matter which is formed into heaps in the manner already described.

The old numbers of the *Journal of the Royal Agricultural Society* contain a vast amount of useful information, which is as valuable to-day as when written; and not the least valuable is a paper by Mr. Dixon in the October number for 1839, on 'Manure and Compost Heaps.' We give a brief epitome of a method therein described of constructing a heap in conjunction with either peat or sawdust, the manure of the live stock of the farm being chiefly used. In the centre of the farm-yard a pit about 3 feet deep is dug, at the bottom of which a layer of peat and sawdust is placed, about the proportion of three-fourths peat to one-fourth sawdust. On each side of the pit, a well or small tank for the reception of the liquid manure from the various buildings is dug, water being carefully excluded from mixing with the contents. Every day the solid manure from the steading is placed in and spread evenly over the bottom of the pit, and every second day the liquid manure from the side pits is taken out with a scoop and distributed evenly over the surface of the manure in the pit. At the end of each week, a layer about a foot thick of the peat and sawdust is spread over the manure in the pit. This goes on during winter, with the addition of night-soil, which is placed next or above the peat, Mr. Dixon believing it to accelerate its decomposition. The peat, before being used, is weathered by exposure to the atmosphere, so as not only to get rid of its moisture, but also of much of its acid and deleterious constituents. Although Mr. Dixon prefers the compost-heap or pit to be in the farm-yard, he thinks that it may be convenient to have pits as well in different fields, the headland being the best situation for them. Mr. Dixon has a peculiar

way of treating these headlands, trenching and throwing them well up into a central ridge, and the manure, being carted on it, and the soil of the headlands (see a note in this chapter on the value of headland soil for compost-heaps) are well incorporated together. The mass after a time is turned over, and any ditch cleanings or other refuse should then be mixed with the heaps. These are formed with sloping sides, which are then allowed to remain for some weeks, when the contents are again turned over, and fresh heaps are formed, having along their ridges shallow depressions, into which loads of night-soil, urine from the cattle stalls, etc., are poured from time to time. When enough of these has been given, the whole is covered over with soil, and the heap allowed to remain undisturbed until the middle or the latter end of autumn, when it is again turned over, and finished off with sloping sides as before, but with the top closed and the surface wholly covered over with soil, till, in the course of the ensuing winter or early spring, opportunities offer for using it in the field.

We have said enough to show to the farmer what an important resource he has in adding largely to the stock of manure at his command,—a manure which, we have already explained, is particularly valuable for certain important crops.

Importance of attending to the Soils and Materials used in forming Compost-heaps.—Before concluding, however, we would draw attention to one or two points in connection with the subjects we have been discussing, which we consider of some importance. The first is, that the best result in the formation of heaps will be obtained if attention be paid to the quality of the soil of which it is proposed to form it, where soil is used, and which generally forms a large part of its bulk. We have already incidentally alluded to this, but it is a point not usually thought of, although its importance is obvious. On consideration, it will be seen that certain soils require certain constituents, which are either wholly or partially absent from them; now, by so arranging the materials making up the main bulk of the compost, these constituents may be supplied to the soil. True, it is not always an easy matter to secure a sufficient quantity of the requisite materials for the compost-heap to suit all or a wide

variety of soils, which may be deficient, some of one class, some of another class of constituents; still, by careful looking out, and giving consideration to the points at issue, it will be a matter of surprise to many, how, with comparative ease, materials will be obtained to suit a goodly number, probably all of the most important cases. Thus take, for example, the case of light, sandy soils. These are almost always deficient in saline constituents and organic matter, while mechanically their loose, open condition renders them unfitted to retain moisture well or long, so that in dry, hot seasons the crops are burnt up or languish. Now these chemical and mechanical or physical deficiencies will be made up to a large extent by using a compost of which the bulk is made up of the cleanings out of ponds, of ditches and water-courses, the scrapings of roads, together with a due admixture of lime. Where the pond or ditch cleanings cannot be had in sufficient bulk, but peat can, this being in a comparatively good and dry state, not sour and poor like some boggy matter (the difference between peaty and boggy matter is too often lost sight of, is not indeed known to many), a good compost may be made with it, with the addition of clay or clayey soil and lime, which will have the same influence nearly on dry, sandy soils. Again, in the case of soil of a totally opposite character, such as a close, retentive clay, the compost required must be of a different character, the difference lying chiefly in the direction of its mechanical characteristics. The soil having its particles lying closely packed and pressed together, the action of the atmospheric influences is greatly hindered, in some cases of a peculiarly retentive clay completely prevented; while the passage of water is rendered very difficult through them, so that they retain the moisture. Here the compost should have a large proportion of its bulk made up of some material calculated to open up the soil; as, for example, the nodules of burnt clay (see 'The Burning of Clay'), the 'breeze' from the brick or tile kilns, or the cinders or cindery ashes obtained from fires, furnaces, and town manure. Of this last material a very distinguished agriculturist, who used it extensively, speaks very highly, as constituting a specially valuable material in loosening and

opening up the particles of retentive clayey soils. Clay soils being generally rich in manurial constituents, possessing, in fact, an almost inexhaustible supply, the other and strictly manurial constituents of the compost-heap may be comparatively poor; although it is but doubtful policy to give poor manures to almost any soil, however rich naturally, or which have been made so by a long course of careful and judicious cropping and manuring. Again, for peat-moss soils under reclamation, a competent compost can be made of clay, coal-ashes, and lime. Town manure, or, as it is frequently termed in the North, 'police manure,' from being the perquisite, so to say, of the Police Commissioners, who have the cleaning or scavenging department under their control, is a manure of high value for nearly all soils; and when it can be had, it should never be lost sight of. It is, in fact, a ready-made compost. It will, however, well repay the trouble of being thoroughly mixed on the farm, and freed from all extraneous rubbish, especially when used on meadows. For soils lying between these two extremes here named,—the light and porous sandy, and the heavy and close clay soils,—and which comprise the wide variety known, or which may be classed, as general soils, and which range from the friable loam of the richest kind, to those in poorness bordering upon the worst;—for soils of this general character the compost will take in, to make up its bulk, every substance which can decay met with on the farm itself, and the wide range of those obtained from various sources, such as manufactures of different kinds and different industrial processes carried on in towns, should these be within easy reach of the farm.

'Waste' Substances valuable for Compost-heaps.—Many of these 'waste' substances are absolutely allowed to pass uselessly away into sewers, rivers, canals, etc., thus justifying fully the name by which they are designated; or are heaped up in the neighbourhood of the places where they are produced, becoming not only waste, but 'nuisances.' Yet all of them, with at least very few exceptions, can be used with good effect as manures by mixing them in the compost-heap. To some of these, bad reputations as manures are attached by some farmers who have not been successful in their

use of them. But it should be remembered that cases of failure do not always arise from the nature of the material itself, but much more likely from the way in which it is used. Thus, if used alone, its effects may be prejudicial, or at least not beneficial; but when mixed with other substances, a chemical reaction may be set up, which will result in making the manure very valuable. We have yet much to learn as to the chemistry of manures, specially of the various substances which we have seen are called waste; and there can be no doubt that if they were passed under a close chemical examination, many of them, now despised, would be proved to be of great value, and many lessons might be given as to the best method of using them. Thus, for example, many of these waste substances are in the liquid state. Now it is open to doubt whether it is the best way to apply them to the land in this state, either simply, or as mixed with other materials, also in the liquid condition; this remark applying even to the ordinary liquid manure of the farm, the wash of the live stock, etc. The great probability is, that higher manurial results would be obtained by mixing these liquids with solid substances which would absorb the liquids, and the proportion of the solids being so regulated that the resultant compost would be still a solid, moderately moist or wholly dry and pulverized, according to the crop to which it was to be applied. This mixture of liquid manurial substances with solid ones, applies, we think, just as forcibly to the ordinary liquid manure of the farm-yard and buildings; valuable as it is known to be in this liquid condition, it would, we think, for many purposes, be more so if mixed with solid substances. The advantages of solid manures are obvious for many purposes of cropping and manuring. It is just a possible thing that some of the difficulties attendant upon the use of *town sewage* would be got rid of, or at least be more easily dealt with, if this principle was more attended to. The compost-heap for general soils should be made up of the widest possible range of substances; the more numerous and the more diverse in character, the better will the compost be, and the higher the results obtained from it.

Artificial Manure Composts.—The remarks we have given up to this point on the subject of composts have had reference to what might be called the formation of *natural* ones, inasmuch as the materials which have been proposed to be used in them are those which are to be found lying around the farm-stead, or in its immediate vicinity, or which may be obtained from some sources not very distant from the locality at which the compost-heaps are formed. But as these natural substances are not always conveniently to be had, and as, moreover, at times the farmer desires to have a compost, the constituents of which, being of known character and manurial value, may be designed to serve some special purpose, as in manuring a special crop,—it will be seen that the composition of these artificial compost-heaps will vary with the purposes for which they are designed.

Grass Crop Artificial Composts.—Some, however, while they are so far special as to be applicable to one class of land, are so far special as to be applicable to one particular crop; as, for example, the 'grass crop,' or rather for pasture land which has been neglected as regards manure. The soil which forms the basis of the heap must be as light and friable as possible, and free from stone, pieces of wood, and all hard undecomposing matter, which interferes very much with the proper mixing of the ingredients,—a point of great importance, and which, indeed, applies to all compost-heaps. The amount or bulk of the soil will depend upon that of the heap, and of the other ingredients which compose it, the soil acting only as the basis for holding or binding the whole together, and facilitating their distribution. The other ingredients or constituents are in name and weight as follows:—Lime, 19½ cwt., or say a ton; farm-yard manure, 6 cubic yards; earthy compost with decayed organic matter, 12 cubic yards; Peruvian guano, 1 cwt. 22 qrs. 17 lbs.; nitrate of soda, 1 cwt. 0 qrs. 15 lbs.; sulphate of ammonia, 1 cwt. 0 qrs. 19 lbs.; superphosphate of lime, 3 cwt.; sulphate of potash, 2 cwt. 0 qrs. 23 lbs.; muriate of potash, 1 cwt. 0 qrs. 15 lbs. This was applied in March to an old pasture which had not been manured for twenty-five years, and the increase of the produce was very satisfactory.

While the soil of composts which forms their basis should be in such a mechanical condition as to be easily mixed with the other ingredients, still it should be borne in mind that the constitution or chemical components of it should be such as to be suitable for the land to which the compost manure is to be applied, and this will be best secured by having it of as nearly an opposite character as possible. Thus, if the dressing is to be given to heavy land, the soil of the compost-heap should be light, and *vice versa*; while advantage may be taken of the mixture to add or restore to the land those chemical constituents in which it is deficient, or of which it is exhausted. And of this the farmer will be the best judge, knowing the nature of his land; or if he does not, he ought to have it examined and analyzed. As a rule for top-dressing grass lands which are situated in inland districts, salt is highly valuable as a constituent in compost-heaps; but where the fields are close on the sea margin, or within range of the sea breezes, this is not so much required, as it is surprising to what an extent salt is conveyed by the wind from the sea, and distributed over the lands in its vicinity. When the gales are heavy, and continue for some days blowing inland, we have known the leafage of trees to have a distinctly salt taste fully thirty miles from the sea. Soot, also, should always be made available wherever it can be had. It gives wonderful vigour to grass, and is also specially valuable as an insect destroyer; its powers are, however, perhaps best developed in the liquid state—that is, mixed with water, or added to the liquid-manure tank.

Lime as an Improver of Soils.—We have somewhat frequently alluded to lime as a highly valuable manure. We therefore have thrown together, as likely to be useful, a few hints and cautions as to its nature and uses. Of all the substances provided by nature, and placed within more or less easy reach of the farmer, it is difficult to name one which plays such an important part, and which has so wide and varied a use, as that of lime. Known to and used by the Romans with that practical skill and those beneficial results which characterised so many of the agricultural operations of that wonderful

people,—operations which we would do well to study, and in some instances to revive, now-a-days,—its use seems either to have died out in what are called the dark ages, or, if used, writers make no mention of it in their records of the social history of our country; and it is not till nearly the commencement of the nineteenth century that we come across the records of its use amongst us. In Flanders,—that refuge, so to call it, of agricultural and gardening operations, from whence, in process of time, the knowledge of them, and that of the crops which were grown there, and which were utterly unknown to our farmers, spread abroad, and gradually formed part of our regular crops,—lime was used, as also in France, and in both countries with what seems to us great judgment and true economy of material. Gradually with us this important agent in improving soils, and no less crops than soils,—as, for example, in the case of the top-dressing of pastures, etc.,—took its place as one of the most important substances which the farmer has at his service. Lime as used agriculturally is very different in its physical and chemical characteristics and constituents from those which it possesses in its natural condition. It is met with as a rock in one or other of the several formations of what are called limestones, which are rarely found composing parts of other rocks, but are almost universally found distinct by themselves, either as separate masses bedded in other rocks, but, as above said, generally quite separate and distinct from them, or as masses not connected with other rocks. The two great classes of limestone are the carbonate—which is divided into the clayey, the sandy, and the pure, such as marble—and the magnesian. Limestone as taken from the quarry, or cut from the face of the rocks which are exposed by the work of excavating and cutting out, is wholly unfitted for agricultural purposes, or indeed for those of the builder. It has to go through certain processes, and although we have already described them in another chapter, it may be as well to recapitulate here briefly the best process in calcining or burning the rock or limestone, which is done in a furnace called a limekiln. When thoroughly calcined by the action of the burning fuel in the kiln, it is

known as ‘quicklime,’ or in some districts as ‘limeshells.’ When quicklime is exposed to the action of water thrown over the shells, they crumble quickly apart with a crackling or hissing noise, while a high degree of heat is evolved, till finally the whole assumes the condition of a finely pulverized powder, beautifully white in colour. The same effect is produced, though more slowly, when the quicklime or shells are exposed to the ordinary atmospheric influences, the moisture in the air and the oxygen gradually operating upon the lime. In both cases the resulting powder is called a hydrate of lime, and, as may be supposed from its mechanical condition, is then in the state best fitted to be mixed with the soil, or used as a top-dressing either for arable crops or for grasses or clovers. If hydrate of lime is allowed to remain for a time exposed to the atmosphere, rain, etc., it then undergoes another change, absorbing carbonic acid from the air, becoming thus a carbonate of lime; it hardens into lumps or masses, resembling, as indeed they really are, set mortar, lacking only the sand with which mortar is usually made. In this hardened or indurated condition, lime is wholly unsuitable for agricultural purposes; hence will be seen the absurdity of the practice too often adopted of carting valuable limeshells (quicklime) to the farm or farm-yard, and allowing them to lie exposed to the air, rain, etc., until they become first a hydrate or powder of lime, and then, by the addition of extra moisture or wet, the hard indurated lumps above named;—a system this which is simply equivalent to throwing away the money expended in purchasing the lime.

Application of Lime to Land.—In applying lime directly to land,—leaving out of consideration, for the present, its uses in the compost-heap,—say arable land, with which it is to be mixed, the best mode of proceeding is as follows:—Cart the limeshells as rapidly as possible from the limekiln to the field, and lay them down in heaps, the distance between which and the weight of lime in which must be calculated according to the amount of lime desired to be given to the land. As rapidly as possible, cover each heap of quicklime with soil, giving a pretty fair thickness of it. After

some time, the moisture in the soil, and that which it attracts from and which is yielded to it by the atmosphere, rains, etc., slakes the lime, which swells and ultimately forms a hydrate or powder of lime. The completion of this process is easily ascertained by probing each heap with a stick, and when found to be complete, the heap should be turned over and thoroughly mixed, and then allowed to stand for some little time, after which the mixture of soil and lime is thrown over the adjacent stretches and ploughed in.

Action of Lime on Soils and on Manures.—The action of lime on soils and crops varies much according to circumstances, but in all cases excepting in those in which lime is naturally present in the soil, as the calcareous or chalky soils for example, it is powerful, and, if judiciously applied, uniformly beneficial. In no class of soils, perhaps, is the action of lime more noticeable and marked than in peaty soils, and mossy land abounding in crude and sour vegetable matter. Here the lime acts at once and powerfully, from the rapidity with which it absorbs carbonic acid from the vegetable matter, rapidly changing its sour and crude qualities, and converting it into a good rich loam. For the same reason, and in the same way, it acts most beneficially on lands newly reclaimed from heaths and commons on which there has been a rank growth of vegetable matter, and which has been ploughed in, and, in truth, on all soils rich in vegetable matter. Nor is its action less noticeable and beneficial in the treatment of close, adhesive, clayey soils, and strong clayey loam or loamy clays, in opening them up and rendering them friable and amenable to the action of the atmospheric influences. And what is still more remarkable, although some doubt its action in this way, its use renders very light soils stiffer, and gives a firmness to them, making them capable of growing crops for which in their original condition they were not well suited. In soils of a very light character, chiefly of a siliceous nature, the mistake in the use of lime is in its employment alone; for in such soils the lime is apt to form with the sandy particles a species of mortar, so to say, which gives rise to hard or indurated

nodules, exceedingly difficult to be brought into a friable condition. The course to be taken in such cases is to use a certain proportion of clay or marl along with the lime. But while acting mechanically on all soils in which it is not naturally present in required proportions, its chemical action is not the less marked and valuable. As Liebig shows, it enters freely into combination with, and sets at liberty, certain chemical constituents, so as to make them fitted to be taken up by plants; thus it sets at liberty certain alkalies, which are present in minute quantities in the soil, forming soluble silicates which are useful to certain plants. And from the affinity which exists between lime and acids, which are present in some soils to excess, as in the case of peats already noticed, it enters into combination with them, decomposing them, and forming new compounds which are valuable for the crops. Its action, also, or use as a manurial agent itself, should not be overlooked, for to many plants lime is an essential element; and if wanting or in deficient amount in the soil in which they grow, a supply of lime adds fresh vigour to their growth and greatly increases their produce. We need only cite one example, namely, that of clover. While it promotes the vigour of good plants, it is specially useful in destroying the vitality of bad ones. The most marked instance of this, perhaps, is in the case of heathy common lands, covered with bent grass and other coarse vegetation, which, on being well top-dressed with lime to a pretty heavy extent, it soon causes these to disappear, and to give place to a fine covering of healthy, nutritious grasses, to the encouragement of which, again, the lime is useful. But while acting itself as a manurial agent more or less powerful, its action on other manures must not be overlooked. In the case of the majority of manures, the lime hastens their decomposition, and, entering into combination with some of their constituents, forms new compounds, which are readily assimilated by the plants. Lime also brings into active operation such portions of manure as may, from one circumstance or another, have remained inert in the soil, or may not have been taken up by the preceding crops. All such undecomposed manures are in the great majority of arable soils attacked

by the lime, and brought into active operation. Hence its value on the compost-heap in decomposing its materials, and in helping to bring all into a uniform mass or homogeneous condition. On all organic matter present in soils, lime acts more or less energetically in hastening their decay, and bringing them into the condition in which their constituents are best and quickest assimilated by the plants. But from what we have said, it will be seen that lime, although acting in itself to a certain extent as a manure, does

not by its use obviate the necessity of using other manures; on the contrary, its very use necessitates in many instances comparatively large doses of manure. We have stated enough to show the important uses to which lime can be applied in improving soils, and by consequence, the crops which they bear, and have also, however, cautioned the reader as to there being certain circumstances in which its use is to be deprecated, or at all events gone into with care and previous judicious inquiry and examination.

CHAPTER V.

AN EXTENDED COURSE OF CROPPING ADAPTED TO YIELD INCREASED SUPPLIES OF FOOD FOR LIVE STOCK
—WEEDS AND WEEDING.

IN a succeeding chapter in the next division, in which the leading features of the question of the live stock of the farm considered as improvers of landed property are glanced at, the reader will find brief allusions made to the principal modifications introduced of late years into the system of feeding, by which higher and more economical results are obtained. Amongst these, that of soiling takes a prominent place. This demands, of necessity, as wide a variety of crops as the circumstances of the soil, locality, and climate admit of. To the principal features of this department of land management and cropping we here propose to glance, in the briefest way possible, this being the most appropriate place, as we deem, in which this can be done. Hitherto, as a rule, the crops used as food for live stock have been confined to a very few only. But in view of the great advantages obtained from having changes of food, we need not wonder at the above point being paid attention to by advanced farmers to a much greater extent than it has been. Another advantage is that which all systems of mixed cultivation yield,—the increased degree of safety, so to say, which it gives to the farmer, inasmuch as, however adverse or peculiar the season may be, all the crops will not suffer alike, some very likely yielding the highest produce under circumstances prejudicial to others. When we compare what has been and is being done now in other countries in the way of having a wide variety of forage and root crops, with what is the system which has so long satisfied our farmers, we may well express surprise; for in other countries plants are grown, some of which are known only to a few here amongst us, while others have no place at all in British crops. But our surprise

may well be greater when we consider that even of those crops which are known to us, and grown with great advantage by our most advanced farmers, some are utterly neglected by many; or if they do grow them, they are only occasionally seen on their farms, and form no part of the regular system of cropping. Thus a great many content themselves with ringing the changes upon turnips and mangold, for example, reminding one of the story of the lad who, when asked what he had for lunch, replied, 'Bread and butter,' and when further asked if he had no change, replied, 'Oh yes; I have sometimes butter and bread.' Now in the one class of root crops we have other roots besides turnips and mangold, such as carrots, parsnips, beetroot, khol rabi, and the much despised Jerusalem artichoke. And in the other class of what may be called 'leaf' or forage crops, we may have varieties of rape, mustard, chicory, gorse, bromus schrader, and the recently introduced leaf crop, which promises on certain soils and under certain management to be a most valuable addition to our stock of leaf feeding crops—namely, the prickly comfrey; while the cabbage affords perhaps one of the best and most economically grown crops of this class, to say nothing of its variety the thousand-headed or Jersey cabbage, which is seldom or, as a rule, never seen upon our farms. All these are valuable for food. Thus the parsnip, which can be cultivated in almost any kind of soil, possesses other advantages, such as a capability to resist frost, and of being sown at almost any period of the year, while it is much liked by stock of all classes. As for the Jerusalem artichoke, regarding which the last remark is also true, it may be grown on any piece of waste land not otherwise appropriated. Then as

regards forage or leaf plants to be cut green for summer soiling, the term including a part of the late autumn and early spring, we grow, as a rule, a much more limited range than is possessed by other countries; and of those we have, some are neglected, just as we have above stated in the case of roots. Thus we have the gorse, a most valuable forage shrub, as we may call it, for cows and horses, but it is seldom that even the natural or indigenous plots of it are made available, much less artificial ones specially laid down. The subject might be pursued to a much greater length, but we have said enough, we trust, to show its leading features, and to urge some of our practical farmers to adopt means of carrying the system out.

Weeds and Weeding.—In all districts, in every locality, on all farms, appearing in every soil, no matter of what class or kind, under a wide variety of circumstances, and infesting and reducing the value of the crops which the land bears, in all stages of growth, and comprising unfortunately an enormous variety of kinds, weeds are to be found, to 'vex the soul' of the farmer, test his patience, and try his skill. It is not merely their variety, but the ease, so to say, with which they take to the soil, and their amazing fecundity, affording to the farmer anything but a satisfactory contrast to the difficulty he often has in establishing a good and healthy growth, and to have a heavy produce of those crops which are useful to him. Without any care bestowed upon them, nay, in spite of the care taken to destroy them or to lessen their productive powers, weeds bring forth—to quote, certainly not irreverently, the words of Holy Writ—'some fifty, some sixty, and some an hundred fold' (a few, indeed, exceeding this, as we shall see); while the valuable grain crops of the farmer, with all his care, bring forth such scanty increase as three, four, five, six, or seven fold. Weeds, of course, make the greatest progress in hot weather, especially if with the heat there be moisture in the air. In such weather their development is something marvellous.

Uses or Value of Weeds.—Indeed, they increase at such a rate that there seems to be considerable truth in what this circumstance has suggested to some writers, who maintain that they must be

designed to serve some important purpose in the economy of the vegetable kingdom, and that we may yet some day have the discovery made what this is,—even, possibly, that it may show that they may be valuable either in agriculture as crops, or in some one or other of our manufacturing processes. And, by the way, we have an example of a very striking kind to support this view, in the esparto, or, to give it its correct name, the espartero grass, which at one time overspread the vast plains of certain parts of Spain, and was quite a nuisance as a weed of the worst kind. At last its value for papermaking was discovered, and from worthlessness it became literally a gold mine to those who had lands infested (?) with it. Hence, also, the true meaning of the definition of a weed by another writer may some day be known—namely, that 'a weed is a valuable plant, but only in the wrong place;' and the right one, as we have just said, may soon be found for it. There is certainly one useful purpose which weeds serve in farming,—that is, when they—that is, the weeds—are weeded out from amongst the growing crops. For the soil is opened up by the very act of weeding them, so that even from this point of view the farmer who keeps his crops clean is abundantly repaid for the trouble which the work involves.

Exhaustive Powers of Weeds.—But there is yet another view to take of the matter. Our readers know, or ought to know, if they have closely studied the subject of plant culture generally, and if they have not, they should do so now; but presuming that they have, they will, we say, know that, as a matter of necessity, thriving weeds must draw a good deal of fertilizing matter from the soil. And all they do so draw, is a dead loss to the crops which alone ought to occupy it, and being so to them, is no less a dead loss to the farmer. This is what an agriculturist calls a 'living fact.' It lives to little purpose, though, in the minds or estimation of some farmers, if we are to judge by the fine crop of weeds they grow on their land. Some would almost seem to be proud of them, if they do not actually boast of them, as did an old Cheshire farmer friend of ours, who, honest fellow, had the best of everything on his farm,—so he said, and it must have been true, since he did say it,—and who, on our pointing

out some gigantic thistles which grew on his land, chuckled with amazing glee: 'Ay, dang it, mon, they are rare uns, for sure,—no finer i' th' country.' There is nothing like hearty doing; if ever one does go in for boasting, do it thoroughly, like our old friend, thorough character as he was. We should like, however, if there were more hearty doing in the weeding of farm lands; if there were, the country would be the gainer, and that to no small amount. For not only do weeds exhaust the soil, but they do so to an extent far beyond the belief of many who have not given the special attention to the subject it deserves and should obtain.

Prolific Character of Weeds.—Some idea of the prolific nature of weeds may be obtained from the following facts, which we have gathered from a paper by Professor Buckman, who, perhaps, never did a more useful service to agriculture, amongst the many useful services he has rendered to it, than when he took this subject up and exhausted it so thoroughly that he has left nothing for future observers to record. Thus the groundsel (*Senecio vulgaris*) bears 130 flowers, and having 50 seeds to each flower, the number of seeds a single plant produces is 6500. The corn-cockle (*Agrostemma githago*) has 7 flowers, each bearing 370 seeds, giving the plant's produce at 2590. The musk thistle (*Carduus nutans*) has 25 flowers, and each bearing 150 seeds, gives 3750 as the number produced by the plant. But large as these numbers seem, and prolific in produce as these weeds are, they are nothing compared to the produce of other weeds and seeds which are too common in our fields. Thus the red poppy (*Papaver rhæus*), a weed which makes too many fields brilliant with its radiant presence, bears 100 flowers on each plant, and as each flower bears 500 seeds, we arrive at the astounding number of 50,000 seeds: multiply this by the thousands of plants in a field,—we have seen fields with large spaces ruby red with it,—and some idea can be gathered of the amazing rapidity with which a whole district may soon be covered with weeds if no warfare is waged against them. Take, again, the case of the corn sow thistle (*Sonchus arvensis*); we find that each plant bears, or may bear, 100 flowers, and each flower 190 seeds, giving no fewer

than 19,000 seeds as the produce of one plant. Then, again, the charlock (*Sinapis arvensis*), that 'curse of many a field,' as it has been somewhat profanely called, gives 4000 seeds to each plant, one plant bearing, or capable of bearing, 400 flowers, and each flower bearing 10 seeds.

Compulsory Weeding—Cultural Advantages of.—Taking all things connected with weeds into account, the rapidity with which they grow, their fecundity, the ease with which they spread themselves abroad, the amount of fertilizing matter they rob from the soil, and which otherwise might be assimilated by the crops which minister to man, it is scarcely to be wondered at, that from these far-seeing men, the go-ahead farmers of the day, an outcry should have gone forth of late against those who will not do anything to clear their own lands from this burden of waste, and a demand, moreover, seeing this indifference, that as they will not do this willingly, they should be compelled to do it. For it is an axiom or a maxim of our common law, that we have no right to do what creates a nuisance and a loss to our neighbours. And if we can, at a court of law, get redress for a noxious manufacture carried on in our neighbourhood, and resulting in loss to us, is there much of a wrong done if we wish to have the power to stop our neighbours from allowing the breezes which blow over and from their fields to ours, to bear with them thousands of seeds of weeds, which they are too easygoing or indifferent to extirpate? But, after all, willing work is better than forced work; and while desirous to see a less lively, vigorous, and extended crop of weeds cultivated in our rural districts, and the space they occupy and the fertilizing matters they take from the soil given to more valuable crops, we are nevertheless sanguine enough to hope, and crotchety enough to believe, that as knowledge spreads and lightens up now darkened districts, our farmers, who look upon a weed now as almost as necessary a result of tillage as the crops alongside of which they grow in all their greenness, will come to see that weeds are worse than worthless, that they are wasters, and that it in every sense pays to get rid of them. For it is a somewhat assuring and pleasant thing to know that in extirpating weeds we are not only getting rid of a perpetual

and wasteful drain upon the resources of the soil, but that at the same time we are improving the land, opening it up, and exposing it to the action of the atmosphere. In removing a weed which clings round and chokes up a plant, we not only remove its blood-sucker, so to speak, but we loosen the soil around it, and give all the benefits of a miniature horse-hoeing. The labour of the 'weeder' is thus twice rewarded. Everything has its uses: men have wondered what use a weed can possibly have; may not this to which we have above alluded be one of them? A well-weeded soil is not only productive, we venture to say, because the weeds are absent from the soil, and the crops which it bears are alone recipients of the fertilizing virtue which it contains, but because the very act of getting rid of the weeds brings the soil into and keeps it up to that condition in which plants best thrive in it.

Classes of Weeds, and Methods of getting rid of and destroying them.—It is needless to specify the particular weeds against which a warfare should be waged; all should come under its scourge, and that ought to be thorough and ruthless extermination. No quarter must be given to this enemy, or rather to these hordes of enemies, of the crops, and the worst foes we have to contend with in endeavouring to have them yield the largest produce. All that we have space to say on a subject which would demand that of a volume to do justice to its requirements, is, first, that weeds may be classed under two great heads—(1) the annual weeds, (2) the perennial. The annuals are all characterised, as a rule, by having roots 'loose set'—if the expression may be used—in the soil, so that they can be removed with greater or less facility, but generally easily pulled up. The perennial weeds, on the contrary, are distinguished by their 'firm set' in the soil. There are, it is needless to say, exceptions more or less marked to these two rules. These characteristics demand different ways of getting rid of them, although some have to be treated in the same way. The perennials, with long and very deep-seated roots, such as the dock and the thistle, the pests *par excellence* of our pastures and meadows, are so difficult to be pulled up that they more frequently break short off than are fairly and clearly drawn

up; in such cases, the best way to get rid of them is to keep mowing down their leaves. As these are their lungs, the plants soon die out if this be persistently done. Some are easily poisoned out by manurial applications, as, for example, the dock with dressings of nitrate of soda. In moderately heavy soils this is a specific, but its action may and likely will be modified according to soil, etc. Salt is a capital thing to get rid, or to help to get rid, of the twitch or couch grass, the great pest of our heavy and wheat soils. The annual weeds are generally best got rid of by being hoed up either by the hand or the horse hoe. The second point we have to specially notice is that all weeds should *be extirpated before their seeds ripen*. We need say no more on this, so evident is the reason for the advice. If by bad management weeds are allowed to grow till they do ripen their seeds, get them out of the ground before they shed their seeds upon its surface. The third point is, that all weeds which have seed-pods developed should be burnt, and the ashes put to the manure or the compost-heap. Nothing short of 'cremation' will destroy weed-seed life, so remarkable is it for its vitality. The fourth and last point we have space to note is, that the seeds of the crops to be grown on the farms should be carefully examined, to see that they be not mixed with the seeds of weeds. This is a prolific source of weed plant crops, and one, we regret to say, too often owing its origin to the cupidity, and something, which shall be nameless here, worse than that, of some Seedsmen. We are glad to say the number of those who wilfully mix farm crop seeds with weed seeds, or send out the former in such a dirty, badly cleaned state that the weed seeds abound in the lot,—a course less criminal, but not less carelessly culpable, than the wilful mixing, and practically as mischievous and ruinous to the farmers' interests,—is now very small. The only remedy to be depended upon in this case is to buy crop seeds only from the first houses; their reputation is too dear to them to purchase profit at such a price as the practice demands. If these four points we have above noticed be well attended to, the farmer may look upon himself as pretty well guarded against the evils arising from weeds on his land.

Amongst the various weeds not annual which trouble the farmer, one of the worst is the common *thistle*. This is a troublesome weed to extirpate when once it fairly gets possession of any pasture fields, not merely because of the large number of seeds which the plant bears, and the easy way they are carried from place to place by every current of air or wind acting on the light down with which each seed is furnished, but also because, from the peculiar nature of the prickly leaves, there is considerable difficulty in pulling them up by the hand, which difficulty is increased by the firm hold the roots take of the soil, and the readiness with which the roots break off, leaving a portion in it, from which a new plant soon springs as vigorously as before. These facts point to some other method of extirpating this great pest of some fields than that of hand-pulling, which, even if it was effectual, must necessarily be a slow process at all times, but especially where the crop is a heavy one, as too often it is. Perhaps the best way is to mow down the plants, this being done just as the flower begins to develop, or perhaps even before the plant has reached this stage of growth; it must, at all events, be done before the seeds have matured. This mowing keeps back the growing powers of the plants, but what further growth is made during the rest of the season must be again mown down in autumn, by which season the stem has become hollow, and into which the rains of this period of the year trickle down and soon cause the roots to decay and rot. This seems to us the best plan to deal with young or comparatively young plants; but where thistles have been, through neglectful, careless farming, allowed to attain to what may be called an almost gigantic growth, throwing out many shoots from the root, the only way to get rid of them is to dig up or fork out the whole. This may be a work of some difficulty, but it is a duty which ought to be performed, not only for one's own sake, but for one's neighbours; for so easily, as already stated, are the seeds carried away by the wind acting on their 'downy sails,' that they are carried long distances in a very short time, so that it may be said that a single standing thistle will soon seed the neighbourhood. This forking up of the roots from the soil, in place of allowing

them to be rotted out, does not, however, do away with the necessity to mow down the shoots bearing flowers. This, to prevent seeding, is essential, and one advantage of doing it as soon as the flowers are formed, is that these are not nourished by the stems after being cut up to the point when the seeds would be developed—which often happens if the flowers are cut down late, the damp of the ground in which they lie often greatly aiding the moisture in the stems to carry on the further growth of the flowers and seeds. As all weed seeds seem possessed of a vitality which apparently no ordinary means will destroy, the only true plan is to burn the thistle stems and weeds as soon as they are dry enough, adding the ashes to the compost-heap, as already recommended (see par. on 'Compost-Heaps').

Extirpation of Weeds in Fences and on Waste Lands and Odd Corners.—In concluding our remarks on weeds, we have to point out one great means of reducing the loss to the farmer of which they are the cause. For it is not sufficient that he does his best, by careful and unceasing labour so long as the cultural peculiarities allow him the opportunity, to keep his growing crops in the arable fields and his meadows and pasture lands free from weeds,—and nothing less than this perpetual warfare kept up against weeds will prove effective in getting rid of them,—but his attention must be directed to other places of weed growth, which are unfortunately too often grossly neglected. We refer to the sides and bottom soils of fences of the huge, old-fashioned style of growth, to the roadsides, and to various and often too numerous waste corners and plots of land, which, if not kept for the express purpose of serving as 'nurseries for weeds,' assuredly act the part remarkably well. All those places produce such numerous crops of weed plants, and these, again, still more numerous produce in the way of seeds, which are so easily, widely, and continuously disseminated over the adjoining fields, even for great distances, that it seems almost hopeless to attempt to keep these clean and clear from weeds, making often the whole result of a season's work but as labour lost. If praise be due, as due it is, to one man who makes by superior culture two blades of grass or two ears of grain to grow

where but one grew before, is not, on the other hand, censure as freely due to another who allows the seeding of one weed plant to go on, the result of which is the lessening to a great degree of the work of his more careful neighbours? So long as there is not a law—as law assuredly there ought to be, in the true interests of agriculture—to prevent those who are neglectful of their duties in keeping every part of their farm, be it road or be it field, free from weeds, the prudent man should be a law unto himself, and carry out the duties as stringently and conscientiously as if all the pains and penalties of a strictly enforced and severe enactment would be his lot by neglecting them. The wonder, to those who know the enormous powers of mischief which weeds possess and exercise, is that any farmer will permit or can allow quietly to be produced year after year crops of weed seeds, which in time produce greater and still greater crops of succeeding plants. Nor is the wonder less when one considers that this unfortunate system brings about a double loss to the farmer who produces it, or rather allows it to produce itself. For it is not only the injury done to growing crops of grain or grass which terminates the loss, but there is a waste of manurial constituents otherwise under a better and wiser system made available, so that the loss is greatly increased. If the weeds and curious collection of rubbish, which gathers and multiplies exceedingly where weeds abound, were collected carefully, and, when seeded, burned, to destroy utterly in the only possible way all their vitality, and the ashes added to the compost-heap, the farmer would be agreeably surprised at the value of the resulting manure. For, as we have already pointed out that the majority of our weed plants draw largely from the manurial constituents of the soil, as well as broad-leaved

ones from the atmosphere,—more largely, in fact, in some instances than many of our paying crops,—it is evident that by using them in the way above indicated, a large percentage of valuable manurial constituents will be added to the compost-heap. And in the case of weeds, the plants of which have not matured their seeds, by adding them along with the rubbishy matter, or at least such portions of it as are useful for the purpose already alluded to, the bulk of the heap will be increased. Nor do the advantages of this system of clearing every place on the farm of weeds end here. For not only are such places of refuge for vermin and the breeding places of insects, destructive at once to crops and annoying many of them to cattle, got rid of, but that look of order and the absence of matter offensive to the educated eye, which betokens a well-regulated and well-conducted farm, is secured. The neglected fences, roadsides, and ‘waste places,’ with their accumulated and ever accumulating masses of weeds and heaps of rubbish, indicate beyond all doubt the carelessness of the farmer, who will be apt to be as careless in other and more important departments. But, on the other hand, the absence of those evidences of laziness, indifference, and neglect indicates the presence on the farm of one who possesses a mind which loves order; and where that is, other good qualities are sure to exist. So that it has been truly said, that as fair an evidence of the value of a tenant as can well be obtained is to be got in the fields which he crops and cultivates, and in the general orderly and cleanly condition of his farm. Agents are very apt sometimes to overlook such points, deeming them to be but trifles. They are far from this, and should be carefully looked for, and, if they exist, be valued as a power for good to the property.

CHAPTER VI.

PRIZE AND EXPERIMENTAL OR 'MODEL' FARMS—ACTION OF AGRICULTURAL SOCIETIES—THE AGRICULTURAL PRESS—THE LANDLORD'S OR DOMESTIC FARM AS AN EXPERIMENTAL ONE.

IN concluding what may be called the cultural departments of the property, we deem it right to glance briefly at the above subjects. As more than once hinted at in the pages of this work, the outside public, so to call it, has been long, we may say always, treated with such a one-sided and almost totally erroneous view of what farming is, the position it occupies amongst the arts and sciences,—if, indeed, it be not often represented as having but in the smallest degree the right to be ranked amongst them,—the status of farmers themselves, in short, its condition generally, that possibly small credence would be given to any statement which maintained that farming, as an art and a science,—for it is both,—has called promptly to its aid of late years all the skill, knowledge, and material resources of the members of those professions and callings who can help forward its free and full development. The same treatment would probably be given to the statement, that in so doing our farmers have shown a liberality in the expenditure of both time and money, in securing this extraneous and valuable help, rarely equalled, we doubt, if it has been excelled by any other of our industrial callings. And not only this, but they themselves have put their shoulder to their own wheel so earnestly and wisely, that agriculture now occupies a position for enterprise and skill second to none. Hence we find our first chemists, our best physiologists, our most skilled engineers, mechanics, and architects, devoting their services to it. No class of men have been, notwithstanding all this,—which could easily have been ascertained by a certain class of writers and speakers, had they wished to know the real facts,—so completely misrepresented as our farmers. To quote the

words of one now gone to his rest, but who while living did his best in a kindly yet decided spirit to place farming and farmers in the true light before the public, if they cared to see it, they were treated with 'promiscuous and exaggerated invective.' More, and worse even than this, they were, while these matters were being discussed by the public press and platform, forced to listen to it 'in terms that were almost insulting to the very men whose ear it is most important to gain,—men who naturally repudiate the fancy portrait drawn of themselves and their brethren, who, though not the pioneers of progress, are in the van, and moving steadily onward, observing and reflecting, though not called upon (or indeed warranted) to risk their means in ventures where the follower is pretty sure in the end to outstrip the leader.'

No better evidence, perhaps, of the truth of the latter part of this statement can be obtained than in the results of those thorough investigations which have been made of late years into the state of farming as practised in various districts of the kingdom, and which have been published from time to time. But possibly more has been done to show what this farming is by the establishment of the

Farm Prize System.—This, as many of our readers are aware, was commenced some years ago by the Royal Agricultural Society of England; and its leading feature is, that the farms inspected by the best and most practical authorities are chosen each year from the particular district in which the Society happens to be holding its great annual show. By this means, just as the Society visits a different district in England each year, and thus compasses in time the round of the

whole kingdom, so will the prize system in due time have been applied to or carried out in all its districts. The labours of the various inspecting committees are embodied in elaborate reports, which are published in the Transactions of the Society. When all the districts have been visited, and the respective reports published, we shall then be in possession of a vast amount of information of the highest practical value, giving a history, so to say, of English farming during a certain number of years.

It is not within our province to enter into an examination of the results of the system, so far as it has been carried out, but we may say that they have been of a highly satisfactory kind. It is difficult, indeed, to estimate the benefits which will result from the system, or to adequately conceive the directions in which these will flow. Certain it is to our mind that these will be great and various, and as time progresses they will increase in number and value. The mere stimulus which the system will give to farmers in various districts to do their best, will of itself exercise an important influence on the farming of the future, keeping out of view the lessons which their practice will yield to those in the other districts, similarly or nearly alike circumstanced as regards the class of farming they carry on, soils, climate, or locality.

Value of the Extension of the System over the Three Kingdoms.—It is to be hoped that the system will be adopted by the Highland and Agricultural Society of Scotland and the Royal Agricultural Society of Ireland. But if done at all, it ought to be done at once, so that the various reports of the three Societies will range as nearly as possible over the same period of time,—an important element of usefulness, which will be obvious. The series of reports which the three Societies would be able to bring out, if all adopted the system, would be somewhat like the work of a Royal Commission which might be appointed to inquire into the farming practice of the United Kingdom. But the work would be infinitely more valuable, as the reports, in place of being drawn up by the same men but for different districts, would be so by men connected closely and by the same business ties and interests, and who would almost of necessity

have a thorough knowledge of the peculiarities of each district, and in addition a likely knowledge of the farms in it, offered for their inspection and report. In addition to the value of such work done by the three Societies working harmoniously together in producing a series of reports detailing the practice of the respective kingdoms, it would in one respect add greatly to the advantage of the farming community if it were possible to have the whole of the leading districts of each kingdom inspected and reported upon as quickly as possible—if simultaneously, as we have said, so much the better. For while, on the one hand, we do not lose sight of the attractions of the present system of reporting farms in the immediate vicinity of the yards of the great annual shows, which can be inspected, if so they wish, by the visitors themselves; still, on the other, we see how the simultaneous, or at least so quickly carried out reporting that a few years only would finish the whole kingdom, would get rid of this objection to the present system—namely, that the reports founded upon the farms first inspected would be out of date, so to say, as compared with those which will be published many years hence, for it takes a pretty long series to go the ‘round’ of the Society’s meetings.

At all events, and at the worst we trust the expression will not be misunderstood, the farmers of the later periods will assuredly have the benefit of the most recent applications of science to farming, of the newest discoveries, and of the most recently brought out appliances and mechanical aids. A good illustration of the point now brought forward is, indeed, to be met with in the pages of the *Journal* of the Society itself. In these, from the period of its inauguration, or at least shortly after, up till now, a series of reports upon the farming of various districts of England have been regularly published. These, written by the best authorities in each district, present an admirable evidence of its farming peculiarities and practice. But in looking over some of the earliest of these reports, while one cannot fail to be struck with the immense amount of information, valuable now as when it was first published, neither can one fail to be struck, and even much more forcibly, with the fact that, had the farmers of these dis-

tricts had the opportunity to avail themselves of the various discoveries of science, and the wide variety of mechanical appliances of the present day, and had used them, many of the details of farm practice, as there described, would have been very different, and would have presented quite a different aspect. The difficulties which the farmers of these early periods experienced, and which are recorded, or may be gathered from what is recorded, would have been got over, or would not have existed, had they possessed all the advantages farmers now have at command.

Future Action of Agricultural Societies—Power of the Agricultural Press.—We may be wrong in the view we thus take of the advantages derived from a simultaneous or more quickly gone through inspection of our farms, if such could be done by the Societies with their present means and organization, of which we do not profess here to have the ability to judge; but we know that we are not wrong in this, that the Royal Agricultural Society of England have, in inaugurating the present system of year-to-year inspections and reporting, done a good work, and that the plain duty of the societies of the sister kingdom is, taking the hint, to 'go and do likewise.' It has long been the subject of grave complaint against our leading, and indeed we may say all our Agricultural Societies, that they have not taken that enlarged and widely-comprehensive action which the requirements and pressing wants of British farming demand. This complaint has not been held by a few only, and these obscure men connected with agriculture, if any practical man can be called obscure; but it has been held by many of the most influential and the most practical of our advanced farmers. Now, although it has not found the frequent expression, either by public press or platform, which its importance demanded, it should not be taken for granted, therefore, that it has not existed, or does not now exist. Farmers, as a body, are slow to speak, and are not given, by any means, to that restless spirit of agitation which so characterises many men of the callings pursued in towns; hence the quietness which this feeling has displayed. The feeling of regret exists widely that our Societies have hitherto taken up the

comparatively very limited fields of investigation and research to which it seems as if they thought their duty and their work only extended, while so many other subjects, each in its way as important in its bearings upon the progress of agriculture as those to which the Societies have so long and so persistently given almost their undivided attention, are lying waiting for notice. Apart altogether from this fact, there can be no doubt that they should have looked to these neglected points. True, they have—at least the Royal Agricultural Society of England has—made a few important moves of late in the direction of a wider field of research and practical work. But what they have *done* is as nothing to what yet remains for them *to do*. To one at all conversant with the wide, varied, and extremely interesting, yet at the same time thoroughly practical range of subjects which agriculture as an art and science thus presents, it is not quite a gratifying thing to do to read over the records of the *work done* by our Societies during the last twenty or thirty years, as represented by their prize lists. Judged by these as a standard, the encouragement has been given to subjects very limited indeed. A stranger, for example, reading the prize lists, would see in it somewhat dry details. When one is in a fault-finding humour, it is by no means a difficult thing to find something to find fault with. At such times momentous matters are made out of what are in reality trifles light as air; exaggeration is the spirit of the hour, and woe be to the unfortunate servant who meets his master in such an irate mood. Fault-finding has, however, its merits, not being—paradoxical as the statement seems to be—all faulty; and thankless as the duty is, and disliked as the fault-finder generally is when he carries his hobby to an excess, the duty is often invaluable, and the fault-finder worthy of all praise. What we may here style the 'special fault-finder,' is the dread of easy-going office-holders. Red-tape is his especial abhorrence; and when, like the matador in the Spanish bull-fights, he flourishes it in the face of the foe, all the sting of the insult is felt in full force. The 'special fault-finder,' when distinguished, as he often is, by sound common sense, by a thorough knowledge of human nature, and by a capability to tell his story well,

elevates the fault-finding to almost the dignity of a science, and straightway becomes a ' reformer ' of the most useful kind.

The Agricultural Press.—The Press has its special duties as a fault-finder to do, and as a rule it has done it usefully and well. Indeed, without exaggerating in any way its powers, it may be said of it that all useful and recent reforms owe their existence to the Press, and the powers which it has brought to bear upon their realization. It is needless here to quote instances; but it may be well to say, that while the Press generally has done admirable service in the cause of social or needful political reform, not less marked has been the influence of the agricultural Press upon points bearing more closely on the interest of the agricultural world.

Partiality of the Prize Lists of Agricultural Societies.—In a preceding paragraph we have briefly alluded to the prize lists of societies; but if we examine closely the action of our National Agricultural Society, we must perforce be struck with one feature, this being the *partiality of its prize list*. If one will take the trouble to glance over any one of the lists of prizes published during the last ten or twenty years, and see in its somewhat dry details notices of prizes given to Shorthorn, Hereford, and Devon cattle—Leicester, Southdown, and Cotswold sheep—horses, pigs, and poultry—he cannot but be struck, on reflecting over all these, with this fact as a natural result or ' outcome ' of it, that apparently British agriculture is confined only to the points of interest connected with *stock*. ' But,' says the reader, ' you forget the prizes given to implements and machines.' No, we do not. We know very well that the battle of the implement-makers is fought every year, and that no end of prizes is given to the successful amongst them; but still, knowing all this, we may well ask, What is it all about—what are these implements and machines for? ' Is it not, it may be asked, ' to aid the cultivation of the soil, and to increase the value of its produce?' Just so; but *where are these products*, and how do we show, at our great agricultural meetings, the interest we take in them? Amongst the display of—too often—obtrusively obese cattle, and the imposing array of implements, where do we find officially registered

samples of agricultural produce? We may look for them, but look in vain; and if seen at all, they are to be seen only at the stands of private firms, who simply show in order that they may sell. And yet there can be no disputing this grand truth, that without produce we can have no stock; and if implements are worthy to be noticed, and their improvement promoted by the attractions of the prize list, surely the produce which it is their aim to increase should receive at least an equal share of the attention and of the protecting and fostering care of our Societies. We do not dispute the importance of the question of improvement of our stock, or of our implements. We would rather, indeed, urge the truth that all branches of farming are mutually dependent one upon another, all bound together in the links of a perfect chain, not one of which can be wanting without destroying the whole connection. But seeing this, and thoroughly imbued as we are with its vital truth, we are therefore just the more compelled to ask the question, Why give such prominence to one or two departments, to the practical exclusion of a third, and many more than this? We have done wrong, the reader may rest assured, in having, through so long a course of years, neglected the various points connected with the *vegetable produce* of our farms. We talk enough of the mighty progress which the art of agriculture has made during the last quarter of a century, and that progress we do not deny,—on the contrary, are *reasonably* proud of; but we have only to call to mind certain points which have often enough been discussed in connection with our vegetable produce, and to ask certain questions relative to them, to discover rapidly enough that of their true answer we can give nothing. A clever agriculturist could easily put a round of questions now to our wisest savants, and they would be compelled to say they could not answer them. Of certain things all we know is that we know nothing. In answer to all this it may be said: ' This department of the farm is not neglected by our great Societies: witness the papers read before them, the elaborate essays published in their *Journals*, the investigations made by their chemists on foods, manures, soils,' etc. But while gladly granting that this has been done, and admitting the value of it all, we submit, nevertheless, that it is

not in paper-reading, nor yet in elaborate essay publishing, nor even in the work of the laboratory, that the Societies best do their duty. 'Agriculture is not,' as it has been remarked, 'a fixed science;' its truths cannot be demonstrated with the unvarying precision and truth of a mathematical problem, nor its facts stated with the definitive purpose of a chemical formula. It is an art or a science upon which an endless variety of influences are at work, many of them most conflicting, and apparently contradictory in their nature, all of which must, nevertheless, be noticed and carefully attended to, if on the one hand we wish to avail ourselves of those which are favourable, or, on the other hand, to avoid those which are unfavourable to our purposes. The science of agriculture, therefore, is made up, as it has been well observed, 'of an accumulation of isolated facts;' and it is by carefully recording these, and watching them in all their phases of action, that the 'science of agriculture' can *alone* be advanced. This was the opinion of an able authority, and given twenty years ago. It is no less true to-day. And yet how wonderfully persistent Societies have been in ignoring this truth in connection with the 'vegetable products of the farm'! An immense number of facts have been collected and collated, doubtless; but these have been done by private individuals chiefly, and scattered here and there, and in many cases now unfortunately for ever lost. They lack the unity of purpose, and the facility of being readily grasped at by practical men, which a similar or great collection would have possessed if made under the auspices of our National Societies. In conclusion, we cannot do better than quote, in favour of an extended and philosophical system of careful attention to the vegetable produce of our farms on the part of our National Society, the words of one who, at all events, was not peculiar in his opinions. While pointing out the advantages of such a system, he says that they may 'be expected to be numerous, and far exceed those of any single experimental farm; and as the Society would not have any particular system to uphold, it would have no bias to anything but an accurate and true result.' Further, he says: 'Even in detail, these experiments would check earlier than is done at present the adoption of much erroneous

and unprofitable, and encourage that of much improved and profitable practice; while, by degrees, you would acquire a state of facts which could not but form, sooner or later, the groundwork of a very general and extensive improvement in our agricultural system.'

Much, however, of this state of matters is being rapidly reformed, and it is at least gratifying to know that the Royal Agricultural Society of England has, under its new management, become alive to the pressing importance of extending its line of operations, and widening its circle of investigation. We must and do not expect a large organization, such as the Society is, to move as rapidly as we are but too apt to think should be the case. Even when an individual runs for a lengthened period in one groove, he finds how very difficult it is to get out of it, and to go along another and perhaps a totally different one. Enough, then, for us to know meanwhile, and it is much, that the Royal Society, under a new impulse and able management, has entered upon a new development of its usefulness. We have seen what it has done in the prize farm system,—one which can be developed in directions not at present thought of, but which will doubtless become obvious to the Society as time progresses and experience is gained. It has, however, taken a further step in connection with the experimental farm of which Mr. J. Bennett Lawes has been the inaugurator, thus adding another to the long and valuable list of services he has done to agriculture through a great many years. Much could be written here on the subject of

Experimental Farms, and to which more frequently the term 'model' is applied. We object, however, to this latter term, just as we objected to its application to farm buildings; for it is not more possible to institute a farm than it is to erect a farm building which shall be a guide to or example for farms situated under a wide variety of circumstances, as soil, climate, etc. Still experimental farms can do good service to agriculture, if properly managed and conducted. But we have nationally almost everything to learn in connection with them, for they may be said to be quite new to us, the only exceptions to be met with being the experimental farm attached

to the Royal Agricultural College at Cirencester, on which Professor Wrighton has done good work, and those farms in Ireland supported by Government, and which, under the admirable management of Professor Baldwin, have been of incalculable service to the farmers of the sister kingdom. For information on almost every point connected with them we must go to the Continent, and especially to Germany, where they are not only numerous but well conducted. We may expect, however, from the arrangements made by our Royal Society of England, and the eminent men to whom its conduct has been entrusted, that its experimental farm will be so conducted, and do such good service, that it will be the means of attracting national attention to the important work which a wide extension of such farms throughout the kingdom could perform. And this, look at it from whatever point of view we may, is a subject of the highest national importance. The difficulties connected with the raising of the food supplies demanded by our dense population are increasing every year; and in view of the fact that our lands are capable of producing very much more than they are doing now, it is of the highest importance that we should know the best way to bring about this increased production. This knowledge, experimental farms, established in such numbers as to embrace representative examples of our leading soils and localities, can greatly help us in obtaining. Hence, then, the importance will be seen of having as great a number as we can possibly obtain, and of getting the nation at large so interested, that some means will be hit upon of arriving at this greatly to be desired result.

Practical Suggestions in connection with Experimental Farms.—It does not come within our province either to show how this can be brought about, or, if ever it can be so, how they should be managed; but we may suggest the following as affording a practical hint or two. Thus, in connection with the new system of board schools, those in agricultural districts, at least in the leading ones, might have, in addition to agricultural classes, small plots of land, which might under the care of the teacher do some service. True, each could not do much, but

the aggregate of so many—as we are presuming that many would be established—would form a large collection of facts, of a very varied and useful character. Of course, it could not be expected that the teacher could have either time or money sufficient to carry out anything like elaborate experiments, although extending over lengthened periods. Still there are many points connected with the practice of farming, of great practical importance, but of which we know comparatively little, in connection with which simple trials or experiments could be made by him, which would, at all events, be some contributions which might go to the general collection, affording not a few hints tending to clear up doubtful questions. And certainly such small plots would enable the teacher to impart many a lesson to his pupils, calculated to be useful to them in their after farming life. Nor need this benefit stop here; it might be extended to the young labourers of the district, and even to the elder ones, with some advantage. The difficulty of obtaining land fitted for the purpose should be easily overcome; for if the school board funds could not find all required, the landed proprietor might do worse than find the small plot required. Indeed, so well assured are we that the landlord's interests would be promoted in a very marked degree by the carrying out of the plan we have here suggested, that he would find no better investment than by giving all the land required. It would not be absolutely necessary to give the land out and out; the purpose would be secured, at least in the first instance, till the success of the scheme was tested, by his provisionally giving it, say, for a certain term of years. As regards the larger or first-class experimental farms which may yet be established, we hope that their conductors will not be above testing points of everyday practice, which they might be tempted to consider beneath the dignity of science; there are many such waiting, so to say, for the time when difficulties connected with them will be solved. Attention to these does not involve the necessity to neglect elaborate experiments, which, of course, should be carried out, as they will be, with the painstaking care which our scientific men always bestow upon their work. With regard to these

experiments, we trust we may express the further hope that, however elaborate may be the official reports of their results, a clear and short epitome will also be published. Our farmers have neither the time nor the inclination, as a rule, to wade through long and necessarily dry statements, far less to examine tables and test calculations drier still. The registration of facts stated in the briefest and clearest way is all that is required for general farming purposes. While waiting the time for the establishment of experimental farms generally throughout the kingdom, which many of our readers will doubtless think will be coincident with that rather dreary period the 'Ides of March,' a good deal of experimental knowledge might be obtained through the means of

Landlords' Domestic Farms.—These are known by various names, but perhaps more frequently as the home farm, sometimes the park farm; we prefer, however, giving the title of domestic farm, as perhaps more clearly or popularly indicating the uses which it serves in supplying to a large extent the mansion and its outbuildings with the varied farm produce which the inmates require. Some of our readers may think that, in expecting 'domestic' to serve the additional purpose of experimental farms, we are demanding from them more than we have a right to expect; but the truth is that they have for a long time acted in this capacity, and as such have done most valuable service to agriculture—not less so because it has been done quietly and unobtrusively. To those who know the history of the 'domestic farms' of England, there is not the slightest doubt in their minds as to the enormous advantages which the districts surrounding them have received from the work carried quietly on by their managers, most if not all of whom have been men of first-class attainments as practical, indeed many of them as scientific, farmers. We could name so many domestic farms which have sent out the best specimens of our live stock, and the fields of which have been the scenes of experiments the results of which have had a world-wide fame and utility, that they would make up a list in its mere length surprising to many of our readers. This would not consist of the names of extensive farms of the nobility only; but many of very humble

pretensions indeed, as compared with these, would appear in it as having given to the farming world much of the highest value. No doubt, the effecting on domestic farms the combination of experiments in both the stock and cultural departments with the requirements of the mansion, demands the exercise of no small degree of skill and care. Nothing must be done in a slovenly way, for whether the manager considers it as a farm set on the property to be an example of good management or not to the tenants on the property, they will assuredly consider it as such, even although they do not follow the example set, if it be conducted as it ought. In this view, the manager will do well to consider how he can arrange all the departments so that each will show its highest capabilities. The subject of this section is so wide, and embraces so many points of interesting detail, that larger space would be required to do full justice to it than we can give. So far as making the domestic farm useful in a certain degree as an experimental one, the manager must be allowed considerable scope. It will not do to limit him, for example, in carrying out certain experiments in dairying, to those periods of the year when the family is from home, or if at home, receiving few visitors, stopping his experiments at the times when there is a great demand for dairy produce. He may, indeed will, require a whole season in order to arrive at certain results he is aiming at. Experiments, therefore, may be to a certain extent costly; but the manager, by the exercise of some care, will be able to carry out much at little or no extra expense. Field experiments will be more easily carried out, indeed the majority of them, at a cost very little extra to that of the ordinary working.

The view, however, which we take of the domestic farm performing the offices of an experimental one, is not that it should, or indeed can, be carried on on the same principles and in the same style as experimental farms are. This would be quite foreign to the main object of the domestic farm, which must not be lost sight of. What the manager should have in view is, so to conduct all the work of his farm in such a thorough, business-like way, that it would serve as a model or example farm for the tenants. A vast deal of good would be done to them by the

manager showing how the ordinary work of farming could be done in the best way; more so, we may fairly expect, than by special and more or less elaborate experiments. The farmers, as a rule, would not take the trouble to follow the experiments from beginning to end in all their details, while in some instances it is probable that they would not even take the trouble to read a published record of them; but one can easily understand that they would readily, and indeed gladly, notice and comment upon any new or improved method which the manager might introduce, calculated to aid ordinary farm work. But at the same time, however, keeping the domestic farm in such a way that it would be really an example one for the neighbourhood, it does not follow that experiments of a special character, and even some which would be considered somewhat elaborate, should be excluded. The two objects can be easily enough worked out harmoniously by tact and skilful management; all that we would insist upon being, that the legitimate object of the domestic farm should be strictly followed up, but in such a way that the work done, and the way in which it was done, would serve as examples for the tenants, and act as inducements for them to adopt the same on their farms, wherever suitable. One point must not be lost sight of by the manager, although some may think that it scarcely comes within the scope of experimental work; and this is, that the domestic farm should be an example of order, as perfect as can be obtained. Take, for example, the farm-steadings, which on domestic farms are specially designed for, or if not, are certainly considered by the tenants and neighbourhood to be what they call model buildings. Now, however unique these may be in point either of arrangement or fitting up, they certainly will not act as good examples if they are kept in a state of slovenly disorder. Amongst the many farm-steadings in connection with domestic farms, more or less celebrated, which we have visited in various parts of the kingdom, we have come across instances of model steadings, so called, which were kept in such a slovenly condition that they really reflected the greatest disgrace on the management; while, on the other hand, we

have met with instances, where no pretension to being model steadings was made, where every part, from the open yard to the most confined corner in the buildings, was kept in such a high condition of what housekeepers call 'apple-pie order,' that it was a delight to inspect the buildings. In the one case above cited, the stading was an example to the farmers around of what was to be avoided; in the other, of what was to be strictly followed. This same order should be witnessed in every part of the domestic farm, throughout the fields as well as in the fold. In brief, the manager should ever bear in mind that everything he does will be sharply criticised by the tenant-farmers of the district, and that he will not be spared should he show any neglect or ignorance, even although the critics themselves may not be up to the mark in the working of their farms. This position of the manager should at once act upon him as a warning not to neglect, and a stimulus to excel in everything connected with the domestic farm. While domestic farming in its general details is made the same as that of ordinary, there are features connected with it which render it in some degree special; this arising from the circumstance that its main purpose is to supply the wants of an establishment, the circumstances of which are necessarily, from the social position of the proprietor, peculiar and varying in character. The manager, therefore, must have a ready adaptability to meet those varying circumstances, and even what may be called household emergencies. We might pursue the subject much farther, but this scarcely comes within the scope of the chapter; moreover, we have in several preceding sections, while treating of cognate subjects, given several remarks and thrown out not a few hints, which are obviously applicable, more or less modified, to the subject now under consideration. With what we have here given upon it, and with the matter above alluded to, the reader will be able to gather suggestions enough by which he may be enabled, with the aid of an intelligent manager, to make the domestic farm eminently useful to the tenants, not only in the directions we have indicated, but in others more or less obvious, and also as tending to promote and increase the general prosperity of the property.

DIVISION SEVENTH.

GENERAL CONSIDERATIONS AND PRACTICAL POINTS CONNECTED WITH THE BREEDING AND REARING OF FARM LIVE STOCK AS AFFECTING THE INTERESTS AND INCREASING THE VALUE OF LANDED PROPERTY.

CHAPTER I.

INTRODUCTORY REMARKS—PRESENT CONDITION AND FUTURE PROSPECTS OF THE CATTLE TRADE AND OF CATTLE FARMING.

It is not easy to overrate the importance of this subject to the interests of proprietors of landed property. And yet, important as it is, and influencing in the highest degree the interests of landlords and farmers alike, it is nevertheless a subject on the details of which an extraordinary diversity of opinion exists. Possibly we should be more correct in saying has existed, in view of the outcome and our more recent experiences, although there is still diversity of opinion enough to make it a difficult matter to decide which of the systems recommended should be adopted by those who wish to make this department yield the maximum of results with the minimum of cost. What these diversities of opinion are, and in what direction they lead, will be described as fully as the space now at our command will afford.

These diversities of opinion are found in the very front, so to say, of the discussion; for some maintain that it is not the interest of the farmer to increase his live stock, inasmuch as it is not merely doubtful, but it is certain, they say, that, at least so far as cattle are concerned, their keeping does not pay the feeder. The reservation as to cattle in this case is wisely made, for this opinion could scarcely be maintained with regard to others of our live stock; while at the same time the opinion is based upon facts somewhat doubtful, to say the least, as to their accuracy, and the point is altogether ignored, that if their opinion be correct, the result arises not so much from any inherent impossibility to

make cattle-feeding pay, as that there may be some defect in their systems of treating them which brings about the difficulty. And that this is likely to be the case may be gathered from the opinions of eminent authorities, who hold that this is really so, and who give facts and figures to show why it is. Still more convincingly, moreover, from the fact, which cannot well be disputed, that feeders not a few, who have devoted themselves mainly to the department of cattle rearing and fattening, have not only made money, but in numerous cases accumulated large fortunes.

But the subject is one involving interests of such enormous magnitude to the country at large, and, what is of special importance to us in the present instance, to landed proprietors and the farmers under them, that the points connected with the question as a whole cannot be settled in the easy, off-hand way done by some, and of which we have above given an example, and which simply takes into consideration for the main part but one point, without looking at others. Certainly they have a difficulty in overcoming such striking points as are concerned with the large demand existing throughout the country for animal food,—a demand which has increased to an enormous extent of late years, and is still increasing,—and the high prices obtained for dead meat, or, more correctly, we should say paid by the purchaser, the producer not always, if ever, obtaining correspondingly high prices. For beyond a doubt, apparently, is it that there is a great deal of truth

in the assertion of an eminent authority, 'that although it is a fact that the prices obtained from the public are high, whoever benefits by this, be it the grazier who buys, the salesman or the butcher who sells, the farmer, at all events, is not on the gaining side; so far from this, he is little if any better off than when the public gave much lower prices for their food than they do now, while his rent and other expenses have greatly increased.' On this point the reader will find a few remarks farther on; meanwhile we may simply note that to some extent the farmer may himself be to blame for this state of matters, and that certainly a reform in the whole system which intervenes between the producer and consumer is imperatively demanded in his own interests at least, although it would be no difficult matter to show that it is no less demanded in those of the general public.

Meanwhile, taking it for granted that cattle-feeding does, or can be made to pay if properly conducted, and keeping out of consideration for the present other animals of the farm, the important changes which are being introduced for the supply of butcher-meat into this country make it a matter of vast importance to our feeders how best to increase their herds, and at the same time to decrease the cost of their breeding and feeding.

Thus, if we glance for the present at one only of those changes, namely, the importation from America of meat ready to the hand of the butcher for sale, we see that the farmer has here to face the diversity of opinion we have already pointedly alluded to; for while one party maintains that the farmer has nothing to fear from this competition, another maintains with equal vigour that he has. Again, while some, admitting the fact that the quantity or weight of the meat imported has already reached a point which at least is noticeable, and is likely still further to increase, hold that the meat itself is not of that quality which should make the farmer fear competition, taking into consideration that of the meat which he can produce; others are found to maintain that the meat imported is of such a high quality, that, to use the words of one entitled to give an opinion on this important point, 'no English beef can brown up or come to table of finer flavour.' On this point it would be worth

inquiring whether the 'cuts' and the qualities of the meats examined in these two cases, and the way in which they were treated on board ship, are similar; for, so far as the systems of transporting are concerned, it should be remembered that there are two in use, and that of the two, one is, in the opinion of the best authorities, that which has the least deteriorating effect on the meat imported. It is not our province to enter into any details on this point; we only advert to it as showing how necessary it is, before one decides between two conflicting opinions, to know whether these have been given on things similar or equal; for if not, the value of the contrast is so far worthless. The same remark applies, though in another direction, to the department of live animals, now so largely brought from America. If sold to the butcher, and by him killed immediately on landing or very shortly thereafter, the quality of the meat will be affected by the deteriorating effects of the transportation system, however well devised and conducted. There is no doubt, however, of the fact that the trade of importing meat is, while we write, increasing daily, and that the demand for it exists not only, as some have said, 'among the lower classes only,' but rather, on the contrary, amongst the best of the middle classes; not only because it is decidedly cheaper, but actually better, as they think, than much of the meat sold at higher prices by English butchers and produced by English farmers. Moreover, the 'prejudices' of the 'lower classes' against the meat are much more marked and difficult to overcome than is generally known or suspected, save by those who know the working classes well. The trade has now so long been carried on, that we may fairly assume that it is sold with a profit, and that if it takes the course that other trades follow, if there be only a fairish margin of profit, it will increase still more decidedly. One point connected with the trade has, however, been singularly overlooked by nearly all—at least has had till now no public utterance; and this is the likelihood of cattle disease, in one form or other, breaking out in America, or amongst the animals in transit, either having a predisposition to the diseases, or taking with them the germs, to break out in the often too favourable circumstances on ship-board. We say singularly overlooked, for

but a little consideration was required to show that, the disease existing in America as with us, the time would almost certainly come when it would show itself at the port of debarkation, when, as a matter of course, under the new regulations the traffic would be stopped. This is what has actually happened. Further, it should not be lost sight of that there are other outlets for the trade; for if meat can be brought over from so great a distance as America, surely those connected with the cattle trade of the Continent will before long begin to see that the system can be applied by them with equally and, indeed, more favourably paying results. The matter for surprise, indeed, is that they have not by this time moved in the matter, for assuredly they have more chances in their favour than those who are carrying on the trade between this country and America, so far, at least, as cost of transport is concerned. Whether they will be able to compete as favourably in point of the quality of the meat is another question, and is, we confess, open to doubt. Not but what there are on the Continent many eminent and successful breeders and feeders, but they have to compete with, if not a wealthier, at least a more numerous body in America, while the latter have feeding advantages which many of the Continentalists have not. Whether or not this new trade will in time assume such proportions as certainly to affect the interests of our own farmers, time alone can show. As we have said, the most contradictory opinions exist on the subject, and all are alike based simply upon conjecture, as, indeed, in the present condition of the question must be the case. One influence it is to be hoped will arise from it, to which we have already alluded, and that is in modifying, and in time wholly altering, the system which at present obtains in bringing the meat produced by the farmer to the consumer. 'As it seems to us,' says one of the first authorities of the day, 'the existing system is adapted to enhance the price of meat to the eater, and to prevent the feeder from either knowing what he has produced, or what is its real value. No other article of general consumption is sold, as cattle are, by guess-work. The anomalies which provoke surprise in the meat trade can never be removed until public abattoirs be enforced, and cattle con-

verted into beef by parties anxious not to conceal, but to establish the truth about the weight's worth of meat, offal, and hide.' In connection with the influence of this new trade upon the interests of British farmers, and on this same point, another eminent authority says: 'The question is also worthy of consideration as to how the producer of beef can get more directly at the consumer than he now does. As it is, two profits are made before this can be done. Then it is also a question *whether the dairy products may not, under the new state of things, pay the farmer better than raising stock for beef.*'

There are two other causes, which have greatly, we may say generally, been overlooked, which will go far in the opinion of many to lessen the chances of the importation of the American dead and live meat injuring permanently the British breeder and feeder. The first point is one closely connected with the shipping interest. At present, and unfortunately for a long time back, the condition of the Atlantic steamship carrying trade has been altogether different from that which is its ordinary state in prosperous and even moderately prosperous times. With a depression in our manufacturing businesses nearly unparalleled in our history, the American trade has gone down till it is the mere shadow, so to say, of the solid substance which it formerly was. Not only has the number of the steamships belonging to this country engaged in the American trade been brought down to a minimum, but even those running, few as they are, run in many cases practically empty, passengers and the mails being the chief existing causes of their running at all. Better for them, in returning, to bring freights which pay any price, than to return with none. Whatever be the freights chargeable for the transport of live and dead meat, it is notorious that it yields a much less profit than that yielded by the freights of prosperous periods of ordinary trade. And not only so; the meat trade is one which demands special arrangements more or less costly, not merely in their first construction, but, what is more to the point, in their regular carrying out. This objection may be met, as regards dead meat, on the ground that it can be conveyed so as to take up little room, or barrel bulk, or 'cargo space;' but even dead

meat requires, under the necessities of the preserving system by which it is brought over, more space than ordinary goods or raw cotton require, they being capable of being so packed that the maximum weight can be stowed away in the minimum space. But in the case of live stock, the conditions of transport are still more antagonistic to its being carried on cheaply, the animals demanding for their comfort and health comparatively large space; and it is obvious that they will require and must obtain much attention during the voyage, and this must be more or less costly. These things being so, the chances are, indeed the certainty is, that when the ordinary carrying trade revives, the whole of its present conditions will be changed, and higher freights for the meat trade will be demanded. If this be conceded, the result is inevitable that the price to the consumer here must be raised. Whether it be true or not, as stated, that even at present the margin of profit is narrow enough, it is notorious to those who have watched the progress of the trade from its beginning till now, that, so far at least as the 'prime cuts' are concerned, the price charged for them was undoubtedly at the first below that charged for the same cuts by English butchers for English-fed meat, but was gradually raised till there was little difference comparatively—and this is truer now in many cases—between the cost of American and that of English-fed beef. The sale, in many districts at least, fell off, and could be only, if it ever was, brought up to the same point by a resumption of the lower prices. Now the truth brought out by this was, that as between American and English beef, however good the former might be, English beef was invariably preferred by English purchasers, although a higher price was asked and given for it. It was only when there was such a marked difference between the prices of the two that the American beef was in demand amongst more classes than one; that one was chiefly the middle class, or a certain section of it, which from the beginning of the trade were steady customers, and have continued to be so. Indeed, if report says truly, English butchers in some cases sold largely of American beef as English—a fact conveying a double proof that American beef was as good, or thought to be as good, as the English; for no

complaints were ever as a rule made, and it seemed that, as is natural, the mere statement that the beef was English, whether so or not, carried the day with the purchaser. It is by a now long experience and by a long series of facts—not very creditable to the intelligence of purchasers—proved that where the difference of price between the two is comparatively small, a halfpenny to a penny or even three-halfpence the pound, the English beef gains the custom. Price, however, is not the only element or factor in these important calculations; prejudice is all-powerful—so powerful, especially amongst the lower or poorer classes, that it largely influences the trade; so much so that it is well known that in the case of other American products, as bacon, cheese, and butter, the dealer in many districts, to sell, has to palm them off or placard them as English. The outcome of all this is, we believe, that, so far as price is concerned, the moment freighting is raised, the demand for American meats will assuredly fall off, prices rising as a result. This, beyond a doubt, carries with it some comfort to the British farmer.

So also does the other point we referred to, although the realization of that may be more or less doubted by many, and must be in some measure comparatively remote. This is, that although at present the supply of American-bred meat seems unlimited, it is only apparently, not in reality so. This arises from certain peculiarities of American farming. Those who know the United States, know that the system of purchasing and working land is altogether different from ours. Land is bought, and advantage is taken of its extraordinary fertility to raise a succession of crops, without returning anything to the soil in the way of manure, till it becomes exhausted. When this happens, and usually long before it does happen, the farmer, with that peculiarity of American character which leads them to perpetual changes, having literally 'no rest for the soles' of their feet, moves off farther west, and still farther as the same impoverishing process goes on. The result is, that in the neighbourhood of all older and established towns, farms, exhausted and neglected, are to be had for a 'mere old song;' but, with the exception here and there of an enterprising improving farmer from the 'old

country,' comparatively few take them. Production is therefore driven west, and the farther west it goes the greater the difficulty and the higher the cost of sending it off to the markets of Europe. But another point is enforced by those who have closely studied the question, and that is, that American farming, even on good, that is, new lands, is essentially a vicious and defective system. That we particularly noticed on the occasion of our visit to the United States, and our views were given in a long series of papers in the *Journal of Agriculture* and the *Transactions of the Highland Society*, under the title of 'Notes on American Agriculture.' The British farmer, then, it is stated by those who can speak with authority, has nothing to fear ultimately from the competition of American farmers. It is, indeed, only a peculiar but by no means prominent characteristic of American farming of late years, that they happen to have had ready to hand the stock which has been so largely sent to us. With the dying out of these peculiar circumstances, conjoined with the bad system of American farming, the importation, so it is said, will die out. Time alone will show whether this be correct or not. But enough of actual facts connected with the system actually existing are to hand to show, as we trust we have shown, that the British farmer, with a return to his reasonably good times, has not much to fear from American competition. He may and will have it in readily transportable farm stock, but that competition, not a few of our most practical men believe, he can meet if he chooses by adopting new and improved systems of management. The importance of the subject is an excuse for thus so fully considering its details. If it be true that, as regards difficulties, a 'man forewarned is forearmed,' so also is it that he is rendered all the better if he is freed from the fear of what may never be realized; the dread of something coming, which may never, perhaps cannot even come, has a bad effect upon the efforts of all of us who are workers.

We have given enough to show that this new system of meat importation is likely, in one way or another, to influence the future of British cattle-farming. The first of the two authorities just quoted believes that this system

is likely to injure our farmers materially; the second authority thinks they have nothing to fear from it; but we see that both are agreed on one point, that the relationship between the producer and the consumer of English-fed beef must be altered. We have long advocated this alteration, and that it is necessitated is so far proved by two authorities, who hold different opinions on the one point which is likely to prove the cause of the alteration, but agree to the full in this, that the amendment in the selling system is imperative in the interests of our farmers. But it is proved by many other authorities and in many other ways, of which latter the most important, obvious, but too frequently overlooked one is that of 'common sense.' What has this to say of the system? Various and conflicting as are the views held by practical men in this country as to the future of this trade of meat importation, it will surprise few of our readers to learn that many in America, equally entitled to be there considered authorities as are ours here, take an exceedingly sanguine view of it. So much so, and to such a large extent do they consider their country capable of supplying meat, either as live stock or dead meat, that, according to the very latest news as we write, capitalists with large means at command are making arrangements for a further development of the trade. And this is proposed to be such that what has been done in it will be as nothing compared to what it is proposed to do. Further, and the worse for our farmers if the prospect be realized, the price at which the meat is to be sold here— $2\frac{1}{2}$ d. to $3\frac{1}{2}$ d. per lb. in Liverpool—will simply be ruinous to our farmers, who produce meat bred and fattened under the difficulties they have to contend with. It remains for the reader to come to his own conclusions as to whether any of the conditions to which we have alluded will ever come into force, so as to cause the present speculations of Americans to fail. Granting that these conditions are not fulfilled, farmers here may take such comfort as the proverb affords them, which warns American speculators that 'there is many a slip between the cup and the lip.'

Important Points to be attended to in our Live-Stock Farming.—From what we have said as to the diversity of practice in cattle, or, as embracing all

the animals of the farm, what may be called live-stock farming, the tyro will perceive that in the setting out of the farms and lands of the property to be devoted to this department, the manager has not a few points to which his attention must be directed, and some of which will at first be difficult to decide. The peculiarities of soil and climate, and also of position of the farm with relation to certain prevailing winds of an adverse kind, etc., and of locality as regards nearness to market, etc., must all be taken into account. Thus, for example, on some soils cattle may be said to be producers of manure only, in no sense paying as beasts for the butcher; and even as regards the manure, they may be said to be but poor producers of it. Some authorities, indeed, maintain that stock-keeping all round serves a purpose but little better, if any, than the above, and even if better than this, but a risky source of income at the best. Still, stock must be kept on the farm, and it is the duty of the manager and the tenants he takes to see that everything is done to make its keeping in the highest degree paying, as far as that is possible. We have shown incidentally, in the consideration of the arrangement of certain classes of soil (see preceding chapters), that even on the most unlikely farms, modifications in practice can be introduced, tending ultimately to improve their prospects as stock producers.

And we shall see as we proceed, that in addition to what we have already there said, and hinted at in the present chapter, there are not a few improvements upon old practice which go far to modify the difficulties attendant upon certain soils, under certain climates and in peculiar positions and localities, rendering them very much better, as stock farms, than those enamoured of the old systems, and who persist in working upon the old lines, are disposed to admit. To all these indications, which science on the one hand, and the outcome of careful and advanced practice on the other, have already afforded, the manager must give heed; and to all probabilities of others yet to come, he must ever give a watchful eye. These are not the times, with the increased and ever increasing wants of dense population, to 'go to sleep,' as the expressive phrase is, or to rest satisfied with what has been done. The question to be daily asked is, What can be further done to supply these wants as fully as can be, and at the same time to make the work a paying one for the farmer, and, by consequence, for the landlord of the property? The facts from which the answer to this vital question may be derived are to some extent supplied in foregoing chapters; what remains to be stated or briefly glanced at will occupy our attention in a succeeding section.

CHAPTER II.

THE BREEDS OF CATTLE SUITED FOR DIFFERENT LOCALITIES, SOILS, AND SYSTEMS OF CATTLE-FARMING.

Circumstances influencing the Breeds to be kept, and the style of Farming to be adopted.—Having thus given a few remarks of some importance as introductory to the general subject of live stock, we now take up in succession the various points connected with the practice of this department; and, first, as to the selection of the breed. At first sight, at least to the tyro and inexperienced, this would seem a matter very easily to be decided, but it will be seen presently that it is not so. It would seem that it would be a point of positive, or at least comparative, indifference to the young farmer; after having decided that stock would form the main feature of his business, it would matter little whether he introduced this breed or that, or whether he would devote his attention to the production of meat or of dairy produce, or perhaps a combination of both. He might, for example, as regards breed, having heard so much about shorthorns, determine to confine his attention solely to that class of stock; or taken, perhaps, with some discussion on dairy-farming, and the profits to be made from it, determine to devote himself exclusively to that branch; but he might very shortly find that, in place of pleasant profits, his balance-sheet would show nothing but lamentable losses. This may be supposed to be an extreme case of ignorance on the practical points of the subject; but there is no doubt that examples of it are not altogether unknown, while beyond a doubt, modifications of it, more or less marked, are of frequent occurrence. In point of fact, cattle-farming, to give it a generic name, involves many systems, each demanding its own particular breed and style of management, influenced by its own particular class of soil, its climate and locality. Thus, one farmer

devotes himself to the breeding of animals of a certain class, and the feeding of them up to a certain point for some special or specific purpose. This may be either for the production of meat, or of milk, or butter, or cheese only, or for the three latter products combined. Again, these two great divisions of cattle-farming have subdivisions, so that while concerned with stock for meat purposes, the farmer may devote himself solely to the purchase of store cattle, and their feeding during the winter for sale during the spring months; or he may confine his attention to the breeding, rearing, and fattening of some particular breed of cattle suited to his farm. Again, he may take to dairy-farming; and this he may conduct in one of two ways,—either purchasing his cows, selling them off at once when dry, or fattening them thereafter for the butcher, disposing also of such calves as are born on the farm, thus setting aside all rearing of dairy stock; or he may, while conducting his general dairy business, take up the rearing of calves, and the production of first-class cows for sale and the supply of his own stalls. And even as regards the products of the dairy, he may, as we have already hinted at, produce and sell milk alone, or this along with butter, or he may confine his attention solely to cheese-making, according to circumstances.

It is obvious, then, with such a diversity of practice, a careful selection of the breed is necessary, while this also involves the necessity of attending to the best methods of producing food; and this, again, brings with it the requirement of certain soils, and a careful choice of locality and climate. Thus it will be seen how it is that one farm is classed as a dairy farm, another as one devoted to cattle feeding and fattening, while, if we extend the subject to live stock generally, another

is devoted to the production of sheep. This, then, accounts for the diversities of breeds; for it is not always merely a matter of taste or prejudice that we find one farmer confining himself to shorthorns, another to Herefords, another to West Highland cattle, a fourth to the Polled breeds, and so on, the fact being that he is compelled, so to say, by the peculiar quality of his land, and its locality and climate, to devote himself, as a rule, to that one particular breed most suitable for these circumstances. But there are other conditions which bring about a still further diversity in the details of practical cattle-farming; for it is not, as the tyro might suppose, that this is simply divided into two great classes,—first, breeding, rearing, and fattening beasts for the butcher; and second, dairy-cow keeping. There are in each of these classes what may be called sub-classes or divisions, any one of which only may be taken up and its practice followed out by the farmer, to the exclusion of all others; or he may work out a system in which there may be a combination of two or more of these subdivisions, the peculiarities of the leading ones of which will be noticed presently. With these facts, and others which could be named, it becomes a matter requiring the most careful consideration on the part of the farmer devoting himself to cattle, as to the breed which he should adopt. This, of course, will in a great measure be decided by the farm; and as regards this, he may be placed in one or other of two conditions: first, he may be already in possession of a farm at a time when, from certain circumstances, he may consider it wise to make his special business the production of meat rather than that of corn and arable land produce, in which case he will have to adapt his breed to the peculiarities of its soil and climate; the locality will in a great measure decide the kind of market opened up for his produce. On the other hand, supposing he has determined from choice or some other consideration to go in for a particular class of stock, and for one or other of the departments or systems of management of it to which we have already incidentally alluded, he will have to exercise his skill in looking out for a farm best adapted to the object he has in view. Thus, in these two cases, the first compels him to adapt his breed, and style of managing these, to the

farm and the locality he already possesses; while the converse course is the case of the second, in which his choice or predilection for a certain class of live stock compels him to look out for a farm best suited to this. No doubt all this may be in great measure dispensed with, and the farmer may rely upon making profits without paying particular attention to breed; or he may take up shorthorns wherever he be placed, that breed being sometimes called a ‘universal’ one, as it certainly has wonderful powers of adapting itself to an exceedingly wide range of climate, soil, and locality. Nevertheless, where practice is really scientific in its details, the circumstances we have named will be found to exercise a powerful influence, so that it cannot with safety be affirmed that there is a ‘breed’ adapted to all circumstances. The shorthorn would in a measure starve where other breeds would thrive. The very bulk or weight, indeed, to which the shorthorn attains, or is capable of attaining under the most favourable circumstances, and to arrive at which should of course be the very object at which the feeder aims, and the rapidity, as compared with other breeds, with which that bulk is formed, indicate that poor pastures are not suitable for it when grazing is adopted, or poor soils incapable of growing the crops necessary to carry out the home or sheltered system of feeding and fattening, when that is the one decided upon. Much of what is here said applies to the Hereford breed of cattle, which is often called the ‘rival’ of the shorthorns, and which, for beef-producing or feeding qualities, often comes closely up to it, and the meat of which is highly esteemed for its high quality, its fineness of grain, and general richness of flavour. But if we come to the Devon breed,—of course we refer here to the pure breed, not the mongrels which go by this name and are but too well known to buyers in certain parts of England,—although we find it but little inferior, if indeed at all, to the Hereford, for its feeding and fattening qualities, and for the rich, juicy meat which it affords, it is in its habits so hardy, that the fine qualities it displays in its own *locale*, with its rich pastures, suffer but little deterioration when it is kept in less favoured districts as regards climate, and upon poor and even comparatively scanty grass as regards soil.

Upon the skill and judgment which the live-stock farmer possesses, first as to the animals themselves, second as to the land, etc. which is to maintain them, and the best way of feeding the one and cultivating the other, depends entirely his chance of success. The difficulties attendant upon stock-farming are therefore of no ordinary kind, and to meet them all with even but a moderate degree of success, demands a knowledge of so many points, that it is not to be wondered at that few succeed in reaching the highest standard, and so many fail. Nor are the difficulties lessened if he takes into his counsel many who are supposed to be authorities, for he will find in the diversity of opinions which meet him, an apt exemplification of the proverb, 'Many men, many minds;' so much so, indeed, that a man of determination and self-reliance will decide that he will have to think for himself, and by patient and careful observation find out what he requires and what he must do.

Breeding, Rearing, and Fattening Beasts for the Butcher.—We shall first devote our attention to the consideration of the points connected with breeding and fattening beasts for the butcher. Having decided upon the breed to be taken in hand,—this decision being based upon one or other of the considerations we have already noticed,—the first question which the cattle farmer has to decide is whether it will be better for his ultimate interests to purchase in the open market, or to breed and rear them on the farm. The system too much in vogue with many, to go into the 'open market' and buy whatsoever offers itself, is one which has done more to spread disease, and to deteriorate the general quality of stock, than almost everything else put together. No doubt, if the farmer does not see animals which are up to the mark, he may not, or will not, buy; but he is, nevertheless, often tempted to buy animals of an inferior kind because they are 'so cheap.' This holds true, of course, more with the farmer of limited means than with the one who has the command of sufficient capital to work with, but it operates at times even with the latter. And even where good animals—that is, in the sense of being 'well-bred, shapely beasts'—are bought, the farmer is by no means sure but what he is thus directly importing into his farm, and placing amongst his

otherwise healthy stock, diseases or complaints which may cause him great and grievous losses. The true way, then, is to 'begin at the beginning.' This is better even than this other way, which no doubt is safe, or if not absolutely safe, which has been recommended by good authorities, of buying good stock from a neighbour or a well-known breeder, who has got a reputation to lose, and cannot afford to lose it by having bad stock for sale. But safe as it may be, it is not the cheapest way, inasmuch as it is evident that the breeder must be paid for his skill and care as well as for his reputation. But, by the farmer himself being his own breeder, beginning at the beginning, he knows what he is about, and saves money by securing to himself all the advantages which breeders who breed and rear to sell gain, and gain quite legitimately. Beginning thus, he knows each animal he has, can weed out the bad or poor and dispose of them in the most profitable way, and keep the best ones for his own stock. And as he knows the peculiarities of each animal, tracing it up through all its stages of progress from the calf to the cow or the bull, he can adapt his management to these, and thus in obvious directions save expenses, and secure what he is aiming at—good stock. No doubt, first-class animals can be bought in the market; but it is not every one who has the means to do so, nor, what is perhaps of more importance, the ability to select the best suited for his purpose, for, as an authority remarks, 'one has to be governed by nice rules in this matter.' The man who can go into a stable or barn, or into a pasture, and select from a herd of cattle the *best* animal to put into the field, yard, or stall for fattening, the best cow for the double production of beef and milk,—that man has cultivated his powers of observation, perception, and judgment up to a point equalled by few. It is astonishing how quick, accurate, careful, and precise a man's eye has got to be in order to settle these questions. You may talk about the exquisite skill with which the manufacturer changes the colours of his warp and woof, and all that, but we have never seen any men with sharper perceptive faculties than the men who have been successful in the selection of animals. Much more difficult will be the task of the farmer in choosing the best animal in open market

than in the yard, byre, or pasture, where, at least, he will have more time given him to examine and consider; for in the market this will not, cannot indeed, be obtained. Moreover, the best beasts he wishes may not be in either of these places, and so he has to go elsewhere, and this involves at once expense and loss of time. True, he has the pens of the leading shows to choose from, but show beasts are dear, and not always quite those he wishes; as they may, as they sometimes do, possess qualities, such as inability to beget their like, which he does not certainly wish for. All this is not the popular, but it is the absolutely correct view of the matter, and which is conceded by those who have known or know how the best breeders of stock almost require a life-long application of patience and observation before they can be said to be 'masters of their art.' Indeed, one of our most eminent breeders has stated that so many, and so nicely and finely adjusted, are the points connected with cattle, that at the end of a long and eminently successful practice, not a day even then passed over his head but he was observing something new, which was of practical value to him in his business.

Points to be observed on commencing a Breeding Stock.—Such, then, are the difficulties with which the young breeder has to contend, but which he should aim at mastering. What are the points to be observed, then, in first starting the breeding of cattle, chiefly for fattening for the butcher? Obviously the selection of the male and female animals. To begin with the female, which, according to many good authorities,—although this is a disputed point,—gives the stamp or impression of any certain peculiarity to the herd: she should be 'round-bodied, fine-boned, clean-headed, straight in the back, straight in the rump, sharp clean chine, good depth through the heart, firm legs to walk upon, a good, ample, luxurious mouth—the expression of a good feeding animal being always seen in the mouth, and in that part of the head which is devoted to the business of feeding. All these points, added to a good mellow skin, should always belong to the female out of which you intend to breed a herd of cattle for the purposes of feeding.' Although the influence of the

female on the breed is very marked, the characteristics of the progeny are, of course, influenced to a very great extent by the first male with which she has connection. In selecting the bull, it should present exactly 'the same points as the female, except in a masculine degree. But the head must be specially distinct, with none of the characteristics of the female head and neck. Talk about a bull that has a feminine head upon him—you might just as well talk about a man with a woman's head on his shoulders! You want, in the male of the breed of animals you are producing to kill, everything that is in the female double-distilled, multiplied tenfold, because it is from the male side that the whole vigour, power, and force comes, after all; so when I describe a cow for the purpose of meat production, and a cow for the purpose of the dairy, I always describe the bull as having the same points for the same purpose, only added to, multiplied, and increased, so as to make the animal strong and masculine.' We have said that the fact that the female exercises the most direct influence upon the progeny is disputed; indeed, the opposite may be said to be the view held by the great majority of the best breeders. Whether or not, it certainly is a fact that it is very difficult to obtain or to breed a female possessing all the points desired; this, therefore, determines the practice of directing attention chiefly to the breeding of bulls. But this, even although the simplest or apparently so, demands, nevertheless, as we have seen, the exercise of the highest degree of patient observation and care before a high degree of skill can be obtained.

'In-and-in' and 'Cross' Breeding.—The herd being supposed to be increased till it comprises several animals, the question next arises, whether on increasing it he should confine himself to the best of his own, thus breeding 'in-and-in,' or whether he should get good animals from another herd or breed with which to cross his own, thus introducing 'cross-breeding.' The relative merits of these two systems has given rise to a large amount of discussion, carried on in many instances very warmly. We have not space here to enter into the points of these two systems, but taking a balance of opinions on both sides, it would appear to be in favour of the

'in-and-in' system; that is, of course, on the supposition that the breeder has succeeded in obtaining, to commence with, a good 'pedigree' animal. Some of the best herds of shorthorns, the 'crack' cattle of the present day, have been produced by following the 'in-and-in' system; certainly where one follows the system of not going to open market to purchase his stock, the 'in-and-in' is best suited. Its value has been shown in other classes, for the best flocks of sheep, as well as the best breeds of horses, have been produced in the same way. One eminent authority puts it thus: 'Feed well and breed closely, and you can make the type you want.' But even here it will be found that the results will depend very much upon certain circumstances and peculiarities, for which the breeder must ever be on the watch; for him there is no rest from the toil—or pleasure—of continued observation and care. Before dismissing the subject of breeding, and as bearing closely upon the choice of the male, to which we have already alluded, we would draw attention to a point of some importance, unknown to many, and which has, indeed, having only apparently very recently been suspected, been investigated as yet by very few. This is, that the effect of a first copulation is 'felt not only in the product resulting from that connection, but in the products which result from subsequent copulations.' This, however strange it may appear to some, has been proved by so many instances, by so many animals, and in countries differing materially in climate, etc., and extending over what may be called the whole history alike of men and of animals, that there seems to be scarcely any denial of the fact. This strange influence,—for strange it is,—although in many cases and from a variety of circumstances not perceived, has an effect which is unmistakeable, and which cannot but have a close bearing on stock-breeding, and is therefore worthy of the notice of those engaged in it. For supposing, as an eminent authority on physiological subjects puts it, 'that only 10 per cent. of animals received by their first connection an influence which is felt in the following offspring, would it not be well to save a valuable animal from the possibility of being subjected to a bad influence, to be carried through life, by securing for the first male an

animal which should at all events not contaminate the female, and bring in the possibility of bad offspring in consequence of that unquestionable influence which the first male has possibly, not necessarily, on future productions?'

The 'weeding out' of the lot of young calves is an important part of the duty of the breeder. Supposing the whole to be derived from first-class stock, the selection may be made in the following order:—First, calves to be reared as dairy cows; second, bulls for breeding purposes; third, male calves to be reared and fattened as bullocks for the butcher; and fourth, the residue, as they may be called, of the lot, set apart for being killed young for veal, or to be sold off at once to the butcher. Great skill and judgment are necessary, for example, in the selection of calves for dairy cows. In the first place, they must be the progeny of cows known to be good milkers; and the sire should also come from a good milking stock. These two requisites 'outside,' so to say, of the young calf being known, the points connected with the calf itself must next be consulted, these having special reference, of course, to its milking capabilities.

The good points in a calf indicating its milking capabilities are chiefly these:—(1) The head should be fine in its general outlines, small in size, and the muzzle rather long and tapering; the eyes should be clear and bright, free from the yellow colour, muddy look, and dull expression, which are easier known at first sight than capable of being described in words, and they should have a mild, gentle expression; (2) the neck should be thin and tapering, the opposite, in fact, of what is so well known as 'bull-necked;' (3) the legs should be fine-boned,—fawn-like, in fact,—small and well shaped, gradually tapering, and supporting (4) a body which should be long, with the hind quarters large and well set, and well developed behind; (5) the coat should be of fine silky hair, on (6) a skin soft and giving to the feel that peculiar attribute known as the 'touch,' which a good judge knows at once, but which, like the expression of the eyes, cannot well, if at all, be described; and lastly, but not by any means of least importance, (7) the milk veins and the udder should have a good place, large and well

developed, and give promise of being soft to the touch; to which should be added, (8) the udder well placed between the legs, with a full set of teats. Both the milk veins and udder can only at this early age of the calf give indications of these points, as nothing more can be expected. As to colour, more is made of it than it deserves, some holding that a calf of a certain colour of coat will never make a good milker, or a good cow to breed from. Thus, some have a strong prejudice against pure white, especially in shorthorns; others dislike the black and white, although the milch cows of Holland are nearly all of this colour. As a rule, a very favourite colour is 'roan' and 'strawberry.' Some have such strong prejudices as to colour, that they will send a calf to the butcher simply because it happens to have that colour which they dislike, even although it has all the points that would make a good cow. This is a good example of the claims of prejudice being stronger than those of the pocket. If a calf be pure white, the tip of the nose, or rather the front part of the muzzle, should be black, this extending but a short distance beyond the nostrils; a red nose is almost by all considered a bad origin, at all events it is not liked.

In selecting the male calves to be set aside for store cattle, and ultimately to be fattened off for the butcher, the following points should be attended to, as affording the indications of good future value:—(1) The head should be well shaped, shorter than that of the cow calf, ears small, with the eyes clear and bright, and expression bold rather than mild; the head should be set upon a (2) neck, thick, short, and deep; (3) the body should be long, with a straight, level back, brisket deep, broad expanded chest, the shoulders well rounded off behind, loins wide, quarters wide; (4) the tail set well on behind, long and tapering; (5) the coat fine and smooth, and 'touch' good. Very close attention should obviously be paid to the selection of the calf when it is to be reared for the purpose of breeding from. The points indicating a good calf of this kind are very similar to those just described, but there are certain fine shades of difference in different calves, dependent upon the breed and its peculiarities, which should be carefully noticed; but these are difficult to be described, and, indeed, may be said to be understood, but scarcely to be expressed; a knowledge of them, moreover, being only attained after long, patient, and most careful observation.

CHAPTER III.

NOTES ON SOME OF THE LEADING POINTS CONNECTED WITH THE PRACTICAL MANAGEMENT OF STOCK, AND OF RECENT IMPROVEMENTS IN VARIOUS DEPARTMENTS OF LIVE-STOCK FARMING.

ON a subject so wide, and possessing so many varied points of detail, as that of the management of the live stock of farms, a volume could be written, if all were exhaustively or even but partially treated. The scope of the work, however, precludes our treating the subject even in the last named of the two ways. At best we can but glance at some of those points of special interest, describing briefly the direction in which changes of practice have been recently, or are likely yet to be made.

Food and Feeding.—(a) *Turnips as Food for Fattening Cattle and for Dairy Cows.*—One direction in which change of opinion amongst practical feeders has to a considerable extent taken place, and is likely still more extensively to be manifested, is in the place which turnips and roots have occupied as food. This change, which will appear remarkable in the view of most, is in the direction of using them to a much less extent than has been, and is still now in the great majority of instances, the practice of feeders, but followed, of course, by the substitution of other feeding substances. The opinion is gradually gaining ground that the giving of such a large weight of roots per day,—even in some cases to the extent of 2 cwt., but generally about 1 to 1½ cwt.,—with their large percentage of contained water, does materially reduce the temperature of the body of the animal, while the amount of nutritive matter they contain which can be readily assimilated by the animal is very small. The case is considered all the worse in cold weather, and still more so where the cattle are exposed in the open fields without shelter. As regards the evil brought about by giving the animals so much

cold food, it is scarcely necessary to remind the reader that warmth is equivalent to so much food; and that, therefore, the converse holds good, that to keep the animals cold is simply wasting so much of the nutritive matter of the foods given them. But recent researches into animal physiology have clearly shown that even a much more important influence is exerted on the condition of the animal by keeping up the temperature to a certain point than has been hitherto suspected.

(b) *Temperature of the Bodies of Cattle as influenced by Food, &c., an important Element in securing Health.*—The benefit to be derived is very marked in the prevention of certain diseases, as, for example, the much-dreaded scourge, pleuropneumonia. Mr. Allender, of the well-known Aylesbury Dairy Company, in an able and suggestive paper read recently before the Central Farmers' Club, drew marked attention to the value of the thermometer in ascertaining the temperature of the bodies of the dairy cows of the Company, the use of which had been suggested to him by the Royal Veterinary College.

The use of this instrument gives, with a very small amount of trouble, 'almost perfect security' from a general outbreak of pleuro-pneumonia in a herd of cows. He has established a system of observation, since the adoption of which the Company have been perfectly free from this dreaded complaint. He says: 'Twice every week, on the same days and at the same hour, the temperature of every cow has been taken, and the result recorded in a properly kept book, each cow being known by her number over her head. The temperature is taken in the vagina; a thermometer about six inches long and as thick as an ordinary lead pencil is used. The normal

temperature of a cow is 101° . Our practice is, if we find the temperature of any animal to be 102° , to take the temperature again in six hours' time. Frequently the increase may have been caused by some very temporary derangement,—say, a cow may have over-eaten a little,—and the temperature will be found to have returned to the normal figure. If, on the contrary, we have a slight increase, even to $102\frac{1}{2}^{\circ}$, we watch carefully, give a dose of physic, and if we get an increasing temperature, up to say 104° , we never hesitate a moment, but have the animal sold for slaughter. As our cows are always kept fat, the loss is nominal, and of course the animal is killed before any disease has developed itself.

These facts, which carry with them points of the highest importance, all indicate the necessity of the feeder rigidly examining the systems of feeding which he may have been in the habit of adopting from year to year, with a view to ascertain whether they are in harmony with the latest teachings of science. Certainly it does appear inconsistent with these to give our live stock such large quantities of cold, watery roots, combining these with the practice too frequently, indeed in many districts generally, adopted, of exposing the animals so fed to the further and perhaps still more potent evil influence of exposure to cold, in open yards without sheds, or, what is worse, in damp or wet and muddy fields, swept by every wintry wind which blows.

(c) *Condimental Foods for Cattle and Dairy Cows.*

—A feature in the feeding practice of not a few of our leading men—and the number is assuredly on the increase—is the giving of these. Many experienced farmers strongly recommend the occasional, if not the regular use of small allowances of condimental foods. We are aware of the prejudices existing in the minds of many feeders as regards these, but we would ask the feeder not to dismiss the subject without due consideration of all the points connected with it simply because there has been so much said against them. We regret that space does not permit us to give the remarks which we had prepared on this subject. It is one which, however it may be viewed by some, ought at least to be discussed in a scientific way, this involving physiological as well as chemical considerations. A

few isolated facts will or should not decide the case in favour of the use of condimental foods, any more than they will decide the case against them. Moreover, the idea that they are designed to serve as substitutes for all other foods should be discarded as erroneous. They can only, so far as our present knowledge is concerned, be used, if used at all, as additions to ordinary foods, with the view to make those foods better and more quickly assimilated.

(d) *Cooked and Warm Food.*—In view of the importance of warmth to the live stock, which we have now dwelt upon all too briefly, the system of using cooked or warm food assumes a value which has not hitherto been accorded to it, and which accounts for the more advanced farmers adopting it in their practice. Where the system is thoroughly carried out, it certainly has nearly always resulted in perfectly satisfactory results, not merely as regards the fattening of the animals, but, what is of no less importance,—if, indeed, the one is not the complement of the other,—in keeping the animals in remarkably good health. We do not lose sight of the fact that, as in all other questions connected with agriculture, so in this, there is considerable diversity of opinion amongst practical men; and it would be in one sense amusing, if such important interests were not concerned in the matter, to read and listen to the 'pros and cons' which have been published and promulgated through the press and platform. But wherever tried and carefully carried out, the system has been found to be a paying one. Of course it is scarcely necessary to say, that if there be one period more than another during which it shows its paying capabilities most, it is that of winter, to which season it is usually confined; the summer use of it being only exceptional, as in cases of sickness, long exposure to rain and the cold winds which in our climate are not altogether absent, foreigners say generally present with us. There are various ways of carrying out the system, but we cannot find space to enter into the details of these; the practical reader should, however, have no difficulty in deciding as to the best way of availing himself of such facilities as he may possess. Much could be said in connection with this part of the sub-

ject, but we may sum up in brief by simply stating that the principles of animal physiology show clearly that their constitution is very much like our own, their comfort and health being dependent on the same causes, and operating very much in the same way; and we all know the afterward influence which, under cold and its depressing influences, warmth has upon ourselves.

(e) *The Amount, Bulk, or Weight of Food given to Live Stock an important Element in Feeding.*—The above-named physiological consideration should not be lost sight of as regards the amount of food given. Thus it is obvious that a certain weight of food must be given before what may be called its paying capabilities begin to show themselves. The supply of food should not only be liberal, but this supply is necessary to be kept up; spasmodic feeding, so to say, is in no sense paying. Thus an eminent feeder points out that a pig, for example, may be kept for months without its gaining anything, or but very little indeed, in live weight, and yet the animal may be apparently well satisfied. Where, then, has the food gone to? Simply in keeping up the heat,—possibly not that to the proper point,—and the vital functions, and adding to the manure. To increase the live weight of the animal, which, of course, is the point aimed at by feeders, a quantity of food is evidently wanted *plus* that which has been already given to maintain the heat and vital functions alone. Thus, supposing that the animal has received 75 lbs. of any given food, the animal gaining by this consumption no increase of live weight; give the animal an increase to the extent of 100 lbs., and the live weight will be increased, for example, to 20 lbs. Here we have for a consumption of 75 lbs. nothing in the way of increase of live weight, the very 'be all and end all' of the system aimed at; but by an increase of that to 100 lbs., that is, 25 lbs. more food, we gain 20 lbs. of live weight, only 5 lbs. short of the extra food given. Now there is no feeder but what would say that this was a very satisfactory result, independent altogether of the extra manure obtained. But the principle is obviously capable of extension; thus, give the animal 125 lbs., and we gain, say, 40 lbs., and 60 lbs. of a gain if we increase the quantity to 150 lbs. Now,

the point evidently is to get a breed of pigs capable of assimilating the largest amount of the nutritive portion of food given them, and then feed them to the maximum allowance of food, and thus increase live weight to the maximum also, with the minimum of offal, the food given being in excess of that required to support the vital functions and maintain the heat. These facts and suggestions, although not by any means very generally known and acted upon, are of the highest importance as regards feeding our live stock, and are well worthy of due consideration. Care, however, must be taken to remember another physiological fact, that there is a paying point in feeding, which, if gone beyond, will result in no gain to the animal, while, of course, such extra food is loss to the feeder. It is, in truth, by closely observing points such as those, and applying them with judgment to his practice, that the live-stock farmer will best forward his own interests, and, becoming a thinker and observer, will take rank amongst those eminent breeders who have done so much to make the animals of our farms what they are—the finest in the world.

(f) *Straw as Food for Cattle.*—Another direction in which a change of opinion amongst practical breeders and graziers is observable, influencing and modifying, of course, the established practice, is the use of straw as a feeding material.

At first sight this substance does not appear to be a very nutritive or tempting food, yet it can be made to be so in various ways. It is much more largely used now than formerly, and is coming daily more and more into favour with feeders; but we need scarcely say that it is by a very decided modification of the old and wasteful plan of giving it to the cattle in racks in the yards, or simply thrown down in the yards themselves in its natural or ordinary condition. In this state very little comparatively is consumed, a large portion being simply pulled out of the racks, partially eaten, but the bulk of it trodden into manure; or but a small portion only of that lying in the yard is used. But when given in one or other of the different methods now being rapidly introduced into practice, it is not only readily assimilated by the animal, but the manure produced is of a very

superior quality as compared with that made in the open court-yard on the old plan. The different straws vary in feeding quality; and, as a rule, all are more or less nutritious if the crop be early cut, and not left standing till dead ripe. Oat straw, for example, if cut when almost green, and dried, is nearly as valuable as hay; and as a heat-producing food, 100 parts of it are equal to 80 of hay—that is, only a fifth less valuable. Barley straw is excellent feeding, as also bean and pea haulms. As flesh-formers, however, all straws are deficient, so that they should be mixed with other substances. In whatever way food be prepared of which straw forms a part, whether cooked or boiled as a mash, steamed or fermented, the straw must be cut into short lengths. The plan of Mr. S. Jonas affords an excellent method of using straw for food, and is simply and easily carried out. The straw is cut into short lengths, or chaff, as it is termed; this is mixed with green forage food, such as vetches, or a mixture of winter rye and vetches, also cut into short lengths. The whole are then well mixed, then pressed closely together into bins, or in some confined space, as the corner of an apartment. Food prepared in this way keeps for a long time, and is greatly relished by the animal. A like mixture of materials when stored in a loose condition gets into a state of fermentation, and acquires a taste more or less sourish, according to the time during which the fermentation is allowed to go on. Stock as a rule are very fond of this fermented food, some specially so, such as the pig; and in place of having a prejudicial effect upon their health, as some might suppose, it would appear, as experience seems to indicate, that the effect is of an opposite character. These brief remarks will serve to show that we have yet much to learn in the way of merely preparing foods. It is not enough for the feeder to rest contented with the assurance that he has got a nutritious food at command; he ought to, and, if an observant and thinking man, will devote his attention to discovering methods by which it will be made still more nutritious, and its consumption increased. What may appear at first sight to be a very trifling point, may carry with it consequences which, if carried out to their

full extent, may exercise the most important influence upon the value of the food and the good condition of the animals fed upon it.

(g) *Soiling or House Feeding of Cattle and Dairy Cows.*—This system, in other words, is the regular and continuous housing or sheltering of the animals, feeding them either in boxes, or, as in the case of dairy cows particularly, in the stalls. The system is one by no means generally adopted in this country, although it is so decidedly on the increase that not a few of our advanced farmers look upon it as destined to form the feeding system of the future, if not for all classes of stock, at least for dairy cows. It is on the Continent in the Old, and in the United States in the New World, that we find it carried out largely, and in a very complete and methodical way. The system is strongly advocated by all who have adopted it, and for a wide variety of reasons, which may be here very briefly summed up,—that by its adoption the number of animals kept on a given acreage may be greatly increased; that they can be much more economically fed; that in the case of dairy cows larger supplies of milk can be obtained; that more precision and accuracy in the amount of food required can be obtained than under the old system; that it compels, as it were, the farmer to cultivate his land in the best possible way, in order to raise an abundance of the best qualities of home-grown food; and last, but not least, that it greatly increases the bulk and value of the manure obtained. Great objection is taken to it by many, on the ground that the continued confinement must be prejudicial to the animals; but it is to be observed that the ‘unbroken housing’ so called is not absolutely so, as a certain amount of exercise is given daily to the animals. But even where, as according to the practice of some, these are literally kept up during the period they are fattening, or so long as the dairy cows are being milked, it is not in practice found that the health of the animals really suffers. Of course, this involves the essential that the feeding and general management are carefully attended to. On this point of health, setting the soiling system against the practice of many who keep their cattle out in the fields nearly the whole season, exposed to all weathers, and fed by no means generously, we should unhesitatingly

say that the soiling system is infinitely before it. In summer-time, for example, the exposure for hours to the burning sun, and the torture caused in addition to this by insects, exercises a most prejudicial effect on the animals, especially in the case of dairy cows. A cow 'gaddled,' as the term is, and running about the field in a half-mad condition, is sure to be injured in her milking powers, and much more so when in calf. In winter, again, the injury is none the less marked, indeed more so, as the most dangerous complaints and diseases may be brought on by frequent and often long-continued exposure to cold and wet, aggravated by the fact that in snowy weather a sufficiency of food to enable them to resist these evil influences is not supplied. Accidents, moreover, which are frequently an adjunct of the ordinary method, are seldom experienced in the soiling system. Again, the mere tranquillity or sense of repose which housing gives, has a very excellent influence both on fattening cattle and dairy cows. Further, a judicious mixture and change of food can be obtained very easily with soiling, which under the ordinary system can scarcely be carried out; and we all know that by judicious changes and mixtures we can influence the health of the animal in a very marked and beneficial way. A dispassionate or scientific investigation of the pros and cons of the system will, we think, show that, in addition to the above advantages, it possesses the great one of economy, as compared with the not easily estimated, and in many cases wasteful system generally adopted. Here it takes precedence of all other systems of feeding, the reasons for which will now be seen in glancing at its principal details.

The first point in which the economy of soiling is evident is the smaller extent of land which it requires, as compared with the old system, in which pasturing forms the essential element. The mere saving of land by doing away with the necessity to have fences is another item not altogether beneath notice. In the next point, the saving of food, soiling is decidedly marked when compared with pasturing. Our practical readers know well the way in which a large proportion of the herbage is destroyed by the cattle, and this is done in several ways, as thus:

the tramping of the stock injures the grass, and wherever the droppings are left, so much feeding space is lost for a long time; even where, under a good system of management, the manure is at once broken up and spread over the land, it is well known that the grass which grows for a considerable time on the places 'voided' on is so rank that the animals will not eat it till it resumes its proper character. Then, again, wherever the liquid voidings are left, the animals will not eat the grass for some time. In addition, moreover, to the injury done by the animals tramping over the grass, it is also spoiled by their lying down on and standing upon it. The next point in favour of soiling in the case of dairy cows is the increased yield of milk which they give; this is owing partly to the more regular feeding which can be carried on, and the great tranquillity and quietness obtained by the system. The quality of the milk is also improved, partly by the latter cause, as it is well known that milk yielded by animals which have been excited, terrified, or made restless, is never so good as when they are kept quiet. Again, the increased quantity and quality is influenced by the way in which the right properties of the food can be kept continuously up. Under the system, a judicious method of culture, so as to obtain and keep up a variety of feeding substances in the highest state of nutritive value, can be maintained throughout the growing season; whereas it is well known that pastures give their best feed at the early part of the season only, and gradually decrease in value as that goes on. Again, the soiling system produces the maximum of manure, and that of the highest quality. Lastly, and most important from the point of view of improving the land of the property, an important feature of the soiling system is the style of cropping the land for raising the food for the animals. This food should, for reasons already stated, be of as great a variety as possible; and as the very highest style of cultivation is demanded, in order to produce certain crops of great value for feeding, the system has this additional advantage, that wherever it is carried out, the soil is always improved.

We trust we have said enough to show that the system is well worthy of being carefully con-

sidered by the landowner and the farmer. Even if its general principle be but partially admitted to be practically sound, and as a consequence a modification only of its practice be adopted, in so far will the chances be favourable that the land must be improved under it; while the produce in the shape of meat or milk, etc., will be in great proportion increased.

(h) *Grazing*.—But whatever may be the extent to which the system of soiling just described is adopted by the farmers of this country who carry on what we have designated as ‘cattle farming,’ it may be safely assumed that *grazing* will be adopted for a long time to come, and by a large proportion of farmers throughout the country. In fact, as we have elsewhere shown, and as is very generally known, grass-land culture is at the time we write decidedly and steadily on the increase, the converse being the case with that of arable land. Nor need this be wondered at when we consider many of the points connected with it, which commend themselves at first sight at least to a large number of feeders. It is of importance, therefore, to know the best method of carrying it out; for it is quite obvious that in this, as in other departments, there must be two systems—one in which the greatest advantages are obtained, the other in which a loss may be sustained from a want of attention to certain points. Thus, some feeders seem to be quite satisfied with the fact that it is grass land into which they turn their stock, without ever troubling themselves with any consideration as to whether the land is suitable for the growth of the grasses or the production of the pasture required by the particular class of stock grazed, or whether the grasses themselves are properly cultivated or attended to. On the latter point it may be safely stated that, over a large area throughout the country, there are tracts of land bearing produce which may be safely, if paradoxically, designated ‘as grasses which are not grasses;’ meaning by this that the grasses are bad not only in quality, but of a class or kind not suited to produce the highest quality of meat or milk. For it ought to be remembered that different classes of stock, having varying peculiarities, demand the same in the grasses on which they are pastured; one class of land and pasture grasses suiting one breed,

which is not suitable for the other. Again, as regards the actual condition of the grasses in pasture fields in any district, it is obvious that it is the interest of the farmer to see that they are of the best quality, and kept up to this by the most careful attention to every point of their culture. It is wretched economy to pay a rent for land which produces weeds, or something like them, in place of the food which is capable of yielding the highest results. Good farming admits of no suppositions, but demands accuracy as to real facts. Some may be apt to discredit the statement of the highest authority on the subject, who says ‘that at least one-third part of our grass land is occupied by actual weeds; that another third part consists either of noxious or nearly worthless varieties of natural grasses; and the remaining third part of a promiscuous mixture of a better class of grasses, such as the locality in which they happen to grow, or the shop of the seedsman, may furnish.’ Some remarks as to the best mode of treating grass land will be found in another chapter, devoted to a statement of the leading points connected with the cultivation of the principal classes of grass-land farms. The summer grazing of cattle gives the best results when certain things are attended to; thus, in the case of store cattle, if they have not been properly attended to in winter, and are therefore in poor condition in spring, a great risk is run in turning them out to good pastures, and the finer and richer those are, the greater will be the risk run of injury being done to them. It will be much the safer plan to turn them at first into a roughish pasture, or into a field that has been partly eaten down by a better class of stock, then taking them into the yard at night, supplying them with good fodder, as cut straw, with a mouthful of hay and a small ration of oilcake or ground corn. When by this treatment they are brought into good condition, they may be put into superior pastures. On the other hand, when store cattle have been well wintered and are in good condition in spring, the summer grazing is a matter of easy routine, known to every one. There is, however, more trouble and risk attendant on store cattle than is generally supposed; but, as above hinted at, the great point to be aimed at is their proper winter treatment, as on

this depends all future success. It is a good plan to have a succession of pastures, rising in feeding value from the rough grass or well-consumed field or aftermath to the richer grasses, by this means enabling the feeder to choose the quality of grass best suited to the condition of his stock. A change of bite, as already alluded to, is good for all classes of stock, and good also for the pasture. The length of the intervals between the changes will depend very much on circumstances, of which the farmer will naturally be the best judge. The value of this system of changing fields is not so widely known as it deserves to be; but if once adopted, we have no hesitation in saying that it will be carried out as part of the regular system of the farm. The system is more valuable in the case of young stock than in that of more advanced, as they seem to thrive best upon a wide range of fields, more especially if those fields be of small extent; and the change should range through as great a diversity of locality as can possibly be attained on the farm. Where seasons are wholly adverse, as in great droughts, to the good growth of grasses, the farmer will be compelled to resort to yard feeding or to summer soiling, when he has made arrangements for the raising of successional crops of cut or forage food. In the reverse case, where the season is excessively rainy, the farmer must provide dry food, and be careful as to the extent to which the animals are allowed to partake of the early, succulent, and rank grasses of the pasture fields. Nor will they, in being taken from the pasture fields in such seasons to the dry sheltered of the yard, or of the covered yards if these be provided, receive otherwise than a beneficial change from the excess of slushy wet grass in the rain-covered fields, to the drier food of the yard or byre. The autumn grazing of young stock will have to be conducted also with a due exercise of care. The grazing may be done in aftermath or edditch fields, of which the safest are those of ordinary meadow grass, the clover aftermath proving often too strong. All these points serve to indicate the extreme care which the feeder has to take in looking after every particular of the system of grazing, and in noting what modification of any plan he has adopted is required to meet the ever-varying circumstances

of crops, soil, climate, and of the physiological conditions of the animals which he breeds, rears, and feeds.

(i) *Bedding of Stock.*—As regards bedding of stock, great diversity of opinion exists among practical men. This leads to a practice so wide and so antagonistic in its features, that it embraces those who are lavish in their use of bedding, and those who believe that bedding of any kind is unnecessary—the animals, the latter maintain, being as comfortable lying on bare stone flags as they are kept healthy. With regard to the last of these, which may be looked upon as the antipodal opinion to that generally held on this subject, we do know that sheep, for example, will choose the hardest ground to lie upon, leaving the soft bedding of grassy stretches, —a lesson too often forgot when they are shed or house fed and supplied with thick or deep bedding of straw, which often induces the lameness and tendency to foot-rot which it is the object of the careful herdsman to avoid, and which is almost sure to end in an aggravated form of the disease should the sheep be turned out afterwards on foggy, damp pasture lands. In the case of cattle fed in the house, the system generally adopted as a rule is anything but economical; long straw is used, and that in quantity far in excess of that absolutely required. While long straw in itself is anything but economical, straw cut by machine into short lengths is decidedly so. By the use of cut straw a more uniform bed of litter can be obtained. Those who dispense altogether with litter use chaff or sawdust, or even sand; while others for these and litter substitute timber in the form of spars. Mr. Mechi, as is well known, is the great advocate for this system of bedding, and he certainly has a great deal to say in its favour, and he uses it for all classes of stock. His bedding, or rather the floor of his stall, is formed of spars, three inches thick or deep, the same wide, and having spaces between each of one and a half inches; these spars being firmly attached to, and supported by, beams underneath. The voidings pass through the spaces to a brick tank from two to three feet deep. The width here specified is that adapted for bullocks, that for pigs and sheep being from half to three-quarters of an inch. The only point we should

be doubtful about in the use of wooden or sparr'd bedding floors is that of pigs, which are very susceptible to cold, being almost hairless animals; and we fear that in winter-time, especially in northern districts, they would suffer from the cold.

Whatever be the kind of bedding, however, adopted, one point must never be overlooked, and that is, giving the animals abundance of room or floor space, in which they can be at ease in any position that their comfort seems to demand. The word comfort in connection with live stock may sound odd to some ears, but it nevertheless carries with it many points of great practical importance. Thus, experienced physiologists know well that if uneasiness, however caused, be present with animals, it has a bad effect upon their fattening and food-assimilating powers. Now, one has only to observe cattle, for instance, tied up in a cramped and confined stall, and especially in the case of a double stall, and it is easy to see that they are not at ease; and the thing is still more noticeable in comparing the condition of the same animals when left free to assume their own natural positions, either in pasture fields or in roomy stalls or boxes. This is specially noticeable in the case of horses, and we have frequently expressed surprise that those who must have noticed the remarkable enjoyment of horses in stretching themselves out and rolling over in the fields, have not taken the lesson it conveyed as regards their house accommodation. As we have said before, we say now, physiology teaches us that all the mammalia, man included, are very similar in their bodily wants, likes, and dislikes. Could we feel rested after lying all night in a cramped and confined bed? This point, in fact, is one strong argument in favour of the box and hammel systems, in which the animal has perfect freedom of motion. One feeder makes the observation that he was struck in going round one night, after the animals had settled down, to observe the various postures into which they had thrown themselves; but all were unquestionably at ease, and thoroughly enjoying themselves in the position which ease alone can give. This freedom of movement is no less beneficial to them than it is to ourselves; if it did nothing else to the animals than give them the liberty to lick them-

selves, this allowance would be an advantage worth obtaining. No one conversant with the habits of our farm animals but must have noticed the unmistakable signs of satisfaction they give when they are at liberty to lick themselves, or, if congregated together, how they lick one another, especially those parts where each individual animal cannot reach itself.

Sheltering of Farm Live Stock, and Production of Manure, &c.—It is scarcely necessary to dilate on the importance of attending in the most complete and careful way to all classes of stock; for it must be obvious that the more thoroughly this is done, the fewer will the losses be, and, as a consequence, the higher will be the profits accruing to the farmer, and the greater the rent which he will be enabled to pay. We thus see how closely the interests of the landlord are bound up with the highest and best interests of the farmer in this important question, and how essential, therefore, it is that the two should work harmoniously together, in order to bring about the most economical results, and that in the quickest way possible. This subject we have elsewhere gone somewhat fully into, in describing the various forms of shelter sheds, &c. We have alluded but briefly to the important influence which shelter plays in the well-being of cattle; nor is it less marked in the case of sheep. We may here, as affording some indication of the important points involved, give some very remarkable and striking facts connected with this class of stock, as given by Mr. John Scott in the *Times*. A loss of 5 per cent. on the sheep stock of the country represents the enormous amount of a trifle short of a million and a half of animals. Some idea of the loss sustained by farmers, and to the food supply of the country, may be formed, when we state that in many districts the loss is not 5, but three times 5, while in some it is higher even than this. In the case of tegs and hogs as high a percentage as 50 per cent. of a loss has been sustained by some farmers between Michaelmas (September 29) and Ladyday (March 25); while on one farm, in the case of lambs, 600 have been lost in a season. It is well worthy, then, of inquiry whether such grievous loss can be prevented, to which some reply in the affirmative may be given. This is proved by the fact

that there is even in the same districts a remarkable difference in the number of lambs reared from the like number of ewes. Thus, while one farmer will rear only 80 lambs from the hundred, another will rear as many as 150. There are, beyond a doubt, many points in favour of sheep farming being conducted with at least a considerably lower percentage of loss than is at present the average of the kingdom. Thus the sheep, as compared with some of the more delicately organized animals of the farm, is an animal comparatively easy to rear, being hardy in its constitution, and capable of standing a considerable amount of exposure; but that there is a point reached, and in many cases too easily and quickly, when exposure to severe weather does bring about heavy losses, is proved by the experience of the past few years of those who have introduced in their system of sheep-rearing shelter more or less complete, not only during the extreme cold and damp weather of our ever varying climate in the winter months, but also during those of summer, when they are tortured with insect plagues, resulting also in deterioration of their health and in actual loss of life. But if the losses be great in the case of sheep, arising from defective shelter, it is obvious that they must reach a far higher point in the case of lambs, which are not provided with the woolly covering of matured animals, and are, moreover, in that weakly condition in which of necessity they are more liable to the malign influences of cold and damp, existing alike in the air and in the soil or grass on which they lie. But it is not alone in the matter of shelter, or rather its neglect, from which the loss of sheep arises; for in many cases—and we regret to say it, as it reflects on the humanity of the parties concerned—no small percentage is caused by defective supplies of food. On this point Mr. Scott says that few lambs die but from starvation and exposure, and they are frequently allowed to die rather than spend 5s. in food for the ewe. Nor are the matured sheep, folded on turnips or fed on full pastures, much better attended to by some farmers in some matters of food,—snow-covered, and this often through a hard frosted surface, through which no animal can break; and the poor animals are left to make the best of the

wretched circumstances they can. We need not wonder, therefore, when we read the statistics of our live-stock year that is just past, to learn that the number of sheep fed throughout the country is gradually decreasing, the falling off being very marked during the past year, and that we have been compelled, through the necessities of our population, to import largely from other countries; and thus inflicting, as it were, a double loss upon the farmers, which, of course, reacts on the landlord in the matter of rental. Nor is the matter rendered more pleasing and satisfactory when we consider that these losses can be prevented; or, as Mr. Scott puts it, 'good feeding, dietary, careful tending, and protection from weather, would preserve to the nation sheep and lambs exceeding the number which their losses compel us to import from other countries.'

It is not, however, the losses arising from disease and death amongst the live stock on our farms that have to be considered as affecting the interests of landlord and farmer alike; another source of loss must not be lost sight of, namely, that of the manure. Now, as we have elsewhere shown, this is a matter of vital importance; for, as we have pointed out, what indeed must be self-evident, the increase of agricultural progress generally must be dependent upon manure, and that again, of necessity, upon the live stock from which it is obtained. It is scarcely necessary to point out the fallacy of the opinion, which some hold, in meeting this difficulty, that we can afford to be careless in the matter of the supply of farm-yard manure, inasmuch as we have such a wide range of artificial to draw from, some of which at least may be said to be practically inexhaustible, although this may be taken with a reservation. For notwithstanding the admittedly important benefits our agriculture has received from the introduction and extensive use of artificial manures, still farm-yard dung cannot be dispensed with; and, being absolutely essential for many crops and soils, it will, so far as we can see, be the mainstay of the British farmer. This brings about that close dependence between the different departments of farming which is so well expressed in the epigrammatic statement, 'No corn (crops) without manure, no manure without cattle, no cattle without crops.'

We have thus here the complete cycle or circle of agricultural production.

Dairying—its Future Prospects.—From a variety of circumstances, which it is here needless to enter upon, dairy farming during the past few years has taken a very low place in British agriculture; why it is difficult to say, more especially in view of the enormously increased demand which has grown up, markedly during the last decade or so, for all kinds of dairy produce, and the high prices which they bring in the market—prices altogether unprecedented in our social history. Whatever may have been the cause of this neglect, certain it is that dairy farming has been so far from being an important department of our agricultural system, that it is but a comparatively short time ago that opinions were freely expressed that the art of making some of its produce would be entirely lost, and that speedily, to our country. This was, perhaps, more marked in the case of cheese, and this, perhaps, on account of the contrast which the later condition of the trade afforded with its earlier one, when our reputation was, if not the first, certainly among the first in the world for the production of cheese of the highest quality. The demand for this not increasing, as we have seen, other countries were not slow in taking advantage of our deficiency, and the result has been that practically they have ruled the market. Nor, in fact, is butter itself excluded from the strictures we have passed on the cheese trade; nay, it seems that we are placed even in a worse position with regard to it, for, as Mr. Allender, in his admirable paper on Dairying recently read before the Central Farmers' Club, remarked, if we are 'being driven pretty hard by the Americans and others in our cheese trade, we are being utterly smashed by the foreigner in the matter of butter. English butter, even from our best districts, except from just a very few special farms, is fast becoming a thing to avoid. Not only are we now dependent for nearly all our best butter upon Normandy and Brittany, and for considerable supplies from the north of Europe and Italy, but America is coming into our market on an enormous scale. From New York alone, to say nothing of shipments from other American ports, we have received this year

(1878), down to September 1st, over 15,500,000 lbs., as against a little over 6,000,000 last year. In cheese we have received 85,000,000 lbs., as against 80,000,000. I am convinced that I am well within the mark when I say that nine-tenths of the highest-priced butter sold in London comes from abroad, chiefly from Normandy. Not that all butter coming from France, or made and used in France, is good; a great deal of it is most vile stuff, only it is well manufactured.' That dairy farming occupies but a very low position amongst us is evidenced by the slight attention paid to it and its details by our leading agricultural societies. Those in the habit of attending the leading shows must have witnessed with some surprise—probably with no small degree of regret—the miserable position which the various appliances connected with their practical working occupied in their stands; and, save for the occasional appearance of a prize for dairy cows, and still less frequently for samples of their produce, one would have been inclined to think that dairying formed no part of British agriculture.

It is difficult to see why dairy farming should not occupy the position which assuredly the commercial value of its products gives it; nor is it less difficult to understand why dairy farms should not pay, in view of the high prices which those products command in the market. There must be, one would think, some special reason for this state of matters being the rule, and it will be worth while to inquire, even if it were done very briefly, what that reason likely is. That dairy farming does pay, if properly conducted, we have more than a few examples to show us, and we believe that the true reason lies just in the 'if.' The authority we have quoted starts with the firm conviction that dairy farming will be found far more profitable than it is supposed to be, if it is entered upon on a large scale, made a thorough business of, and all modern improvements and appliances introduced. There is, perhaps, also something in the reason given by the same authority why dairying as a rule is left to small farmers and ignored by the large ones, namely, that the latter do not care to be troubled with the constant attention and close personal supervision which the details of dairying demand,

and which small holders are inclined more readily to give. It does not follow, however,—indeed the opposite may be said to be the fact, and that which gives rise to the low quality of British dairy produce to which we have already alluded,—that because small holders are more willing to give closer attention to the working details of the farm than large holders, that attention is judiciously given, or is of the kind required; for it is beyond dispute that ‘the work of the dairy, whether it be the production of cheese or butter, requires greater attention, and more careful observation and management, than any other branch of farming.’ But it is not alone in connection with what may be called the interior working of the dairy that the cause of loss, or the making of its produce of the inferior kind complained of, arises; we believe, on the contrary, that a potent influence is to be found in the important department of the out-door or field management, as in that also of housing and feeding. We may, from a consideration of the correct principles upon which dairy farming, considered strictly as farming, should be conducted, be able to decide whether this be the case or not. Certain it is that, in going through any district where dairy farming is practised extensively, it takes but little observation to see that there are grave defects in the management of many of the farms, the existence of which accounts at once for those defects in the quality of the produce so much complained of. It is, however, gratifying to know that there is now a prospect of a better and more satisfactory state of things being introduced, and that the British farmer, equally with his compeers in other branches of British industry, seems determined no longer to allow those of other countries to excel him either in the amount or quality of dairy produce, and to monopolize altogether, or nearly so, the market for its sale. What has been done lately in the way of advance not only shows what can be done, but the large amount which is yet to be done, before British dairy farmers can resume the position which many of them held as makers of the highest class of produce. This reform or new movement has been as yet almost wholly confined to the department of cheese-making, the impetus given to which has probably arisen

mainly from what the American dairymen, as well as those of certain Continental countries, have done by the introduction of the cheese factory system. This has to a certain extent been introduced into this country, with every prospect of reasonable success. If this success be speedily secured, it will be owing in no small degree to the efforts of the best writers and practitioners of the day, who have in various ways been steadily drawing the attention of farmers to, and impressing them with, the vital importance of the subject.

Where so many have done good work in this direction, it would seem invidious to name a few when we could name so many. But there are always the pioneers and the advanced guard in every movement, and of the most untiring and energetic of these we may name Mr. John Chalmers Martin, Mr. Gilbert Murray, and Mr. Allender. Nor would it be right, in noticing the causes of a better state of matters amongst us, if we failed to draw attention to the great efforts made by Mr. Jenkins, the able secretary of the Royal Agricultural Society of England, in publishing, through the medium of the *Journal* of that Society, not merely the results of his own painstaking examination of dairying in this and other countries, but in opening its pages to the writings of other distinguished authorities on this important subject. We trust, therefore, that a new era in British dairying has already opened, and that its produce will take the high place which the efforts of our farmers are so well calculated to give it, if these are made systematically in the right direction. That these efforts will be well repaid, it is impossible, in view of what is known to be the experience of those who have paid attention to this department of farming, to doubt. In the text we have described and illustrated the leading features of the practice of dairying, so far as the points coming within the scope of our work are concerned, both in the buildings and their constructive appliances. We could here add to what we have there given, plans of dairy buildings for farms of various acreage; but having given already all the principles on which these are arranged and constructed, it is obvious that such plans may be designed with comparative ease, and will depend for extent of accommodation and

the completion in detail of their appliances upon the circumstances of each case. These will vary according to the acreage of the dairy farm, or of that part devoted to dairying on farms not wholly confined to this department, to local peculiarities, contiguity to market, or other facilities for a ready

disposal of the produce. So far as the elevations are concerned, see the styles we have illustrated in connection with one or other of the classes of farm buildings; the adaptation of these to a particular plan should be a matter of comparative case.

DIVISION EIGHTH AND LAST.

SUPPLEMENTARY.

A WORK so voluminous as the present, embracing such a wide variety of subjects, demands very numerous drawings and diagrams, the great majority of which, although on a necessarily reduced scale, are nevertheless 'working drawings,' taking, even when done regularly and with all reasonable activity, considerable time in their planning and projection. The various technical details connected with the reproduction of these drawings and diagrams in the form of plates and woodcuts, and the labour of the 'press,' absorb also much time, even with all the facilities which the progress of the arts and the desire of all concerned to avoid delays alike afford. With all this to be done, and done with all due thought and care, time passes rapidly away. It is thus that, as a necessity which cannot well be avoided, a comparatively wide interval exists between the period when the various divisions of the volume were thought over and arranged, and that in which, with a sense of relief only known to those who labour at the oars, so to say, in the sea of literary work, however much they may love it, the final correction is given to the concluding sentence and the last drawing.

The result of all this is, that although in commencing such a work every detail embraced within the subjects and the limits of its plans was included, still by the time that plan is completed, the author finds that there are lying before him many which have been created, so to say, in the time which has passed over him, which he feels he ought, alike in justice to the reader and to himself, to take at least some notice of. This work of keeping a large volume 'up to time,' as the phrase goes, is considerable. Nor need surprise at this be felt, when one considers the times in which we live. In every department of practical science a remarkable activity exists; an ever increasing population demands

larger produce and cheaper, the exigencies of the labour question become more numerous and more pressing, the desire to save time in the execution and money in the cost of work exists everywhere and always. All these bring alike into operation the services, and provoke, so to say, the inventive and improving faculties of many men, eminent in their respective branches of art and science, so that new discoveries and inventions are brought out so quickly and in such numbers as to make our times a contrast between those dating from a period but a day ago, as it were, in the history of a nation, as striking in its features and as powerful in its results as can be well imagined. We thus live in fast times and at a fast pace; nor is this peculiarity confined to material objects. The thoughts of men move also as, nay much more, quickly, urged on by a desire for change simply because it is change, which, in the opinion of the best, most prudent, and wisest of our thinking men, is not the most hopeful characteristic of the age. Moral and social subjects also are therefore found to be changing almost daily in their aspects; although this difference between them and what are called practical or technical subjects is clearly seen, that progression does not always mean improvement. One can move as quickly in a wrong as in a right direction, nay, more quickly, if the classical proverb carries with it the truth which has invariably been accorded to it, *Facilis descensus Averni*. With such activity in all departments of our national life, it takes, therefore, but a very short period of time to admit of what is really a great collection of material being accumulated. With a subject so comprehensive as that which the pages of the present volume embrace,—and this feature alone shows its vast importance to the people generally,—it may easily be conceived that of this collection a very large proportion

applies more or less directly to it. But so numerous and so varied are the details of this material, that it is obvious that within the limits—limits which we have been compelled to considerably widen—of space left us we can at best glance at but a few. These we shall endeavour to make as practically useful as possible, and to bear upon some of the leading features of our subject, giving them in the form of sectional paragraphs classed under the special Divisions as arranged in the text preceding this. It is, perhaps, scarcely necessary to state that it is to a few only that supplementary notes will be here given.

Farm Buildings and their Constructive Details (see Division I).—The general subject of buildings for the farm remains very much as it was at the period we penned the matter of this Division, so far as the choice of a class suited for certain soils, locality, and consequent mode of farming, and the principles of arrangement of its apartments, are concerned. If there be any change worthy of note in this department of building arrangement, it is that called for by a peculiarity which is perhaps becoming more and more a feature of modern farming, namely, that attention is devoted chiefly, in many cases wholly, to one department. Thus many farmers now have each what the French term a *spécialité*. This has no doubt been always a peculiarity of farming, although chiefly necessitated by the locality and character of a farm. Thus, sheep-farming and grazing, rearing of young stock for fattening by purchasers, dairy farming, may be instanced; while it was only in certain and what may be called favoured districts, that mixed husbandry could be carried on, in which all classes of stock were bred, reared, and fed, and a wide variety of crops grown, either for the use of these or for sale.

This feature of *spécialité* runs perhaps more in the direction of raising produce and rearing stock for town consumption. This, of course, arises from the increase of the population and the larger means at their disposal for purchasing which has been the normal characteristic of late years. When close attention is paid to what may be called the average of demand, so that a steady supply of its articles be kept up, and further, if through any of those changes of taste, often of fashion, and not seldom of prejudice,

which come over our consuming town populations, a demand arises, and this is skilfully and readily met by the farmer, those special departments pay remarkably well, of which not a few instances can be brought to mind by those of our readers who have watched their later development. The farms for such are, of course, situated as near the towns of demand as possible, although the facilities afforded by railways to carry produce to the towns, and to bring back manure from them, may enable the special farmer to have as good and certainly a much cheaper farm at a distance from the town he trades with, leaving a balance to meet the cost of carriage, and this, again, leaving a fair margin of profit.

This style of farming, which is generally known as 'town' or 'suburban' farming, is of course regulated by the circumstances of the nearest town, to some of which we have above and in the preceding text alluded. Milk is doubtless the most prominent article produced, to which, under certain circumstances, butter and, in a comparatively minor degree, cheese-making are added. Of the live stock, pigs and poultry constitute the leading features, if to the latter the term live stock will be thought by many to be at all applicable. Both departments, if skilfully conducted, yield large profits, notwithstanding the assertion—and we doubt not it is based upon their experience—to the contrary made by many. The mere result of experience in many departments of farming is only as a rule given, without mention of the details of the practice which has brought about these results; hence so many conflicting, practically useless opinions. There is a world of difference between the results of good and bad or careless practice. The cultivation of such farms is confined in the first and essential place to the raising of produce, so far as the soil, etc. is suitable, for the maintenance of the animals reared upon the farm. What is raised for sale in the towns is regulated by their demand, but it chiefly partakes of the features generally of market gardening. By watching closely the demand of the towns, and the variations in the tastes of the population, still larger profits may accrue from this department than even those well known to be attached to market gardening proper. The residuum of the various

crops raised, in no way suitable for sending to market, can all be consumed, and with profit, by the live stock of the farm itself. The successful carrying on of special farming of this kind depends, of course, upon the farmer himself,—a remark no doubt as applicable to any other department as to this, still specially so to it, as a little consideration will show. It obviously requires something more than capital, knowledge of stock, of produce, and of the best possible way of breeding, rearing, and cultivating them; for to all these must be added—what every farmer, however skilful in his own peculiar walk, does not possess—not merely a general knowledge of ordinary business, but a thorough acquaintance with the details of the special departments brought into existence by the very nature of his connection with the towns he does business with.

Special Buildings for Town or Suburban Farms.

—These brief remarks will show, as far as is necessary for the subject we have here in view, the general features of this style of 'special' farming. With its details, save those connected with the *buildings* which it requires, we do not here concern ourselves; but we may be permitted to refer the reader interested in the subject to the under-noted volume.* Where the production of milk is the chief object of the special farm, the buildings required will, it is scarcely necessary to say, be the same in arrangement as those we have illustrated in Division I. for the general purposes of a dairy farm, with such additions or alterations as may be demanded by the special circumstances of the farm. These will be found described and illustrated in the chapter treating of this department. Where butter is made to a large extent, there will be a corresponding proportion of butter milk. Against this as an article of domestic diet a singularly strong prejudice exists in certain districts, these being chiefly in the southern counties of England. There will, therefore, in such places, be no demand for the butter milk, although that, with increased knowledge of dietetics, will before long,

we believe, be fairly established. But as matters at present stand, the only use which can be made of the milk will be in the piggery, tending to lessen the loss which according to some this always involves, to increase the profits which according to others it as certainly makes. But when, as in the towns of the north of England, the people, with a higher estimate of the great value of butter milk as food derived from a long experience, cause a demand so great for it that the supply is never sufficient to meet it, and by consequence a high price is obtained for it,—we have known it sold for very nearly the same price as that obtained for sweet milk,—the farmer may find that he can get a higher profit by sending it for sale in the towns than by giving it to pigs at home. In such cases, should the farmer not make a specialty of pigs, he may keep none or but a few for family or neighbour use, and to consume the refuse of the green food, etc. grown upon his land.

Under other circumstances the farmer may make this a very marked feature of his farm,—for the rearing and feeding of pigs to meet all the demands of the market, either in the supply of sucking pigs, of young porkers, of animals sold for the purpose of breeding, of fattened pigs for the butcher, or for the curing of hams and bacon. For one or other or for all of these objects, the accommodation required in the way of a piggery or piggeries will be of a kind more or less complete in arrangement, construction, and fittings according to circumstances. Pigs kept on an extensive scale may be accommodated in a series of detached houses, with a view to lessen the chances of loss by sickness, on the new principle of 'isolation,' elsewhere in this work described, and its application to various circumstances illustrated. Or, as this 'isolation' principle requires ground space which may not well be spared, the farmer may have his piggery arranged in what may be called the 'concentrated' style.

The breeding, rearing, feeding, and fattening of pigs and poultry do not, some say, pay. But amongst those who keep them, both on a small and on a large scale, some few at least contrive, to put the matter in its mildest form, to make money out of them. But be this as it may, the fact remains, that for both the demand has so

* *Suburban Farming: A Treatise on the Laying out and Cultivation of Farms adapted to the Produce of Milk, Butter, and Cheese, Eggs, Poultry, and Pigs.* By the late Professor John Donaldson; with considerable additions, illustrating the more Modern Practice, by Robert Scott Burn. With numerous illustrations. Crosby Lockwood & Co., London.

long been steadily on the increase, that prices have kept up, and, indeed, especially in the case of poultry, have greatly advanced, and surely some one makes money out of them. Poultry and pig keepers, no more than others, do their work from purely patriotic or philanthropic motives.

There are those, therefore, who believe that pig and poultry farming will form a very marked feature in the future of British farming, which has hitherto as a rule looked down, so to say, upon both, as at the best somewhat exceptional practices; poultry-keeping, in truth, being altogether deemed beneath the dignity of the calling. But changed times bring changed circumstances, and this, powerfully operative as it has been in other industries, seems likely to be no less so in that of agriculture. Nor is it at all an unlikely thing to be realized, that large tracts of waste land, which under our present state of knowledge seem doomed to hopeless sterility, so far as known methods of cultivation are able to change them, will have a very useful and a very profitable part cut out for them, as being the localities of pig or, at all events, of poultry farms; to which will likely be added, much as at present the idea may be sneered at by some, 'rabbitries,' or rabbit-warrens on a large scale. Be this as it may, there is already enough practically done, and more is being contemplated, in the establishment of farms for the production chiefly, if not exclusively, of those classes of provision for which there is a growing demand, but which have hitherto been considered greatly, and often wholly, without the pale of legitimate farming. We therefore deem it likely to be useful to give a few suggestive plans of buildings adapted to this peculiar class of farming.

Combined Pig and Poultry Buildings.—In Plate 72 we give plan (fig. 1) and elevation (fig. 2) of buildings for a piggery and henery or poultry steading combined. The poultry-houses are at the back, all connected with the grass runs still farther in the rear—in which there is a pond—and with the yards for store pigs at the front, to which access can be had by the poultry when desired; which, so far as they are concerned, will be as frequently as possible, for a manure yard—though that of pigs is not nearly so attrac-

tive to them as that of cattle—is the delight of the sauntering, screeching, fussy, fighting fowls.

The object in view in designing this steading has been to concentrate the accommodation as much as possible—not for the saving of space merely, but for the convenient and economical working of the whole. Abundant space or floor surface has, however, been given. Another point aimed at in this concentration has been the saving of roofing, an important item in the cost of construction. One half of the elevation on left-hand side of centre line *a b*, fig. 2, is as plain in design as can well be; but the other half, on right hand of centre line *a b*, is purposely made somewhat ornate. In the case of many of such steadings of the future being built in the neighbourhood of towns, it may, and we hope it will, be the desire of their owners to make them attractive rather than repellent in appearance; but many, even in isolated places or more remote districts, may also be disposed to have buildings something more than useful—pleasing in appearance. As a rule, with unfortunately few exceptions, our farm buildings are as ugly as they can well be. This is a great mistake in more ways than one—how, we have no space here to show; suffice it that the statement is made in the knowledge that it cannot be contradicted on sound grounds. We, of course, do not put forward our designs as those which should be adopted; quite the contrary, we merely claim for them some consideration on the part of those requiring buildings, as being suggestive of what may be done in a much desired direction. As a rule, it is very nearly as cheap to erect a building pleasant to look at; and this is one of the few pleasures which man can enjoy which never palls. If ornamental detail cannot be afforded, ornamental outline or form in construction can, or may always be, involving little or no extra cost. In fig. 3 a suggestion is given for the central part of the elevation in fig. 2 at *a b*, as an alternative design. The roof to suit the elevation to the left of *a b*, fig. 2, will be as shown at *c d*, fig. 3, the ridge *e* meeting this at *f*. The range of piggeries behind will of course have roofs of the simplest form.

In Plate 73 we give plans for separate or single buildings—that is, those for poultry and

those for pigs. The poultry-houses may be placed nearer the house or mansion, if on the home farm; the 'piggery,' of course, farther away. Fig. 1 is plan of a poultry steading on the rectangular arrangement. Some time ago there was somewhat of a rage, many called it a 'craze,' for general farm steadings on the circular plan, as giving a thorough system of concentration of the various apartments, the work being facilitated by a tramway encircling the building. From the circular outline externally, and from the almost inherent necessity to have the various apartments, for stock especially, rectangular in form of floor surface, there was a great difficulty in setting out the enclosed circular space. It was in some instances done with singular felicity, but generally all that could well be said of the internal arrangement was, that it was a triumph over inherent difficulties—difficulties which in a sense were created but to be overcome, and rarely well overcome. The same objections do not apply, or, at all events, apply with lessened force, to circular buildings for the small deer of the farm, such as poultry, and perhaps pigs may be included; while there is this to be said of the circular plan, that for an isolated building it is capable of being made a really very picturesque and striking addition to the surroundings of the mansion or the farmhouse. Some prefer the hexagonal outline to the circular, and in this much greater facilities are afforded for filling in the internal space with more conveniently formed spaces than in the case of the circular, all the apartments of which have the inevitable tendency to run or converge to a point, the centre of the circle. This last great defect of the circular plan is lessened by having a central space either left void as a central straw yard, or partly filled up with some apartment, as a cooking or food house and store. In fig. 6 we give half plan, on left-hand side of centre line *C D*, of a poultry-house or steading on the 'hexagonal,' and in fig. 7 half plan of one on the 'circular' plan, with this central arrangement. From this the reader may be able to judge of the relative merits of the two plans; so also as to the value of the attempt we have made to give the elevations of these, figs. 8 to 12 inclusive, a somewhat pleasing external appearance. These

elevations, as well as those of other plans we give where this has been aimed at, can, of course, be made as plainly bald and sternly ugly, and as deficient in outline of form and in ornament of detail, as seems to be the style—if style it can be called—which is so easily perpetrated everywhere in farm buildings. In fig. 8 the central part *A* covers the cooking and food stores *a a, b b*, in plan fig. 7, this being surrounded by the outer ring, containing apartments as in elevation at *d*. The 'ring' may be covered with a roof as at *B*, or as at *C*, or as at *A B* in fig. 9, or as in fig. 10. Circular or segmental roofs may be adopted, covering in the whole building either in parts, as shown in fig. 11, or in one sweep or span, as in fig. 12. In fig. 11 two forms of roof are shown, one half of each design being on one side of line *A*; *G* and *D* being half of the one design, *D, E* and *F* half of the other, *C*. In fig. 12 the roof *c* on left side of line *A B* is hexagonal, the other half, *D*, being constructed in one elliptical sweep. In fig. 3, Plate 73, we give plan of a piggery; in fig. 4, half elevation on left-hand side of centre line *A B*; and in fig. 5 an alternative design. In fig. 1, the plan of a poultry steading or hennery, the central part is devoted to the cooking house *a*, and food store *b*, so that the food can be quickly distributed to the several apartments, right and left, along the central passages *c c* and *d d*. The hen or poultry roosting-room is at *e e*, the hatching houses at *f f*; the duck houses are at *g g, h h* being the hatching houses for the same. On the other side of the central part *a b*, we have at the extreme end of the range the turkey house *l l*, with hatching rooms at *k k*; *j j* the geese houses, *i i* the hatching houses. The south front and east and west ends may be provided with a verandah, fenced off, if desired, into apartments or spaces for 'chicken cribs' and for 'dust baths.' Grass runs with a pond for the ducks will of course be provided. In figs. 6 and 7 the apartments are the same in number and appropriated to the same use as those in fig. 1. The central space in both places is occupied with the cooking room *a a*, and food stores *b b*, from which the food is distributed to the various apartments all round. The hen or poultry roosting-houses are at *d d*, with hatching rooms at *e e*. The duck house is at *f*, and the hatching house at *g*; the goose house

is at *h*, with hatching room at *k*; the turkey house is at *i i*, with hatching house at *j*. It need scarcely be noted that in the complete plan—either in the hexagonal as in fig. 6, or the circular as in fig. 7—the accommodation is, so far as regards the rooms *d d*, *i i*, twice the extent given in the half plans.

Details of Concrete Building for Walls, &c. of Farm Buildings.—To the various materials and methods of using them likely to be economical, we have repeatedly, in the pages preceding this, drawn pointed attention. Of these, Portland cement concrete is one which has taken a high place in the rank of economical and valuable systems. Some of the details of its use we have in Division I., chap. vii., drawn attention to, but it has been suggested that we might do some service by giving the details of its application to buildings by the adoption of such simple forms of appliances, the making of which may be quite within the competency of the great majority, not of regularly-bred country carpenters or mechanics, but of those men about a farm, 'jack-of-all-trades' as they are somewhat contemptuously but very unfairly called, of whom one good specimen at least is sure to be met with on every farm of anything like moderately fair extent. The apparatus is simply a set of moulds, and these are so easily understood and still more easily applied, that any labourer of average intelligence can do good work almost at starting. This is one of the great advantages of the system of concrete building. All that is required is careful, honest work; scamping or hurrying over it gives, of course, bad results in this as in other methods. Payment by piece-work may be adopted if the honesty of the labourer can be depended upon, or if a good overseer or foreman can give frequent 'looks' at how the 'work is getting on, sir!' Piecework is, however, more applicable when the work to be done consists of long ranges of straight-running work, such as walling; it is scarcely so applicable to cottage or steading building, where corners, wall and door work, and fitting in of timber have to be attended to, all of which take up considerable time in order to be carefully done.

The Moulds or Building Frames.—The more extensive the concrete building to be done, the

cheaper it will be, as it is obvious that the cost of the moulds will be spread over so much more work, that for each department, as for example a cottage, it will be reduced to a mere trifle. But after all, the moulds are not very costly, and may be made less so if home timber is available.

The illustrations in Plate 74 show a system of moulds which is perhaps about as simple as can well be devised. In Plate 74, in figs. 1 to 9 inclusive, we give drawings of these to scale $\frac{3}{4}$ in. to a foot. In fig. 1 we show part plan of the mould arranged for a 9-inch wall. If the half-timbered style—see remarks on timber work in this Division—be adopted in constructing the walls of the cottage or other building, the vertical posts which are left in the walls form part of their construction, as at *a a*, fig. 20. In fig. 1, *a a* are the vertical posts or uprights to carry the sides of the mould proper; they are rectangular in section, with a breadth or thickness about, as a rule, one-half of the depth or width. The moulds are made of boards, as *b b*, which may be tongued and grooved for superior work, and retained together and strengthened by the battens *c c*. The boards are kept in place by the wrought-iron clips, shown in plan at *d*, and in sectional plan at *e*. These are made to tighten upon the boards by means of set or pinching screws, *f g f g*. This will be more uniformly done if two of these screws be given to each clip, as *f* and *g*, although one at one side will be sufficient. There is little, indeed there should be no 'ramming' in and down of the concreted materials placed within the moulds,—the stones being placed loosely in, and then the concrete poured in, so that comparatively little pressure on the moulds will be found to exist. Fig. 2 is a side elevation of plan in fig. 1, and fig. 3 is an end elevation; the letters of reference show corresponding parts in each drawing. In all the drawings, *h h* indicates the concrete wall, fig. 3 showing that the moulds have been raised, to build a depth or rise of wall upon and in continuation of the wall below. In this plan there are no bolt or other holes formed in the wall to be filled up when it is finished.

Mould for Building straight-running or plain Lengths of Concrete Walls.—Fig. 4 illustrates on plan a mould of a still simpler form than those

we have just illustrated, the sides being in this formed of a single plank as deep as can be obtained; or if it be desired to have a greater height of the wall done at one time, the sides of the mould may be made as in figs. 1 to 3. The board or boards *a a* are secured to the posts *b b* by sharp-pointed screws; these must be made specially, say of 7-16ths in. diameter, so as to get a good hold of the posts; eight will be required, one at each corner at each side. To enter and tighten up the screws sufficiently, they have rings or eyes, as shown at *d*. If much walling is to be erected, to prevent the screws from injuring the boards *a a*, or splitting them through carelessness, the holes in these may be protected by a metal cap, shown in horizontal section at *a a* in fig. 5, the first ring of which is at *a a* in fig. 6. This may be secured with four screws, as shown in the fig., but two will be sufficient if set diagonally, as in the line *b c*, not horizontally or vertically, as at *d e* or *f g*. The cap may be simply a flat plate screwed to the board, as in fig. 6, the inner tube as *b b* in fig. 5 being dispensed with, as there is little or no pressure on the plate or ring *a a*, fig. 6. As the lower edge of the side moulds *b b*, fig. 2, Plate 74, are somewhat apt to open outwards from the walls, especially if the timber has become warped through use and exposure, it may be advisable to secure the corners of each side mould by a pinching screw, after the manner illustrated at *d* in fig. 4, Plate 74.

Making the Concrete.—Fitting up the Framework and Filling in the Moulds with the Concrete.—The proportion of the Portland cement to the broken materials (see chap. vii., Division I.) used for making the concrete varies according to the practice of various practitioners. Some use so small a proportion of cement as one part in eight of the materials; others seven; but a safer proportion is one part of cement in six of the materials. This we adopt in our own practice, modifying the proportions, however, according as we require in some parts a greater strength than in others, as pillars or narrow pedestals, in which case we use as high a proportion as three parts of the cement to eight of the material. The best way of mixing the materials is to have a platform made of strong boards well clamped together, and which may be of any convenient

dimensions, as 7 feet square. This is laid upon the ground in close vicinity to the place where the building is to be erected. The gravel, broken or crushed bricks—of size to pass through the meshes of a $\frac{1}{2}$ -inch sieve or screen—are then placed upon the board, together with the cement in the proper proportion, and the whole well mixed together in a dry state. When the mass is well mixed, water is sprinkled over it, gently at first—best done through the rose of a watering-pot—and applied till enough is given to enable the cement to adhere to, or become incorporated with, the broken material; the whole being of that consistency as to be easily passed into the moulds, and to be pressed closely up to the sides and ends, and to embrace, as it were, the larger lumps, put into the centre of the mould and forming the packing, of which more presently. A little experience will soon enable the workman to know the proper state of consistency in which the mass should be for using; care being taken to mix it well up before wheeling it off to be put into the moulds, as if not well mixed the cement is apt to settle to the bottom, leaving the upper portion, of course, weaker than the lower. We now come to the fitting up of the apparatus and the mode of working the same in the building of walls. The first thing to be done is to stake off upon the site the accurate dimensions of the proposed building, taking care to have the walls exactly at right angles to the sides. The greatest care must be taken to have the posts perfectly perpendicular, as upon this depends the vertical or 'plumb' condition of the walls. To secure this vertical condition of the posts throughout the whole proceedings, they should be put a considerable depth into the ground, and well wedged up with pieces of stone or brick; one or two timber wedges to finish off with will be useful, as by driving these carefully in near the completion of the fixing of the posts, the posts can be adjusted with perfect accuracy to a perpendicular position. Before finally adjusting the posts, the trenches for the foundation should be cut. The width of these may a little exceed the width of wall, and the bottom should be well rammed. Concrete is then poured in so as to form the foundation, the upper surface of which is to be flush with the ground level; this

having set, and the posts being adjusted so as to be perfectly perpendicular or 'plumb,' the sides of the moulds are then placed in position, as shown in figs. 1, 2, 3, Plate 74. The moulds rise perfectly horizontal in the direction of their length, and perfectly 'plumb' in the direction of their depth; and the posts being perfectly 'plumb' at starting, these positions will not be altered throughout the whole work, and no other adjustment will be at all required. The packing or central portion of the wall, of larger pieces of brick or other material, is now to be put in, keeping this as exactly in the centre as possible, so that a clear space on each side is left between the outside of the packing and the inside face of the moulds. The well-mixed concrete is then brought up from the mixing board and poured into the mould, so that it runs in between the interstices of the packing, and fills the side spaces between it and the inside of the moulds. The whole of the mould should be filled thus, and the whole allowed to set. In the case of a long division wall the mould should be of considerable length, so that the filling may be done one day, and the 'setting' completed by the time work is begun on the day following. In the

case of a room or cottage the mould should embrace the whole of the walls all round, so that they may be filled in the early part of one day, giving the whole time from the finishing of the filling of the moulds to the beginning of next day, when the whole will be found well set and compacted together.

The next operation is the moving of the moulds so as to give another height of wall. This is done by unscrewing the bolts of the clips *d d*, figs. 1, 2, and 3. The moulds are then lifted up, and secured to the posts by the clips at the proper height. They are then filled as before, and allowed to remain quiescent a day for the materials to set.

Formation of Windows and Doors, or Voids or Openings in Walls.—We have thus explained the mode of building so far only as plain or solid walls without windows or door openings are concerned, but the mode of making these openings is extremely simple. If simple openings only are required, with no framework fixed in same, then all that is necessary is to put in what may be called 'stops' or rough boards of timber in the points of the mould corresponding to the points at which the opening is required. Thus in fig. 30, let *a b, c d,*

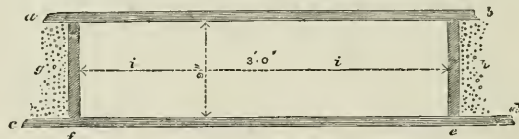


Fig. 30.

be the sides of the mould, and *c f* the points at which an opening is to be made; then at these points, boards, *d*, are fixed between the moulds,

care being taken to keep them perfectly 'plumb' till secured; the concrete is filled in at the spaces *g h*, leaving *i* vacant, and when the desired

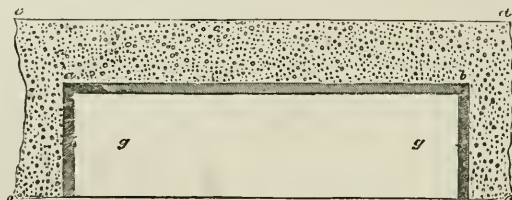


Fig. 31.

height is reached, and the moulds are removed, the boards *a f c* are taken out, leaving the sides of the opening quite flush and fair. If the

opening be in a low wall—for example, the front wall of a piggery—nothing more is required; but if it be a door opening in a high

wall, with solid wall above the opening, then, when the mould is fixed at the rise corresponding to the height of the door, a horizontal board, forming the window head or top rail of frame, is fixed across the two side boards *c d, e f*, fig. 30, and the concrete filled in above this and at the sides, leaving the space vacant. In fig. 31, *c d f e* is the outline of the mould, *h i* being the side boards, corresponding to *b b*, fig. 1, Plate 74; *g g*, the opening in wall; *a b*, the top board. By putting

in a curved top in place of the flat board *a b*, the head of window or door opening may be circular or arched. In regular door and window openings the frames are made in the usual manner, and fixed in their proper positions in the moulds, the concrete being filled up to and surrounding three sides of the framing; but as the width of the frame, as *a b*, fig. 32, is always less than the width or thickness of the wall,—which in fig. 32 is represented by the space within the sides *c d, e f*,

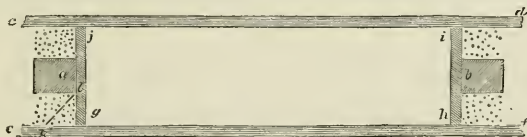


Fig. 32.

—the moulds, screeds, or rough timbers must be put in at *g h, i j*, to fill up the spaces between the frames and the sides of the mould. When the concrete is filled in and set, and the moulds are taken down, these screeds, *g h, i j*, are taken out, leaving the frame *a b* fast embedded in the concrete. The 'reveals' or 'rybates,' as they are termed in Scotland,—the word being evidently a corruption of 'rebate,' which a 'reveal' in fact is,—are here shown to be square, as *h*; but by inserting an angular piece, as at *k*, a splayed reveal may be made, as at *h i*. By giving a curved or moulded contour in the inside of this, it is obvious that the reveal will be moulded in place of plain. This method, shown at *k*, fig. 32, is also applicable to taking off the sharp arris or corners of walls and openings, which we would recommend to be done, as they are in concrete buildings very sharp and well defined, and apt to be knocked away and broken. They may be rounded or 'bull-nosed' in place of being angled or splayed, which is better for the openings of stock-houses, not being so likely to injure the animals as they go out and in. Fig. 33 illustrates the two ways of doing this, *a* being the angled or splayed block put in one corner of the mould, *b* the rounded one; *e* and *f* show how chimneys or ventilating flues may be made, and *g h*, sunk, plain, and ornamented panels. These will serve to show how easily apertures in walls are formed, and how the sides of openings may be made

angled, rounded, or moulded. They will also serve to indicate how ornaments raised or sunk, as panels, brackets, etc., may be formed in concrete walls, as, the blocks being once made by a skilled hand, any labourer can form them in the

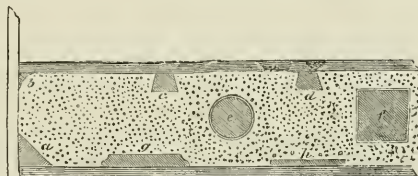


Fig. 33.

mould as readily as the ordinary walling; in fact, he cannot help forming them when once they are placed in the mould. The fixing in of wood brackets for joiner-work is also very easily done, and in a far more secure way than in brick or stone construction; if made dovetail fashion, as at *c d*, fig. 33, it is impossible to pull them out. Without going into the question as to whether concrete building is adapted to cottages, houses, and other complicated structures, we may express our belief that for comparatively long ranges of plain divisions or boundary walls, for the plain structures required in farm buildings, it is well adapted, and will compete most favourably as regards economy with brick or stone work; while as regards strength it will be more than required,

it being, when properly made, much stronger than brickwork.

Pisé or Earth Walls for Outlying Structures.
—The system of constructing walls in ‘*pisé*,’ or earth or soil rammed hard, is worthy of much more notice than it has received or receives amongst us. A modification of it is to be found in the ‘*cob*’ or mud-walled cottages of more than one county in England, say Suffolk; and more comfortable cottages cannot well be. Strange as the statement may seem to many to be, it is nevertheless true that a cottage thus constructed is capable of resisting the weather, and of withstanding even its worst efforts, long continued for a much more extended period than constitutes the ‘*life*’ of brick or even stone-built houses of the inferior classes of construction. There are ‘*pisé*’-built houses standing now, as firm, sound, and thoroughly weather-proof as the day they were built, two centuries ago. And hundreds of structures, of course more especially on the Continent and the various American countries, testify to the real value of the system as securing good houses. Economical they assuredly are in construction,—more so it is scarcely possible to conceive,—and the system possesses these three immense advantages:—First, it can be carried out almost—indeed, for all practical purposes, wholly—as easily by unskilled as by skilled labour; secondly, it can be done quickly; and last, not least, the materials abound everywhere, and cost nothing on a farm. We, however, as the title in the paragraph shows, describe it as applicable to outlying or simple structures, leaving out of consideration its value or otherwise for houses of a superior kind in this country.

The system of ‘*moulds*’ for ‘*pisé*’ building is simple, and may be used also for concrete buildings, in view of which we give illustrations of the appliances. Fig. 7, Plate 74, is a ‘*cross*’ or ‘*transverse section*’ of the mould as fixed to continue the building of a wall, part of which is shown at *a*; the two cross traverses or beams *b b*, 4 in. by 2 in. or thereby, are placed on the walls. The distance between these depends upon the length of the mould or of the wall which it is desired to build at a time without shifting the mould. This may vary from 5 up to 16 or 18 feet, the whole

length of a cottage. If several cottages are to be built on the same plan, the length of mould should bear some definite proportion to the length of wall, as a half or third; indeed, it would be well for the architect so to proportion the length and breadth or frontage and depth of the cottage, that moulds could be made to work in exactly, whether once or twice or in any other proportion. We have found this to be a good system in concrete building. In fig. 8, the ‘*front elevation*,’ the two beams are shown at *b b*. These cross beams should be so placed in and rest upon the wall, that their ends project equally over the wall on either side. The eye of the workman will soon enable him to do this with the necessary accuracy. Mortise holes are cut near the ends of the beams, into which are tenoned the lower ends of two ‘*uprights*’ *c c*, four in all to each set of moulds, and of the same size or scantling as the cross beams *b b*. The height of these is regulated according to the height of wall intended to be raised at one time. Two feet is a good height; greater is apt to prevent the workman properly ramming in the soil if ‘*pisé*,’ or setting the stones if concrete building be adopted. The boards *d d d*, forming the sides of moulds, rest on the inside of the uprights *c c*; these boards may be put together as in fig. 2. In the usual ‘*pisé*’ system the upper ends of the uprights are prevented from springing outwards under the pressure of the closely rammed soil by two cross bars, one at each end, with notches at the ends to receive the upper ends of uprights. We prefer, however, to use two iron clasps, as *e e*, which may be made at their return or bent ends, as in larger scale drawing fig. 9—that is, with an excess of length of the cross part *a*, so as to admit of a wedge, as *b*, being driven in between the inside face, *e e*, of return end of iron clasp, *b*, and the outside of the boards, *d d*, of the mould. As the moulds in concrete work are simply to retain the semi-fluid cement and the stones, between which it permeates or in which they are embedded by hand (see a preceding paragraph at beginning of the section in this Division), until the whole ‘*set*,’ the uprights will scarcely require any cross beam or iron clasp bar to hold the upper ends together; but it will be as well to use the latter

contrivance, or an iron rod or even a long screw-bolt may be used, this passing through holes bored in the face of the uprights *c c*, at their upper end. When the wall is completed, the uprights and screw boards are taken down, and when the wall is thoroughly set, the cross beams are drawn out; when this is done, two holes will have been formed in the walls, which will require to be filled up with the material used for the wall. In some cases these holes will be at such heights that they will be useful to be filled up in the interior with wood blocks, which will serve as 'grounds' or 'wood bricks' for the fixing of joiner work to.

Composite Walls of Timber, Stone, and Mortar.

—Another method of constructing cottage and other walls and the like, is the composite system, to which we have already alluded. In this, timber is used along with mortar and stones. Not only can a remarkably strong and absolutely fire-proof structure be erected on this system, but the materials may be, and indeed are, really the best for the purpose which come under the class of 'waste,' being such as would be useful for little else; but the great advantage is that it obviates the necessity of employing what is called 'skilled labour,'—that is, ordinary workmen, who, as a rule, with few exceptions are under the bane or the blessing of the trade-unions. The illustration of this method in Plate 74, figs. 20 and 22, will at once show how easily any ordinary farm labourer can erect buildings on this system, and how materials, useless otherwise, are by it made useful. In figs. 20 and 22, *a a* are the timbers, *b b* the filling in of stones and mortar. For fire-proof partitions of timber houses, the system can obviously be made remarkably useful; indeed, so well adapted for this kind of work is it, that we are surprised it has not been so applied in the case of houses built in the ordinary way, as a substitute for the framed wooden partitions generally employed, and which seem to be put up with the idea of inviting fire,—certainly they might help in its ravages when once it begins.

The timber used in this system for the outer walls may be of the plainest character, but by choosing curved pieces the pretty and picturesque effect of the 'half-timbered style' may be obtained

at no extra cost, save the trifling one of the little time required to choose, and in some instances to cut up and adapt the timber. These are all, of course, home-grown. The putting together of the materials is so simple that any labourer at all handy, and one who can think a little for, not of, himself and his work, will do it at once as if bred to it. In putting up the timbers, the workman should be careful to divide the spaces into as many triangles as possible, and so that the short pieces between the vertical uprights, placed angularly, may form when in position in reality a long brace or strut, and at a point where most useful to strengthen the structure. This will be seen in fig. 18, Plate 74, in which *a a* are the upright posts or verticals, *b* is a single filling-in piece, *c c* shows how a long strut or brace can be made extending from the central post *d* to the outside post, and this made up by placing the angular pieces in line. These form the leading angular pieces, and the intervening spaces, as *a a*, between the posts *b b*, fig. 19, may be filled up by placing the short pieces at certain distances, as at *c c*, parallel to the main struts, as *c c*, fig. 18. The better plan will, however, be as in fig. 20, after the manner of 'herring-bone strutting' used to strengthen flooring joists, *a a* being the verticals, *b b* the cross pieces; these may have horizontal pieces, as *c c*. The exact angle or mitre, although it be not a regular mitre, of the joint or end *d* of the cross pieces is easily enough found as follows:—Let *a b*, fig. 23, be an upright post, *c d* a piece out of which a cross piece, as *b*, fig. 20, is to be cut with angular or metred end; the piece *c d* is placed behind the part *a*, and in the direction or angle in which it is to be placed, as at *b*, fig. 20, and with a sprig-bit or nail a line is scratched on the surface of the piece *c c*, along the edge of the piece *a b*. When pieces are filled in horizontally, as in fig. 21, they should all be placed in line, as in fig. 20 at *c c*, so as to distribute the pressure as evenly as possible, not in step fashion as at *a b c* in fig. 21. It does not follow that straight or regular-surfaced pieces of wood must be used for the filling in between the posts; on the contrary, all odd branches of trees may be employed, and the rougher and the more irregular they are in outline, the more picturesque will they look when the cottage is complete, especially if

they, and also the posts or verticals, be 'picked out' with black paint, while the filling in can be white-washed. Figs. 24 and 25 show two methods of using rough branches or bent timbers. These latter pieces, if of good scantling, should be passed through the saw-mill to make the surfaces, at least the outer one, flat. They may be used with good effect in making door and window heads, as suggested in figs. 24 and 25. When it is desired to conceal the timber on the outside, especially in the front elevation, they can be easily and permanently covered by the mortar used in the filling in, bringing this well forward between the joints of the stones, and then smoothing the whole surface over. If the mortar be good, there will be little fear of the mortar outside the stone joints giving way and exposing the timber. It will be very different stuff indeed from the wretched cement with which the fronts of so many modern houses are daubed in the attempt to form 'make-believe stone' out of good, honest brick. We should, in fact, prefer the whole of the timber to be seen, so that any one will be able at once to know the materials of which the cottage is composed, and how they are put together. We have indicated how the timber can be so arranged as to look remarkably effective. It is difficult for us to conceive why any one should be ashamed to own to having used cheap materials in place of dear. If the work of the cheap materials be well done, that is the main point; and it is better to show that cheap materials have been used, than to use them and so disguise them that the pretence be made that they are valuable—a pretence easily seen through. One advantage of this method of using up timber for useful buildings of the farm is that it is almost absolutely fire-proof, getting rid thus of the great objection to structures composed wholly of timber (see a succeeding paragraph). The composite buildings are, in fact, almost absolutely fire-proof. The principle is not by any means new, nor has its practice been at all limited; on the Continent especially it has been, and is now, most extensively carried out. The next paragraph goes further into details applicable to the system.

Fire-proof Floors and Ceilings.—We have already described (see p. 150) a specially good

and fire-proof mortar, which may be used for the filling-in work of the combined system above described. In connection with the fire-proof system described in pp. 146, 147, and 148, in which this mortar is also recommended to be used for good work, it has been suggested that we might be doing those readers who may not readily follow written descriptions of technical work, some practical service if we gave illustrations of the methods we have described. This we do in figs. 10 to 17 inclusive. Plate 74, figs. 10 and 11, illustrates the fire-proof ceiling described in p. 146 (which see), *a a* flooring joists, *b b* strips or battens, *c* filling-in mortar. The dovetailed form recommended in the text in Division I. (pp. 146-8) is shown at *d*; or it may be as at *e* in fig. 13, two being cut out of one batten, as at *f*. Fig. 11 is side elevation of ceiling, of which fig. 10 is a cross section. Fig. 12 shows the board *c c* with handle *d*, for filling in the mortar between battens *b b* nailed to joists *a a*. Fig. 13 is cross section of fire-proof floor described in pp. 147-8, *a a* joists, *b b* battens, firing pieces, or fillets, *c c* mortar. Fig. 14 is side elevation. Fig. 15 is side elevation of floor in which flooring boards are required, that in figs. 13 and 14 being finished off either with tiles or with concrete on the surface of the mortar *c c*. In fig. 15, *a a* joists, *b* battens, *c c* mortar, *d d* fillets or small sleepers bedded in the mortar while soft and keyed into it or secured from lifting out or becoming loose by the dovetailed cross section, *e e* the flooring joists. Fig. 16 is side elevation, and fig. 17 plan of the other method described in pp. 147, 148, in which, in place of the battens nailed to top of joists as in figs. 14 and 15, laths are employed, on which the mortar is laid. In fig. 16, *a a* are the joists, to the upper sides of which narrow strips of wood, *b b*, are nailed; these are bridged over with the laths, *c c*, resting on them; on the laths the mortar, *d d*, is laid; *e e* being the fillets embedded in this, which carry the flooring boards, *f f*.

This principle of the combination of materials here described has been applied very ingeniously by Mr. Nichol, of Oxford Street, London, who makes frames of iron wire, wrought so as to form a series of diagonals; these are filled up and form the keys or holding points by which

a certain combination of materials forming a species of concrete are bound together. A series of slabs, of same dimensions as the wire frames, are thus made, which can at once be put together to form the walls and partitions of a cottage or the like. Another patentee formed his concrete or building material into slabs, so arranged as to dimensions, that, as duplicates or multiples of each other, they can be adopted in the construction of buildings with great ease and economy. All such methods, enabling unskilled labour to be used in carrying them out, are movements in the right direction, and, so far as the principle is concerned, many adaptations of it might be made. They may also, and by a little consideration, be useful in economizing waste materials—thus, for example, the slag of iron furnaces.

Corn Barns and Shelter Stacks of Timber.—We have in Division I., at p. 26, given descriptions and illustrations of various methods of forming stacks and their framing, chiefly with a view to maintain what is so essential, thorough ventilation of the mass, whether of corn or hay. For the protection of grain there is no method so efficient as the old-fashioned ‘Dutch barn,’ as it is called, of which Professor Coleman justly, as we think, remarks, that while permanent, and of course costly, they are ‘in the end probably the most economical.’ But they are costly, and an efficient and cheap covering is desiderated which would take the place of the straw generally used, but which, from various causes obvious to the practical man, is becoming scarce and valuable, while good ‘thatchers’ are as scarce as the material itself. An excellent covering for hay stacks is what may be called ‘the sliding or dropping roof.’ This is simply a roof supported at the four corners by vertical posts fixed in the ground at the corners of the space within which the hay stack is built. By simply-arranged wrought-iron clasps and pinching screw-bolts, the roof can be adjusted to any point desired in the vertical height of the posts; so that as the stack is consumed, beginning at the top, and gets less in height, the roof is lowered in proportion, so that it prevents side winds driving in the rain, etc. etc. This could, we think, be constructed still more cheaply, certainly more quickly adjusted and easily worked, by the adoption of

certain improvements, especially, perhaps, in the use of iron for nearly the whole construction. There can be no reason why the system should not be adopted for the protection of grain stacks when the Dutch barn is not available, or the covered-in stack-yard advocated by some. At the Bristol Show, 1878, of the Royal Agricultural Society, Messrs. Morris and Griffin exhibited Tucker’s Patent Rick Covering, prepared as a substitute for straw. This is a combination of wood and iron rafters, covered with waterproof felt. In fig. 24, Plate 74, we illustrate the chief details of this arrangement. The rafters *aa*, of scantling $4\frac{1}{2}$ in. by $1\frac{1}{2}$ in., are placed at intervals of 3 feet along the length of stack, and are held together and the whole strengthened by wrought-iron rods *bb*, 7-16ths in. in diameter. These are provided with collars *c* (in larger-scale diagram), and the ends beyond are provided with slits, *d*, to receive keys or wedges for tightening up the whole. The iron rods at the ridge junction of rafters have longer ends than the eaves rods, in order to meet the extra length required by the thickness of the two rafters. In all constructions it is a great point to have the parts either duplicates or multiples of one another. When they are duplicates, any one piece will fit into any one given part, so that no time is lost in selecting, or error committed by taking the wrong piece. In the arrangement illustrated, the iron strengthening and supporting rods might be all alike by simply notching the ends of rafters at ridge junction with the joint known as the ‘half-lap,’ as shown at *il*. In the appliance as exhibited, the waterproof felt covering *jjj* is secured to the upper surface of the rafters, and these, with the felt secured in them, to the hay or straw by driving in iron-pointed rods, as *h*; holes, as *g*, being made at intervals in edge or face of rafters. This appliance is likely to be very useful; it can be readily put up, is cheap, and possesses, as pointed out by Professor Coleman, who reports upon it in the *Royal Agricultural Society’s Journal*, the great advantage of affording a good space for ventilation between the surface of stack and the felt covering, *jjj*, fig. 24, Plate 74.

Value of Home Timber as a Constructive Material—the Probability of its Extensive Use.—Timber constructions of the farm are, we are well

aware, held in exceedingly small esteem by many whose opinions we are disposed to give full justice to; but it is possible that they may not have given close attention to what the points involve connected with this material, or any other coming within the same category. For many, holding—shall we say?—a prejudice against anything, simply allow that to close the matter, without giving attention further to what may be said in its favour under certain circumstances. ‘Under certain circumstances’—here lies the point. For it is not that other materials or established systems are not better than the cheap or economical one advocated, but whether, although better, it may not be wiser business policy, after all, to use the cheap and—admit the fact—less valuable materials and system. Now, healthy and comfortable farm buildings are essential not only to the carrying on economically the varied work of a steading, but essential to the live stock, inasmuch as life, and valuable life, is involved. Now, if this good accommodation cannot be provided in the best way, and by using the best materials, which is wisest, that the accommodation should not be provided at all, or, waiving wishes in every sense commendable so far as they go, or perhaps prejudices, to give that accommodation in material less costly, and, as thought by many,—on that point we have said somewhat elsewhere,—less beautiful, or rather downright ugly, to look at?

We have seen buildings so bad, alike for the animals of the farm and for the labourers, that any change, however slight, would have been better. But further, and closer to the point, we have seen and closely examined, and have been practically concerned with, many farm steadings, and others of the buildings of the farm, in which timber was the chief—in many the sole—material employed. And not only did they afford thoroughly healthy and in every sense comfortable accommodation, but they looked well, clean, and business-like; so well that, not now comparing them with the wretched, tumble-down structures of stone and brick which, no one knows for how many tenants’ leases, by dint of patching and repatching have been made to do duty for farm buildings,—such duty as they could only do,—but with well-constructed and well-kept

buildings of stone and brick, the timber buildings hold their own.

Nor can it be said that farming, and good farming, nay, in many cases the highest farming, is not carried on on those farms on which such timber steadings are erected; that cannot well be said in face of facts. Let it again be distinctly understood that we are not advocating timber as the material, and the only material, to be used, and that because it is the best; we advocate it simply on the grounds we have named, that it is better, where economy demands, to have good timber steadings than bad brick or stone ones, or none at all of any kind whatever calculated to do justice to the work and the stock of the farm. And we appeal with confidence to professional men, who, connected with construction, have given thought to the subject, whether timber cannot be so employed that it will be almost as valuable in a constructive sense as stone or brick, and that for farm buildings, with their peculiarly well adapted circumstances for cheap construction, timber is specially valuable, and easily applicable.

But we go farther, and appeal to practical farmers, whom we might cite in evidence; but we take the utterance of the last, and certainly not the least authority—Mr. Gilbert Murray, of Gloaston, Derby, in the last published number of the *Journal of the Royal Agricultural Society* (No. 29, part i. vol. xv. 2d series, 1879). Mr. Murray, in reporting on the trial of dairy implements at the Bristol Show of 1878, has some suggestive remarks as to the latest developments of dairy farming; and while noticing the great improvements made of late, he goes on to say: ‘The principal obstacle which at present impedes the progress of improved dairy husbandry is the want of adequate buildings’ (the italics here and following in this quotation are our own). ‘Throughout the whole of the dairy districts good buildings are the exception. Evidently, as a rule, but little thought has been bestowed either to secure the health and comfort of the animals themselves, the economy of labour, or the general convenience of the farmer. The entire system has so completely and rapidly changed, that on most farms, even where the buildings are made substantial, they require an entire re-arrangement, and additional buildings are necessary for

the preparation and mixing of food. There are already indications of the soiling system being adopted by dairy farmers, provided covered yards could be obtained. *Wood and iron might be more generally and economically employed* in the erection of farm buildings, particularly covered yards; by this means more extended accommodation could be furnished at *considerably less cost than heretofore.* Mr. Murray concludes by apologizing for making these remarks, but no one practically acquainted with the subject would deem an apology necessary; quite the reverse, seeing what Mr. Murray says shows the *universal importance of the subject at the present moment.* Just as there are signs abundant enough that farming in its practical details is destined to be greatly changed, just as Mr. Murray above says the dairy system has been so, and that 'completely,' so there are signs, if not so numerous, at least as suggestive in their importance, that construction in many of its details as applied to landed property improvements is about to enter—if it has not already entered—on a new phase; in which the change from the old to the new will be very marked in all its aspects, constructive and economical. In this change, new materials, some of which we have now and elsewhere named, and new methods of working, will form important elements. Trifling as some of the points we have insisted upon may be deemed by some to be, nothing, we conceive, can be trifling which is calculated to add to the resources, and to economize to the utmost the work of landed property improvement. Hence it is that advanced thinkers and observers see that the *economization of waste materials and hitherto neglected resources will play a somewhat important part in the extended and systematic improvement of landed property, which is the economic feature of the times.*

Supplies of Home or Waste Timber.—We have in chap. iii., Division IV., gone pretty fully into the general subject of the utilization of sundry materials of the property; but so important is this, and so much more could be said on it, that, with the aid of the latest facts, another chapter—and that by no means a brief one—might be easily devoted to the consideration of the *neglected resources*, and what are called, and are certainly nearly everywhere considered, the *waste materials*

of landed property. And it would be in this way very easy to prove that, if they were looked after carefully and regularly, and used with judgment, the expenditure in the wide range of improvements would be materially lessened. Money is frequently expended for materials which lie at one's very hand, or for which good and efficient substitutes, easily obtainable, could be readily used. But somehow or other—why, it is hard to say, unless it be accounted for by the pregnant truth that the eye only sees what it brings with it the power to see—such materials are passed by as worthless, nay, not so much as thought of; if so, the likelihood is that the fact would be examined into if they really were worthless. One would think that in many cases the mere presence of waste materials here and there would, as nuisances, things in the wrong place, attract attention to and incite the desire to get rid of them. But so far as the subject of the present section is concerned, if once the determination be taken by the proprietor or his agent to avail himself of the economical system we have advocated, rather than wait till a more costly one can be adopted, it will in many cases be found that a supply of timber is ready to hand without involving the necessity of purchase. For the better part of the work of erecting timber structures, where whole pieces are required, it will be necessary to cut up home-grown trees; but for a large proportion of the structure, pieces will be found amongst what is usually called waste, and as such is often consigned to the flames. We have seen large heaps of such timber burnt, from which it would have been quite an easy matter to have selected pieces which would have gone far to erect a cottage, especially on the composite system yet to be noticed. To aid in the economization of such materials, the circular saw will be found exceedingly useful; indeed, where much work has to be done on the property, this should never be idle, saving cash expenditure in more ways than one.

Storing up of Waste Materials—as Timber.—To many who have hitherto failed to give attention to the subject, what we here say may seem to give an exaggerated value to this source of useful material; but a little consideration, or what will perhaps be better, observation—'a

looking around'—will show that this is not so; that, in fact, we have rather under than over-valued this source. It would, beyond a doubt, pay to collect the waste timber lying here and there on the property, and to save those pieces which are being frequently left after cutting down timber, sawing it up, etc., keeping the pieces in a 'waste timber house' or open shed; not crowding and keeping them in an open-air heap, where the rain, etc. rapidly deteriorates them. The practical utility of this collection would soon show itself, for it is one of the disadvantages of not having things ready to hand, that a piece of work which is really necessary to be done, or ought to be done, is not done at all, simply because the material is not there without sending specially for it to the town. Further, the advantage of having this storehouse of waste *materials*—for its contents need not be confined to timber only, and useful materials abound everywhere—is that much will be saved which would otherwise be destroyed, simply because no convenient place has been provided for keeping them. We have known timber to be burnt, being deemed to be and condemned as utterly useless, which could have been applied to the making good and the protecting of a river bank, the giving way of which damaged a large tract of land. In this, as in many other departments of the property, the proverb, 'A stitch in time saves nine,' is a lesson specially valuable, and the readiness with which the material can be got to make the 'stitch' with is an important factor in the matter. Hence the value of the storehouse we recommend. Such stored-up materials may not always have a use found at once for them; they may lie neglected because not required, but the time will come when they will gladly be taken advantage of. There is much more in the old proverb than at first we think there is, which advises to 'keep a thing for seven years and a use will be found for it.' His experience of life must be very bald, or he must have been very careless, who has not found innumerable instances to prove the truth of these proverbs.

As regards timber, the reader need only glance at the following Plates, in which one or more examples will be found of the way in which much of it which is looked upon as waste may

be most usefully employed:—Plates 2, 3, 4, 5, 8, 16, 18, 19, 33, 39, 40, 42, 56, 57, 58, 64, 65, 73, 74.

Damp-proof Walls (see chaps. xi.—xv., Division I.).—In the text we have drawn attention to the best methods of preventing and curing damp in walls. This fertile source of house discomfort and personal disease is all the more dangerous that it is so insidious; and, as a rule, its presence is rarely suspected till it is too late to remedy the mischief it creates. The contrivances to cure are very numerous; so also those to prevent, which is the best and safest of the two to carry out. To have damp walls in new houses is the best proof that the builder has been perfectly ignorant of the first principles of house construction; and many there must be of this class, judging from the damp work abounding everywhere. Amongst the contrivances to prevent dampness in walls, the most recent is the invention of Mr. Pritchell, the patentee of a hollow flooring, a novelty in conception likely to be of great practical service. As a dry floor in the working parts of a farm or country house is of great importance, this part of Mr. Pritchell's labours has met with the approval of the Sanitary Institute of Great Britain, which awarded him one of its prize medals. Mr. Pritchell's damp-proof lining for walls is composed of what may be called hollow, semi-circular bricks or half pipes. This arrangement takes up little space, and affords at the same time large internal hollow spaces in proportion to the diameter. The pipes or hollow bricks are set vertically in line, so that, the spaces being continuous, a current of air is carried out regularly through the whole course. Another arrangement is the adoption of complete or circular pipes, and these, while they keep the wall dry, obviously afford great facilities for the ventilation of rooms to which they may be applied.

Sanitary Appliances or Contrivances.—Ventilation (see chap. xiv., Division I.).—The name of this department is 'legion.' Not a day passes—almost literally the truth—but what some new arrangement—or even an old one passing under the name of new—is introduced to the public, who, under such a condition of matters, in the very embarrassment of riches, as the French say, must be, and is, driven to the difficulty of making a choice

where choice is so wide and varied; or as is often, we may say generally, the case, determines to make no choice at all, as choice is so varied and perplexing. And, in truth, the general public are not by any means loth to avail themselves of this excuse, for they are by no means interested in the matter. Things have apparently gone on very well without all or any of those new-fangled notions, and they will, they think, go on as well in the future. It will take a long time to educate the great majority of the people to a just estimate of how the matter of sanitary arrangement and construction does exercise an important influence on health, and sometimes largely on what they think as much if not more highly of—comfort.

Meanwhile, waiting for this good time coming, there remains the gratifying fact that there are a large number who really are impressed with a notion that something must be done, and who, having been influenced more or less by the fully expressed opinion of scientific sanitarians on the subject, are anxious to do this something well. Not driven by the diversity of choice to do nothing, they are, even in honest endeavours, doing something. These somethings are pretty numerous; but by no means encouraging must the retrospect be when 'our failures' are drawn to memory, or relegated finally to the list of appliances tried but found wanting. It is of importance, then, to this class—who are really the supporters of these inventions, whose name, as we have said, is legion—that some authoritative opinion be given, upon which they can rely, and make them choose more wisely than when they simply go the round of inventions which are ever being furnished to them. Hence the value of such labours as those of the Society of Arts, and specially—without ignoring the immense service done to practical science in all its departments by that body—the Sanitary Institute of Great Britain.

Banner's Ventilating Cowl.—This name is not altogether appropriate in these days, reminding us of those of the 'monks of old,' who, by the way, were admirable sanitarians in the true sense of the term. But it is difficult to eradicate names once fully established; so 'cowls' will be cowls for many a day. And many ventilating cowls have been brought out, to bewilder the public with

their rival claims, since the day when Tredgold brought out his fixed cowl, which, with its angular deflecting surfaces, is a better appliance than many since introduced. Mr. Banner's 'cowl' is based on the principle of what we may call 'friction draught.' If a stream of water be forcibly sent in any direction through a mass of water, the friction created by the forced stream carries along with it particles of the surrounding water. So decided is this action, that should the general stream or mass of water be flowing in one direction, and should the force of the other stream be great enough, it will overcome the flow of the general mass, or at least a portion of it, and cause it to take the direction of the new force. In still water the action is, of course, still more observable and decided. Advantage has been taken of this principle in many ways where water is used, as where a small stream or vein of water, projected with great force through a mass of water, diverts or raises even to a higher level considerable bulks of the main mass.

But although many would be inclined to doubt it, it is no less applicable to the establishment of currents of air, impalpable, so to say, as that is to our senses. If a stream or current of air be blown across the top of a vertical tube, the friction created will draw within the range of the stream volumes of air from all directions, and equally, of course, in the air present *in* the vertical tube. An upward current therein will therefore be created. By so arranging the tube up which it is desired that a current of air should be established, the current will be more or less decided and stronger than if the vertical tube were simply left with what may be called its natural or normal surface. Tredgold furnished the tube with angular surfaces, which, deflecting the wind currents as they passed along, kept them from descending the tube, and at the same time materially influenced the strength of the upward current.

In Mr. Banner's cowl the mechanical arrangements are very simple, and form what is really a most effective appliance for extracting foul air from the interior of a building. The extremity of the ventilating tube or pipe, fixed into the ridge of the roof, is bent at right angles, and this bent part is covered with another, and of course a larger diametered tube, and of cou-

siderable length. Near the point where the internal or ventilating tube, conveying the air from the apartment, is bent from its vertical to the new horizontal direction, the external tube is widened out to form a funnel, and the orifice of this by the usual contrivance is kept always pointing in the direction in which the wind happens to be blowing. The stronger the wind, the stronger the current through the wide funnel part, and the greater the friction between the wind stream and the air in the vertical or ventilating tube, up which, even with a moderately stiff breeze, the current is very strong. This self-acting appliance is therefore always operating most powerfully when it is required, when, under the ordinary circumstances of a simple ventilating (so called) tube, the tendency would be to blow down the tube, thus forcing the foul air into the apartment in place of withdrawing it. There is, as is acutely pointed out by an eminent authority, an element of weakness in this arrangement, the use of a bent part in the ventilating tube. We have elsewhere, and under other heads,—as, for example, that of drainage and sewage pipes,—pointed out that all deviations from the straight line are productive of grave evils. If, therefore, Mr. Banner could overcome this difficulty in his cowl, it would probably take the first rank as a self-acting ventilator, provided always with a self-adjusting power. In a self-acting ventilator, this ‘friction,’ or, as it is otherwise and perhaps better called, ‘suction’ principle is the only one which can be relied on under all circumstances. The principle is applicable in many ways, and it will not be time thrown away if some of our readers endeavour to find out one or more of those ways useful in their daily work.

While on the subject of ‘cows’ or caps to ventilating tubes or smoke flues, it is worthy of note that very elaborate experiments made lately at South Kensington, in testing the various forms of stoves competing for a prize for the best, proved that, so far as the ventilating power was concerned, a tube, with simple exposed opening at top, acted as powerfully as when supplied with a cowl or cap. Still, in this climate of ours, where rain comes down heavily, or, as the Americans say, ‘solid,’ to say nothing of ‘blow-downs,’ a cap or cowl is necessary. The experi-

ments, however, must not be taken as conclusive; they at the least indicate the necessity for their further extension before the point can be said to be decided.

Water-closets (see chaps. xiii.—xv., Division I.).—In this department the number of new inventions (so called) has not been less marked than in the other departments of sanitary appliances; nor must this be wondered at, when we consider the important part it plays in adding to or taking from the comfort of a house, according as it is well designed and put up, or the reverse.

An excellent form of water-closet is that of Bostel's. In this the outlet is at the back, an arrangement which is much better than the present old-fashioned plan, so universally in use. Another feature, and a very important one, is the arrangement by which the trap under all circumstances is kept full of water, subject only to natural evaporation, which cannot, of course, be guarded against. In country and farm houses, the difficulty is to get a supply of water at sufficient pressure in order to make the water-closet thoroughly efficient, the only or chief source being the rain water collected from the roof, and stored up in a cistern placed as high above the closet as possible, to get sufficient head or pressure. But this at the best, although in the majority of cases the only resource available, is not always, if ever, such as to meet the necessities of the case.

Hence the warm recommendation which the ‘dry or earth closet’ system meets with at the hands of many, originally introduced by the Rev. Mr. Moule, and since perfected by the hints which come usually with experience. Although the plan has been largely adopted, it is nevertheless found to have drawbacks not easily or always overcome. One difficulty is the keeping up of the supply of dried earth or soil upon which the efficiency of the apparatus depends. No doubt to keep up this supply would involve no great labour. But we must take things as we find them in the world we move in; and the fact is, that servants do object to the labour of preparing the soil, carrying it to the closet, and ultimately removing it. Many modifications of the ‘dry-closet’ principle have been introduced, to lessen, if not remove,—but no inventor has ever been so

sanguine as to dream of this being done,—the difficulties of the ‘earth.’ It is something if only a little can be done, and that little has been effected by the use of the ashes of the household fires. This, however, is not quite ready to hand, although nearly so, as they are mixed with the cinders. But cinders are valuable as fuel—how valuable, those can testify who use them. And it is a point gained when two waste substances are stored and made of considerable value by one operation. This is done in the Morell’s Cinder-sifting Ash Closet (brought out under the Sanitary Appliance Company, London, from which information as to almost all appliances can be had). One advantage is that the cinders are sifted and the desired quantity of ash obtained at the closet itself.

A doubt has been expressed as to whether each household can produce as much ash as will serve its closet or closets. This doubt, we believe, need not trouble any householder. We have had a fair amount of experience in this matter, and when the household arrangements are carefully carried out, it will be found that the number of fires kept, the bulk of ashes produced thereby, and those required for the closets, will generally bear a pretty strict proportion to each other, and in the required ratio. So also as to the value of ashes as a deodorizer of the resultant manure. Although, beyond a doubt, earth or dried soil, as in Moule’s closet, is the best deodorizer, still ashes will hold their own wonderfully as against this; and this is not our experience only, although that has been extensive, but it is that of a host of others. Even the common privy, managed or mismanaged as it too often is, when treated with ashes, and in something like a moderate degree of care, is absolutely inodorous; and as to the value of the stuff as a manure, let the produce of innumerable gardens testify, as well they can.

One word as to a point in the practical adaptation of appliances, sanitary and otherwise. This will refer to the ‘putting-up’ of the apparatus as a part of the invention or design strictly so called; for not a few excellent designs, in departments other than that of water-closets as well, are so handled by unskilled or, what is worse, indifferent workmen, that the apparatus has in no sense fair play. This point, apart from

the special subject now in hand, is one essentially worthy of the strictest attention of employers of labour. The evil, for evil it is, we regret to say, is growing; and he who, possessing great influence with the working men, would devote some time to give earnest counsel to them in the duty they owe to themselves, their fellow-workers, and to the community at large, would be doing his country a greater service than the most impassioned appeals to them on political topics. But we fear—nay, it is no longer a fear, but a settled conviction with us—that but too many of our public men of all shades of opinion—we make no exception—are grasping at the shadow and forgetting the substance of that which, after all that can be said or written, constitutes the source of our national wealth, and forms the *raison d’être* of our national power. If working men, as in olden times—in these new ones greatly sneered at—would take a pride in the doing of their work as well as they could possibly do it, many an invention now condemned as useless would have had a different fate. Inventors cannot always be near workmen to explain and direct; but if workmen, in trying to set up an apparatus new to them, would, before proceeding to actual work, ‘walk all round’ the apparatus, so to say, they would likely receive a correct notion of its peculiarities. For our working men as a body are not fools—for this deficiency they would not be responsible, if natural; they are careless, which is inexcusable. These are points which affect so very closely the future of *all* departments of British labour, and not less, but even perhaps more so under present circumstances, those of British farming, that we offer no excuse for drawing attention to them here; quite otherwise, as the labour question is one of the most important connected with land.

Domestic Structures connected with the Mansion or Residence of the Proprietor of the Property, and with the Farm.—Before dismissing the general subject of the buildings of the estate necessitated by the requirements of what may be called its working staff, from the resident manager or head bailiff, the farmer and the chief gardener, down to the cottage of the humblest labourer, whether attached to the farm or the garden, we take the

opportunity now afforded us to offer a few remarks and to give a few illustrations supplementary and additional to those we have given in the text. It will be observed by those who have glanced over the preceding pages, and the plates which illustrate the various sections, that we have embodied in the scheme of the work plans of bailiffs' cottages and farm-houses of varied extent. This section was one which could not possibly have been dispensed with, but it may appear to some that it would serve some useful purpose if we gave plans of buildings not so directly connected with farming, such as houses for the chief gardener, cottages for his assistants, entrance lodges, coach-houses and stables, with living rooms for the coachman and his family, and the buildings connected with the riding and hunting departments of the proprietor, as houses for the huntsmen and the whips, dog-kennels, etc. This to some extent it will be perceived, on examining the plates, that we have met, as, for example, in Plate 68, in which, along with accommodation for the stock of a small farm or a suburban mansion built on the property, we give accommodation for 'riding or carriage horses,' and for the 'carriages' and 'harness-rooms.' So also in Plate 71 we give the plan of 'stables' for a large estate, where a 'hunting or racing stud' on somewhat of a princely style is kept, as befits the princely income of the proprietor of the property for whom and on which they were erected. And in same plate, plan of 'dog-kennels' will be found on a scale proportionate to the stud stables; and in Plate 68 enlarged plans of the 'huntsman's' house and of the cottage for the 'whips.' Further, so far as the buildings directly connected with the mansion or residence of the proprietor are concerned, we have given in Plate 67 the plan of a 'laundry' on a somewhat complete system. But it has been suggested to us by one of the authorities we have consulted on the scheme of the work,—to whom in passing we gladly and gratefully acknowledge our obligations,—whose opinions are of great value, that to these we might add what would serve some useful purpose—plans of houses connected with the garden of, and with the principal approach or drive to, the mansion or residence of the proprietor.

So far as the dwelling-house of the chief or principal gardener is concerned, it will be obvious

that the accommodation required being identical or nearly so with that of a farmer or bailiff's house, one or other of the plans of those which we give in Plates 26, 27, and 28 will do for the gardener. The plans there given may be more or less modified, not only in giving larger, but in giving such extra accommodation as the requirements or notions of the parties concerned may deem advisable that the house should have. The same remark applies to the 'cottages for the garden assistants.' One or other of the plans for farm cottages which will be found in Plates 29 to 33 may be adopted, or modified as regards the arrangement of the apartments, or the extent and character of the accommodation.

We have, however, thought it advisable to give under this head one or two designs which, like the others throughout the work, are to be taken more as suggestive of what might or can, rather than as examples of what we think ought to be done in the way of securing an attractive elevation in conjunction with a useful and comfortable arrangement of plan. We have this further to say, that just as we have given what we conceive to be fair and unexaggerated reasons for not relegating the kitchen garden to the regions of the prosaic, if not the positively ugly, but for making it, as it can be made, an attraction to the surroundings of the mansion which its produce is designed to supply, so we might here urge the same and other reasons for so dealing with the gardeners' houses and outbuildings. These are too often, we might safely say as a rule, treated as if they were mere things to be got rid of, shoved away out of sight as altogether unseemly. In addition to the choice of as remote and awkward a corner as can be got for their site, that site is further concealed by belts of trees. These, while they shut the buildings out of sight, shut out also the light and the air, tending so much to render them in large measure quite unfitted for *living* places. They act, moreover, as prejudicially on the spirits by depressing them as they do on the physical power of those who are compelled to live in them; for compelled they are, the only choice given them being that of the famous Hobson,—a real personage, not a mere presentment of a man, as is popularly supposed,—'This or none.'

This hiding away the buildings necessary to

the garden work is, we submit, altogether a mistake,—as much so aesthetically or artistically as physically and morally. Let the buildings themselves be attractive, and their position or site, so far as the locality will admit, such as will make them more attractive still. So also the surroundings. Trees are not to be dispensed with on this view, quite otherwise; only let them be used, not abused. For shade from sun, for shelter from biting winds, they are useful; for this they can so be made, and yet be for grace and ornament unsurpassed. The buildings should in their style be such as to harmonize with all this, and the principal gardener's house, or one of the group, or even the stables, will add much to the effect if some tall feature be added to the design, as a steeply sloping roof, bell tower, pigeon-cote, or pointed spire topped by a gilded vane or ornamental iron work. There is invariably—the reason for it is not far to seek—a pleasing and suggestive feeling created by the sight caught occasionally through waving trees and gleaming leafage of a rising point. The designs we give in Plates 75, 77, and 78 illustrate in some fashion this feature; so also in the humbler buildings in Plates 67 and 68.

For the cottages, the 'Rustic,' the 'Jacobin,' 'Half-timbered,' or 'Black and White,' as it is sometimes termed, are styles best adapted for detached buildings. If rigid accuracy of artistic rule be demanded, then, of course, the style of the mansion of which they form the accessories decides that of theirs. Still there are those who hold that strictness of rule in such a case may be more honoured in the breach than in the observance. After all, it is a mere matter of taste; all that we wish to be generally considered is, that taste—in the highest, not the lowest, most popular acceptance of the term—be bestowed upon the matter.

'Entrance and Park Lodges,' although not coming strictly within the lines of property improvement, so far as its agricultural aspects are concerned, do so in its general features. For example, in the chapter where we treat of the laying out of the suburban districts of property, we have drawn attention to a way which, by attention simply to certain details, such as the laying out of the grounds, would add greatly to

their attraction, and, by consequence, to their selling value. And in plots which, from their comparatively large extent, may be called small suburban estates, such an addition even as a striking-looking entrance or drive lodge may prove to a certain class of persons so attractive that they may decide to purchase even when the price is high, nay, as we have known, positively to propose a higher price than what was its rated value in the rent-roll of the property. Of course, in the case of the entrance to the carriage-drive leading to the mansion or residence of the proprietor, an effective entrance-lodge is essential. In Plate 75 we give two designs, which again, like all those we have offered for consideration, are to be looked upon as suggestive more of what may, rather than of that which should, be done. Houses appropriately designed offer not seldom opportunities of adding very much to the attractive features of the home park. Those having limited accommodation may be the residences of some favoured servants, or, with larger living space, of some official of the property; approached by a side drive, which, from the way it is laid out, and in which its outline and the immediate neighbourhood is planted, may in itself form an attractive feature in the park scenery. The offices and garden surroundings may, by the exercise of taste, make other features, all adding to this. Although objections may be and are made to having dwelling-houses in the park, the truth should not be lost sight of when conceding the point, that the interest which animate or 'life' features present always adds to the interest of inanimate objects. A landscape is said to be 'cold' when no traces of life can be found in it, and a home park loses half of its attractiveness if it be without its herds of graceful deer, or of some favourite breed of cattle and cows, or flocks of prize sheep. In these and in the other plates of architectural subjects will be found various details applicable to different buildings.

In Plate 76, in fig. 1 we give ground plan of the lodge, elevation of which is in fig. 1, Plate 75. In this, *a* is the entrance-door at corner of wall near the gate, *b* the porch, *cc* the inner lobby leading to the office or parlour *dd* at front, and to the back lobby *ee*, at one side of which is a

bed-room *ff*, on the other what is known in Derbyshire as the 'house-place,' and in Lancashire as 'parlour-kitchen,' *gg*. The scullery *hh* enters from kitchen, next to which is the larder *i*, with swivel window in back wall, part of which may have perforated zinc 'squares' in place of glass squares. The water-closet, or rather privy, is at *ll*, entering from outside in garden or yard; next to which is the coal-house and wood-store *kk*; while a store-closet *jj*, entering from back passage *ee*, is placed between it and the larder in kitchen. A cellar is placed underneath the kitchen, access to which is obtained by stairs under the stairs to bed-room floor. These cellar steps are entered from *p* in the direction of arrow *mm*. The bed-room floor is reached by the steps entering from the back lobby *ee*. The stairs may be shut off from lobby, if wished, by a door, and the direction to landing above is shown by the arrow-heads pointing to right and left. The two bedrooms are of the same dimensions as the office *dd* and kitchen *gg* on ground floor. As the accommodation in this lodge would be too ample for an elderly couple, for example, who might, as often is the case, act as gatekeepers, lodging accommodation could be afforded, even after the office *dd* is taken off the house-room, for one of the staff, such as a young bailiff who might be unmarried. No objection would likely be taken to this arrangement by the proprietor or agent. (For remarks on lodging accommodation in cottages, see chap. xii., Division I. in text.) In fig. 2, Plate 76, we give the plan of entrance lodge, of which perspective elevation is given in fig. 2, Plate 75. In this *a* is the porch, *b* inner lobby, *c* pantry, *d* kitchen (with cupboard *e*), scullery *f* (with boiler or copper *g*). On the other side of the lobby *b* is the bed-room *h*, with bed-closet entering from this. The office is at *i*. An alternative plan for this lodge is given in fig. 1, Plate 77, in which *a* is the porch, *b* the inner lobby, with *c* a pantry at end, *dd* kitchen, with pantry at *e* and cupboard *f* at side of fire, utilizing space formed by fire-place jamb. The scullery is at *g*, with slop-stone *h*, and door *i* leading to back-yard. A larder *j* enters from scullery, or it may be entered from outside. On other side of lobby *b* is the bed-room *kk*, with wardrobe in space *l*; *m* is a bed-closet. The 'office' is at *n*,

entered from back-door *o*. If an office is not required, this may be used as a bed-room, entering from the front bed-room *kk*, or the two apartments *m* and *n* may be thrown into one.

Of these designs for entrance-lodges in Plates 75 and 76, fig. 1, Plate 75, is in style well adapted for a school or small village institute, or for the entrance to a home farm, where that is on an extensive and finished scale. Fig. 2 is well adapted, from its picturesque character, to be placed as an isolated building in a park, partially surrounded with trees judiciously planted; as, seen through the foliage in summer, or even with the bare but always beautiful leafless branches in winter, it will not detract from but rather add to the attraction of the view, as seen from the hall or mansion. And although built in an isolated position, it may still be so placed in relation to the working parts of the farm or the mansion, that it may be a convenient residence, as for a gardener, head gamekeeper, or the like. Communication may be had to it either from the main road or drive, or by a special walk, or by both; and both approaches may be so constructed in winding fashion, with clumps of trees at well-chosen points, that they will still further add to the features of the park. For there is not even the most useful building, and that of the plainest character in style, but what may be made, through means of its *surroundings*, an attractive feature in the general landscape, and on closer inspection may show what can be done to make it a 'thing of beauty' by shrubs judiciously planted near, and by creeping plants and trellis-work attached to the house.

The plans in figs. 1 and 2, Plate 76, will obviously be adapted for other purposes than entrance-lodges, as for houses for one or other of the officials employed on the estate, according to the accommodation required. This may be increased if necessary to a considerable extent, yet so as to make the elevation in the general outline, as given in Plate 75, still available.

In Plate 77 we give, in figs 3 to 9, plan and elevation of detached stables, with living accommodation for coachman or groom, some of the details of which may be made applicable to parts of other classes of estate or farm buildings. In the plan, in figs. 3, 4, and 5, the same letters

indicate the same apartments; thus the coach-house is at *aa*, with folding door or doors at *bb*; harness-room *c*, with special fire-place *d*, or heated by back of kitchen fire-place, as in fig. 5; the stalls as in fig. 8, with dunging or cleaning passage at *ff*, and stalls *gg*. The kitchen or living-room of coachman's house is at *hh*, with scullery *j* and slop-stone *k*. The other places, as at *i* and *o*, are stores and closets. In fig. 5 a loose box *LB* is given to the stable. Fig. 8 is a plan combining stable with cow-house, poultry-house, etc., for a suburban or other residence, to which a small plot of land is attached. It may be taken as supplementary to the design we give in Plate 68. In fig. 8, Plate 77, *a* is the coach-house, with hen-house at back, the duck and geese-house being at *c*, and turkey-house at *d*; or this latter may be made into a rabbitry for the young folks of the house. The stable is at *ee*, with harness and store-room *ff*. The cow-house is at *gg*, with feeding-passage *h*; *i* being turnip store, *j* general food or meal store. Or this latter may be made into a goat or calf-house; if the former, entering from back.

Houses attached to or connected with the Garden.—Of these the principal is the head gardener's house. The style and extent of accommodation of this is, for obvious reasons, much of the same kind as farm-houses of corresponding character. Figs. 1 to 4, Plate 78, are suggestive plans and elevations. Other designs, which may be modified according to circumstances, will be found in Plates 24, 25, 26, 27, and 28. The general remark above made applies obviously to the cottages for the garden assistants, and some of the plans or modifications thereof given in Plates 29, 30, 31, 32, and 33, may be useful in the way of suggestion.

Present Position and Future Prospects of the Cottage Question.—Before concluding our remarks under the present head, we deem it right to offer a few on some of the features of the present position and future prospects of the cottage question generally, and how this may be influenced by considerations not always, sometimes not at all, taken into account.

Apart from other and higher considerations, policy has hitherto demanded good cottage accommodation for the labourer; its demands are

and will henceforth be still more clamorous, now that the labourer is, for good or evil, a 'power in the land.' But just as the demand for cottage extension increases and is increasing, so in like proportion, as we fear is too much the case, is the inability of landed proprietors to expend the very considerable sums which it seems necessary good and comfortable cottages demand. We say seems necessary; but in the preceding text we have, under the appropriate head, stated that the landlord's expenditure in this department could be considerably lessened, although the fact—for fact it is—has been disputed, or at least doubted by many. Still, believing that our opinion was founded on what appeared to be common-sense principles, we felt that it would take a position more and more decided as time passed on and experience tested it. That experience has been of late altogether so much in favour of it, that, where circumstances demand, it will be more and more acted upon.

The principle embraces two branches—first, that of arrangement, or rather the extent of the accommodation given in the cottages, and also its kind or character; and second, the class of construction adopted. We do not require to name again the details connected with the first of these heads, but we may here still more decidedly avow our belief, that by planning cottages according to some 'hard-and-fast line,' dictated either by prejudice or preconceived notions, or upon advice obtained from others, mistakes are very likely to arise which will be found to be as costly as they are useless; whereas, by duly considering the circumstances of *each* case, and by taking into account the real necessities of the labourer for whom the cottage is to be erected, not only will a higher degree of satisfaction be obtained, because it meets the actual requirements and no more, but a very considerable saving in cost will be the result. Hundreds of cottages are now standing examples of how much money can be needlessly expended through lack of attention to such common-sense principles as we have pointed out in the text, and here just alluded to.

Before passing from this head, let us suggest, for the consideration of those about to build labourers' cottages, whether it would not be ad-

visible to give to each apartment a greater floor surface than is thought desirable by many. Landlords may rely upon this, that the labourer, or if not he, certainly his wife, will feel much more grateful if they have a room large enough to afford space for the placing of their furniture, and yet admit of easy moving about in the doing of the house-work,—space which they really require,—than when they get, or if they get, another room, which, in the majority of cases, they do not require at all. And the space will be cheaper than the room, thus reducing the cost of the cottage. It is only those daily concerned in technical design and construction who can form a correct conception—and some of such have not, however, this faculty always—of the space which a room will give, in reading on a plan the figures which denote its size. Those who, for example, set out a living room, in which several people assemble, and in which all their work is done, 12 feet by 10, or even 12 feet square, surely have no idea how utterly unfitted a room of this size is for the purposes in view. This point is very important, affecting as it does the daily doings of the household, and its neglect is all the more keenly felt because it creates a want which is ever being felt, as the work is ever going on. But it need not be enlarged upon, as it is so self-evident. If the designer of the cottage feels that he is not sure that he can take an accurate conception of stated or determined dimensions, he ought to stake out the size upon the ground, and roughly estimate the space taken up from what may be called the move-about space of the room by the furniture required in it. Not seldom will inexperienced designers be surprised, in doing this, at their inaccurate conception of what written or named dimensions give in actual space. Nor will he be less frequently surprised when a pointed difference in the working capabilities of a room will be made by the addition merely of an inch or two to its dimensions. In passages, stairs, and cupboards this will be even perhaps more noticeable. In some of the plans of cottages we have given, this fault of having too small rooms will be observable. It is right, however, to say, in explanation of this, that this arises from the fact that these plans

are given chiefly as examples of arrangement and kind and extent of accommodation, and also as records of what has been done by various authorities in this department, to whom we are indebted for the plans.

As regards the second head, economical construction, we have only, as it were, touched the outer edge of this important subject. Not but that facilities, and these easily taken advantage of and carried out, offer themselves in fair abundance for the consideration of those who are interested, or ought to be so, in their adoption. But more reasons than one exist for so little having been done in the direction of economical improvement, and of these, perhaps, trade prejudices or customs are not the least powerful in action. In the great majority of cases the landed proprietor is not to be censured for the adoption of a system of construction which those whom he employs tell him is the only one open for his choice. Nor is he likely, nor should he be presumed to be aware of the fact that there are other systems as efficient and much more economical, unless he keeps himself *au courant* with the works of the day; and if he be aware of this, he is generally prevented from adopting one or other of them by the very decided antagonistic opinion of his builder. We do not say that all builders are determined not to adopt any new system, or even improvements in the details of the old. But assuredly experience tells us that, as a rule, such progressive movements generally come from those outside, or nearly outside, of the trade or calling in question. There is a vast deal of practical truth conveyed in the boast of the tradesman who, advised to adopt some new material which was undoubtedly valuable for certain work, replied, 'Oh, there's nothing like leather.' Again, one is often afraid to be the first to introduce a new system into a district only accustomed to see the old, as he will be laughed at if the system fails, and in any case, looked somewhat doubtfully upon if it succeeds. No doubt it can be said, and said truly, that the new methods of construction, or new applications of old materials or systems, do not in all cases, if indeed in any, look so well as the system of stone or brick construction, to which we have been accustomed. But looks are but minor matters, and

after all, it will perhaps be conceded even by the most ardent stickler for the keeping to the good old materials, that where materials honestly tell what they are, and how they have been used, the result, in more ways than one, is more satisfactory than shams, which old systems sometimes are. Shams in making materials have the appearance of being something which is more costly than what they are, is bad enough; but shams in pretending to be good materials put together in an honest, sound way, when the very reverse is the case, is worse. To the minds of many, it appears to be a better result when cheap and homely materials—which are not often employed, and which not a few think ought not to be employed at all—are used, so as to give good, honest work, than when the generally used materials are employed in such a way that honest work appears to be about the last thing thought of by the tradesmen and workmen who are engaged with them.

In more departments than in that of building, although, perhaps, it is more specially noticeable in that, we have little cause to plume ourselves upon what is called the progress of our age, comparing what is done in it with what our ancestors did, who did work which stands to this day as sound and good as when first erected, and said nothing at all about it. Simply because each man, master or man as he might be, felt that he had to do his duty, and that meant literally doing his work well.

We have been careful to present the different aspects of this important point, inasmuch as it will be found to exercise no small influence on economical construction generally, not merely as regards cottages, but in respect to all other work in which building materials are employed. Moreover, we must not overlook the social and moral benefit arising from a system which, rather than delay the supplying of comfortable and healthy cottages for the labourers of the property, simply because we cannot afford to erect them in the expensive style generally adopted, is based upon the sound principle of doing the work in a humbler way. Surely, whatever objections may be taken to the employment of such homely materials as may be, and as a rule are, generally found on every estate, it will be infinitely more

satisfactory to have our labourers' houses and cottages built of these, which will minister to home comfort and health, than to see them dragging out an existence in tumble-down hovels of the orthodox materials, in which neither the one nor the other can possibly be secured.

Application of Sewage (see chap. x., Division I., and chap. v., Division II.).—This, the grand vexed question of modern sanitary science, remains as vexed as ever; and, it would appear, so do remain the advocates of the various schemes produced, to judge from the way in which some of them discuss the points, a little removed from the quietness which is presumed to characterise the discoveries of science. Probable, however, it is, that out of the chaos of confusion at present prevailing, arising from so many and various conflicting claims being thus put before inquirers, some degree of light will arise to guide them to correct conclusions as to what method, or combination of methods, should be adopted. To believe some writers, all the difficulties which at one time admittedly surrounded the subject have vanished. Facts, however, go to prove that this is not precisely so.

It is now conceded by nearly all, that by far the best use we can make of sewage is to apply it to crops, which may be of the garden or the farm. It is not always, however, open to us to use it in the judicious way in which it can be best applied. If there were but one difficulty, that connected with having a supply when we do not require it, and a deficient supply when it is really necessary, this alone, and with our present lights, would be quite enough to deal with successfully. To get rid of the one difficulty, the plan has long been proposed to take from the sewage the solid particles, and leave the fluid to find its way, greatly improved in sanitary quality, to the river or other outlet, when, if it does contaminate the water of these, it will do so in a less degree. Apart from the fact, denied by none, that the fluid portion of sewage contains, if not the principal, at least a high percentage of the fertilizing constituents, in such plans for dealing with the solid parts the aims have been too high, and have therefore, unless by costly processes, never succeeded. Later inventors take a more common-sense view of the matter, and,

knowing that they cannot get all they would like, and all which the standard of sanitary efficiency strives to obtain, are content to take what they can get. General Scott has shown us what can be done by making excellent concrete material from the solid refuse of sewage; and very recently Mr. Johnston, with his 'hydraulic filter,' proves that a very good manurial cake may be obtained from the same source. Others followed in the same line with greater or less success. These should serve as hints to others to try to make what has so long been, and still is, a source of annoyance and sanitary evils, one of useful and economically obtained materials.

In the application of sewage to garden and farm purposes, it may be worth our reader's while to consider whether we have not almost invariably gone about the matter in a wrong way; or rather, whether we have not applied the sewage to the plants, in place of to the soil, and the soil only, in which they grow. There is very much more in this suggestion than may at first sight appear. Every practical man who has used liquid manure—we drop the term sewage, as it is not every farmer who can get a supply of sewage, though he can always get one, generally too small, of liquid manure—knows that by the application of the strong liquid to the plants he burns them up, and defeats the process he has in view. He in such a case weakens or dilutes his sewage. But how can he tell at what point the bad influence ceases, and the good one begins? We find an analogical case in the use of strong special manures. If we put the seed in immediate contact with the manure—say guano—we know the result in seed which does not generate, but is popularly said to be burnt up. If we put a layer of soil between the two, the difficulty is got over. We are very strongly inclined to believe that the true way is to enrich the soil with the sewage, allowing the plants to draw from it by their rootlets, which they will send out in all directions, such supplies as their necessities demand. Many systems have been brought out to secure this, which appears to us to be the natural way in which to apply sewage and liquid manure, all of which, more or less costly, have had greater or less success. But to our practical readers, after due consideration,

methods simply carried out, not costly, and fairly efficient, will, we doubt not, suggest themselves. The great mistake made by many inventors seems to be a notion that the plan cannot be efficient unless it displays details more or less complicated. The very opposite should be aimed at. It may be said in favour of the direct application of liquid manure to plants, as by jet and hose, that it is the system which nature adopts in administering her rainfall top-dressings, so to call them. But a very slight investigation will show the circumstances to be very different. Rain-water is vastly different from liquid sewage, chemically considered, in any of its forms, strong or diluted; and the method of application, mechanically looked at, is no less different. There is little mechanical analogy between the 'gentle showers from heaven' and the violently-applied splashes, say from a jet and hose apparatus. There is also another important element in the matter. Heavy thunder-plumps,—which are, however, but occasional,—from the mechanical injury they do to the plants, which they often wash quite out of the soil, afford a good illustration of the evils of the system which we do not think a good one. With the exception of thunder-plumps, rain is applied not only gently, but slowly, so that it has time to enter the interstices, and descend into and percolate through the mass of soil; whereas, so eager are we to get through a certain amount of work in a given time,—one of the great evils of modern styles of working in all departments,—that we imitate the thunder-plump, and bring about all the evils, and more besides, which that does to the soil and the plants, with such added evils as arise or may arise from the sewage itself, which we thus recklessly, ruthlessly, at least roughly apply. We say added evils which may arise, for the truth is, we know but very little as yet of the true action of sewage and liquid manure upon plant life. We know that they are beneficial generally, but the special ones acting under special circumstances we have but to guess at, if, indeed, many of us take the trouble even to do that.

Such considerations as these we deem of some importance; indeed, experience, as well as much investigation, more or less scientific and therefore precise in character, recently made, points to a very decided modification of our plans of

nsing sewage and liquid manure. And if necessary at all times, assuredly more so now than ever, it behoves all concerned with the cultivation of farm land to try every means by which the materials it demands should be made the most of. It is but trite to say, what a long continuance of bad times has brought into very marked prominence, that as a rule this common-sense, or we may say commonplace view has not been widely held. If it had, things which have been, and at the time we write are now so bad, would have been, it is but reasonable to suppose, not *quite* so bad; and the neglect of this rule with many, runs through all departments of their farming.

While on the subject of sewage application, and with reference to what we have given in the main body of the text respecting it, we deem it right, in order to make our notice as complete as may be, to draw attention to the latest plan introduced. It is the 'Pneumatic Sewage System' of Mr. Isaac Shone, which is now being carried practically out on the farm of Lieut.-Col. Jones at Wrexham,—a system to which a very eminent authority applies the following. 'Beyond all doubt,' says this authority, 'the mode of transporting sewage introduced by Mr. Isaac Shone of Wrexham must occupy the foremost place as an important addition to our knowledge.' It promises a very high amount of pecuniary saving, as compared with the methods generally, we may say universally, adopted of transporting sewage from towns to farm lands. A great many of our readers occupying suburban lands are specially interested in this. Indeed, from its great economy and remarkable efficiency, the system offers facilities for transporting sewage to localities which would be practically unapproachable under ordinary circumstances. It is thus applicable to places which are so locally situated, either as regards the dead level of their surface admitting of no fall, or, on the contrary, as regards its excessively steep gradients, as to be beyond the range of the operation of the ordinary system of transporting sewage. Without entering into details, which would require illustrations to render them intelligible, we may state generally, that in place of the large sewers, drains, and conduits of the present system, partly filled with sewage,

which has for this and other reasons a slow and sluggish motion, and which give rise to, and are, in fact, in more ways than one creators of sewage gases, those murderous and dangerous foes to health, Mr. Shone adopts small-diametered pipes, kept constantly full, and the contents of which are kept moving at such a rate and under such a pressure as not only to ascend steep gradients, but to carry along with them all the solid substances met with in ordinary sewage. Borrowing an idea from the pressure or 'head' obtained in water mains, Mr. Shone, by an ingenious adaptation of the compressive powers of air, obtains all these and other advantages at the cheapest possible rate, and without any of the mechanical disadvantages which attend the usual methods of obtaining the power of compressed air. The advantages of this method, if found to be successful in practice on the large scale,—as to which we think there is no doubt,—are obvious, not the least of which is that the formation of sewer gases, such as are present in the long line of ordinary sewers, which, however carefully constructed, admit of these gases escaping to the upper air, is clearly impossible; while the mechanical ones of transportation at a cheap rate are capable of avoiding difficulties which, if they have not absolutely baffled the efforts of our ablest engineers, have only been overcome by them at a cost which has put any economical utilization of the sewage for farming purposes altogether out of court. That the system is likely to be successful on the large scale may be fairly anticipated from what has been already done. On his farm at Wrexham, Lieut.-Col. Jones states that he has witnessed the 'regular intermittent lifting of *erude* sewage at the rate of about 4000 gallons per hour to a height of nearly 40 *feet*, with an effective pressure of nearly 18 lbs. to the square inch. . . . I never before,' the Colonel adds, 'knew crude sewage suffered to enter a pump without previous straining through a grating. *All kinds* of matter usually found in town sewage have freely passed through the "ejector," without causing any trouble in the valves.' The italics are our own, to clearly indicate two of the features of this system.

River-bank Work and Alterations (see chap. vii., Division II.).—In the main body of the text,

under its appropriate section, we have gone fully into this subject. We have here little more to add, save a word or two chiefly of caution, and this in respect of such work as may involve the proposal to alter the course of rivers or streams flowing, as a rule, through flat districts and alluvial soil. Not merely with the idea that such may be the most effectual way of getting rid of the cost and labour, too often to be repeated in some districts, of protecting banks from the erosive action of the stream, but also in view of other considerations, more or less selfish, the temptation to make the river take what are called 'short cuts' is very great. This system to many seems not only the least expensive in the long run, but the most effective. Those, however, who have had long experience in such work, and have carefully and for long time and in many districts watched the 'behaviour' of the rivers and streams under varying circumstances, know well that the system carries with it not merely inconveniences, but dangers. This has had of late years, but specially during the last season, 1878-79, very remarkable and costly exemplification and confirmation. Not a few proprietors, and not a few large districts, indeed, have abundant reason to regret that they adopted the system we have referred to. Even where the evils complained of are in one district got rid of, it is at best but a shifting of them to another district or to other districts; not a very wise proceeding when we consider a river system as a whole. River engineering demands peculiarly careful observation, and the taking into account not merely one point, but many present points, and also many future contingencies. All those have a direct relation to each other; and a serious accident may arise, long after the work has been completed, from neglect of a point which at the time had been overlooked, or, if noticed, considered to be so trifling or so unconnected with the work in hand as to be deemed unworthy of special care being given to it. An engineer, coming, as he probably does, new to a district in which his services may be required, is not likely to know all the local circumstances which bring about changes, and into action forces which must be attended to and guarded against. He ought not, therefore, to be above gathering information from all sources; nor

is he the least but the most likely to get the most valuable information from the working men, whom some might consider as most unlikely sources. From such as have long been resident on the property, most valuable hints may be derived. We could cite not a few instances in proof of the value of collecting such evidence, and of the losses sustained by its neglect. Warnings as to points have been given, which have been, as we know, actually laughed or smiled at, but which, passed over, have brought about disasters of the gravest kind. Nor are the lessons which Nature herself teaches or shows us to be despised. Far from it. Those not acquainted with the philosophy, so to call it, of river engineering, suppose, for example, if they think anything about the matter at all, that the curious curves and bends which rivers take, especially in low-lying districts with light and friable or easily worked soils, are mere whims or freaks, so to say, of the river. But those who do know the 'philosophy' know better than this, and that such results are those brought about by the river or stream itself. We put it thus, for it is difficult at times to divest oneself of the idea of inanimate being sentient objects; certainly difficult, if not impossible, to refrain from using terms in discussing, as now, practical subjects which involve this idea. Through a long course of years, the river has worked out for itself a path, which not only avoids certain points of weakness in the immediate neighbourhood, but serves as a 'safety-valve' to distribute and weaken forces which otherwise might have done serious damage to more distant parts of the same property or to other districts. Many a farmer, although he knows not how, has owed his immunity or escape from disasters to the existence of those natural safety-valves. And not seldom have 'short cuts' been made, which with after and costly experience would have been gladly unmade. Nature, again, if allowed, might have done the work for them, but then Nature is somewhat slow in her working, and will not often, if ever, 'keep the time' which the exigencies of modern times demand.

Another evil arises from the system of making the stream or river take a 'short cut' in a new direction: the temptation is very strong to narrow the new cut or bed, and this in view of the

saving of expense in excavation. This is often done, trusting to the action of the river itself in doing the otherwise costly work of deepening the cut. No doubt the water does this most effectually in soft alluvial bottom soils, but it unfortunately does something more, and this as effectually. Self-evident as the fact is, it is nevertheless too often overlooked, that as the width of the stream is lessened its velocity is increased. Now this, under ordinary circumstances, brings about a series of operations which appear to an ordinary observer to be, as we have above stated, quite erratic and impossible to be accounted for. But Nature, so to speak, knows well what she is about, and will do her work well if she is only allowed to do it. Where, in the course of a tortuous waterway, certain weak points are discovered, often brought into existence by some specially bad flood, one or other of the expedients we have named in the preceding section should be adopted. Certainly every point should be taken into consideration, and all efforts made to overcome such difficulties, before the plan of altering the course of the river or the stream by the adoption of the short cut system is decided upon. In a large proportion of cases this is the very worst work which could be undertaken, even although it apparently offers many advantages, such as straightening the outlines of fields, getting rid of those confined and always awkward corners and banks which hinder greatly the work of the machines, as, for example, mowing machines, which the exigencies of modern farm work demands. Great as are the advantages of thus regulating the outlines of fields, they may be produced at too great a sacrifice when running along a river-side. One caution further only remains here to be given, namely, do not delay the work of repair in the hope, which too many cherish, that some lucky chance may obviate the necessity to do any repair at all. This is rarely if ever the case. A double lesson is conveyed in the scriptural statement, that the 'beginning of strife is like the letting in of water.' A pin-hole in an embankment, neglected, may flood and ruin the cultural prospects of fine fields for a generation, if not permanently. River banks and embankments of reclaimed lands require to be regularly looked after to discover 'faults,' which, when once observed, must be dealt

with then and there. As a highly useful material in such work, we have yet, we believe, to see the advantages of the employment of concrete. Its use on the large scale has been widely, and its value conclusively established. It is one of the favourable circumstances connected with the material, that it is capable of being made equally so on the small or comparatively small scale.

Estate and Farm Water Supply Works.—What is the most important, at all events the most expensive department of work of this class, has been already given under the head of 'Catch-water Embankments and Reservoirs.' What we have now to give will relate to points not yet considered, or but merely glanced at. These will embrace, of necessity, some classes of work involving special arrangements and some outlay, more or less considerable, according to circumstances; but they will also take up the availing of sources of supply, as yet as a rule throughout the country but seldom taken advantage of. This arises largely from lack of a due consideration of their inherent value, and how very cheaply they can be made serviceable, as well also from a positive ignorance of this. Those in a sense minor sources of supply we shall consider first. Of these we take up—

Water Supply obtained from Drainage Areas of Land.—The plan of collecting supplies of water from what may generally be called drainage areas—meaning by this, areas supplied from under drainage as well as from surface or direct rainfall—is in its primary aspects simple enough. Water always tends to flow downwards in the direction of streams or rivers, and when the surface of the country is diversified by hill and dale, these streams will be found meandering in the lowest parts of the dales; and by simply throwing across these dales, at the most convenient points, embankments, dams, or weirs, a reservoir more or less extensive, according to the nature of the valley behind the embankment, will be obtained. Where the country through which the drainage streams flow is level, the difficulties are of course increased,—in many cases to such an extent as, from the costliness of the works necessitated, to preclude all chance of obtaining economical supplies. There are, however, numerous districts throughout the country in which the natural

surface of drainage areas is such as to admit of works being constructed of the minimum simplicity, and consequently of cost. Collecting areas are by no means modern inventions, so to call them; the ancients were thoroughly conversant with them, and carried out schemes in connection with them of a gigantic and imposing character. In agricultural districts, with which we have here specially to deal, the sources of supply which can be made available by the system of *collecting areas*, are, *first*, the rainfall, shedding directly from the surfaces which are wholly or partially non-absorbent, as rocky surfaces, compact clay, grass, and the like; *second*, the rivulets or streams passing through the proposed site of the collecting area, having their origin at a locality or localities above it; *third*, the underlying springs, some of which crop or flow out naturally, others in strata so favourably situated that they may be 'tapped' at a very moderate outlay, and afford a large—sometimes a too large—supply; and *fourth*, the supply from the under-surface drains, which have their outfall directly into the area, or into the rivulets or streams passing through it. In all these cases the primary source is the rainfall, so that in estimating the probable quantity to be derived from any plan of collecting area, the amount of rainfall of the district must be taken into account. This should always be taken at its minimum. The leading principle in the system of collecting areas for agricultural districts may be stated thus: 'To store up the excess of one season to supply the deficiencies of another;' or, in other words, to keep the supplies of the rainy for the use of the dry season of the year.

There is a large amount of water supplied by the rainfall which is at once available for storage purposes. Thus it has been calculated that if two-thirds of the rainfall of England and Wales could be collected, it would furnish, to 'each individual of the population,' a quantity exceeding 2500 gallons per day.

Collecting and Storing of Rain-water — Data for proportioning Tanks, &c. &c.—To the matter already given on the important subject of water supply, the following may be usefully added, chiefly with reference to the collecting and storing of rain-water, both for domestic purposes and for those of our farm buildings. Much more

might be done, and done usefully, than has been or is now being done; although of late it is only right to state that much greater attention is being paid to the subject. Some of our readers may have been influenced by certain opinions put very prominently forward by the Royal Commission appointed to investigate the pollution of rivers throughout the kingdom. These opinions depreciated the value of rain-water, as being rendered impure by passing through a polluted atmosphere, and descending upon polluted surfaces. Our readers who have adopted this view may rest assured that it is based upon totally erroneous assumptions, and that against their single opinion can be placed what may be called the universal consensus of opinion of those who have actually had large experience in the use of rain-water. It is not only the purest water *per se* which can be obtained, but even after passing through the atmosphere and over the roof or collecting surfaces, it will, in point of purity, compete with many other waters obtained from wells and springs. Whatever may be said of the impurity of the atmosphere in manufacturing and industrial districts, surely nothing can be brought forward in proof that this impurity exists in the country; and as regards roof impurities, those in the country are confined to leaves and to the droppings of birds, and are found to be in practice so trifling in amount as not worthy to be recognised as impure agents. We have stated that the rainfall throughout the kingdom is such that it yields a supply considerably, some say greatly, in excess of that which our population requires; to this may be added the somewhat curious coincidence, that the roof surface of our houses is such that the rain-water shed upon it yields a supply, if judiciously collected and properly stored up, equal to the domestic requirements of the inhabitants.

The estimated daily requirement of our population is generally put down at 22 gallons per head per day. This is greatly in excess of our actual requirements, and is provided to meet the waste arising from leakage consequent on the system of town water supply, and the much greater loss arising from positively reckless waste carried on in the great majority of our houses, and throughout, as a rule, our manufacturing and industrial

processes. But in the country the conditions of the case are most materially altered. Suffice it to say that a fifth, and much less even than this, of the above amount, will be amply sufficient for each individual per day. Few cottages will have less than 500 square feet of roof surface, many much more than this; but, taking it as the average, and taking also the average rainfall, this roofage will yield a supply for the whole year of not far off 6000 gallons. This will give per head in proportion to the number of inhabitants. This is or has been taken as six, but we think five would be a fair average. The supply divided by the days will give, say—this is decidedly under-estimated—15 gallons for the day, and this divided by 5 gives 3 gallons per head. The storage is best secured in underground tanks. Those constructed of Portland cement concrete, elsewhere in this work pretty fully described, are the cheapest. In every sense, indeed, they are the best, being quite equal, in some points superior, to a tank cut out of a single solid stone. The water can be withdrawn in the easiest and quickest way by means of a bucket and rope; or the bucket may be attached to the end of a pole, worked by hand, or swivelled to a vertical pole in the way most familiar to many living in rural districts. When not in use, the inlet-hole is covered with a wood or stone cap to exclude the light, but which should be so placed in the inlet that it will admit of ventilation of the interior of the tank. The proportion of tank content to roof surface is to give to each square foot of roof $2\frac{1}{2}$ gallons of tank space,—this giving a supply equal to 78 days, which the experience of Mr. Wheeler, C.E., shows to be the least supply which ought to be provided for. If the tank be 6 ft. deep, and 6 ft. 6 in. in diameter, this will give a tank capacity of 1200 gallons. If in brickwork, the cost of the tank will be at the rate of a little over a shilling for every 10 gallons of tank space. As large tanks are more cheaply constructed than small ones, the plan may be adopted of having one tank of large size to supply several cottages. As regards the supply of rain-water to be obtained from the roof surfaces of the farm buildings proper, it is obvious that the same methods of estimating quantity as given above will apply. But here

the rule should be simply to take every precaution by which the rain-water will be prevented dripping from the eaves, by providing them with gutters and rain-spouts conveying the water directly to the underground tanks. If even the careful, not the wasteful use of the water for the purposes of the farm buildings and the wants of the stock which they accommodate, exhausts the supply, this must be supplemented by water obtained from other sources. If no other purpose, however, was served by guttering all the eaves, and leading off the rain-water to tanks, than that of keeping the wet from the walls, the system would pay. Those who know what building property of any class is, know that there is no more powerful cause of injury to it than rain-water allowed to drip from gutterless eaves, splashing on the ground, not only making the lower courses of the wall thoroughly wet and damp, but keeping it so by thoroughly soaking the soil. This extends far every way, and even to the interior of the houses, and to the yards. Nor do the upper courses escape wet and damp, for, in addition to the cause of this by capillary attraction, drawing, so to say, the damp from the lower courses, the damp from the eaves, by the same attraction, is to a large extent led to the walls. And a worse, or at least a more obvious cause is the wind, which drives the drip inwards against the wall surface, and often, indeed, far up the roof timbers. All this can be avoided by the proper course, as above described.

Rain-water and Drainage Collecting Areas in Fields.—But a supply of rain-water is to be obtained from a source other than off the roofs of cottages and of farm buildings. This may be not only much larger than is generally thought of, even when the plan or system is, in the first place, thought of at all; but it is or can be obtained out in the pasture fields, where it is always wanted, and too often most inefficiently applied. Few even of the least observant of those engaged in farm work but must have often noticed that after specially heavy rains, and indeed frequently in many districts under the usual or ordinary circumstances of the rainfall, water is found to be collected in certain depressed parts of fields. This in many cases disappears quickly, being either absorbed into the soil or evaporated, or through

both causes being at work. In other cases the water is retained for a long time, often, indeed, lasting throughout the summer, of course in gradually decreasing quantity. For reasons which could be easily explained, the water thus retained retains also its good qualities, or, at all events, largely so; and that it is grateful at least to the stock, which may have access to it, is proved by the fact that they will leave the troughs supplied with spring-water, to partake of the rain-water in those chance collecting areas.

The hint thus given may be acted upon with great advantage,—has, indeed, been already so acted upon in such a way as to afford sufficient data to show the useful purposes such collecting areas can be made to serve in field-work. Some judgment is required in deciding upon the site of such areas; but it often happens that the best one in a field is indicated by the position of those very ‘chance’ pools of water to which we have above alluded, although by a careful survey better sites may be found even than those. There is at least one point in almost every field of any extent fairly well, often admirably, suited for a collecting area for rain-water, directly received from the rainfall, and indirectly from the surrounding surface. In those the most favourably situated spots very little work is to be done, save that of preventing the gradual absorption of the water by the soil on which it is to rest. In some cases, when the collecting area has been selected, so to say, by Nature herself, she seems not only to have chosen the site from its form as best adapted to the purpose, but the soil also best calculated to prevent the rapid absorption of the water collected. Yet it will often be found, in connection with this, that there is nothing apparently peculiarly fitted in the soil itself to retain the collected water; compared, indeed, with other patches near, it would seem to be the least fitted.

In close connection with the subject of water supply, and in other departments of estate work, it may be worthy of notice that not a few valuable hints may be gathered by watching the peculiarities of soils, etc., and their ‘behaviour,’ as engineers have it, under certain circumstances. This same point of absorbing power of soils, for example, is a very puzzling one frequently. In walking along a sandy sea-shore when the tide is

out, large pools of water will here and there be met with. What keeps the water there which disappears elsewhere? Examine the soil or sand, and you will see nothing to enable you to distinguish it from the sand even immediately around. It is not kept there by the mere fact of there being a depression or hollow, for other hollows are there which have no water in them. Our conjecture, if we may conjecture on a curious circumstance which may, and we think does, lead to some very practical facts, is that there is something in the mere surface or upper skin or crust which gives the resisting power to absorption. We have given, in some instances, but the slightest scratch or scrape to this, and have found the water to disappear. If this holds good, it would appear to be better not to disturb the upper surface of collecting areas self-selected, and which are to be retained for use. This applies to other works, as the base of embankments, which see. Still, if the area is to be enlarged, disturbance is inevitable, more or less; and, indeed, in any case it will be necessary to lay a non-absorbent material over the area. Even when one already formed is of large enough area, it will be better to do this, to guard against the ‘vagaries’—we use this for lack of a better word, as also in our ignorance of what, no doubt, is guided by a ‘law’—of such places; for a close observer must have noticed that the depression or pool which retains water in the field in one season will not retain it in another. Further, it is better to get rid of all vegetable and organic substances in the area on which the water is to be collected.

A surface more or less non-absorbent may be obtained by the use of various materials on the estate. Close adhesive clay—good ‘puddling’ clay, as it is termed—will make a perfectly water-proof surface if laid down as we have recommended in treating of embanking work; but in course of time it softens and, as the popular phrase goes, ‘melts away’ for a considerable depth, and this, if it does not add to the chemical unhealthiness, will add to the mechanical impurity of the water. There is, however, at command a material in every way adapted to form the surface of collecting areas—that is, Portland cement concrete. It is not only the best, but the cheapest, and the ease with which it can be laid down and made

to adapt itself to the peculiarities of the site can only be understood by those who have tried it under a wide variety of circumstances. Drinking-troughs for cattle, tanks in connection with the collecting areas, etc., can thus all be formed of this material; and the importance of the point will be the excuse for the repetition of the fact that unskilled labour may be employed, giving almost as good work as that done by skilled—quite good enough for the work. It may lack 'finish,' but fine finish is not here needed.

The following notes, illustrated by sketches given in Plate 77, may afford some suggestions in availing of or forming collecting areas. The sketches are not ideal, but are strictly representative of sites of areas naturally selected or fitted to be made into collecting areas. They will be found representative of many which will be found in various districts, varying according to local peculiarities of soil surface. The diagram in *a* presents a section of a depression in a field in which the rain-water was, season after season, retained, while in other depressions not far from it the water was rapidly absorbed. It lay in a part of the field well adapted for a drinking-pond, to which purpose the cattle actually put it, evidently having a decided preference for the soft water, as compared with the hard spring-water which supplied the drinking-trough—a spring which often failed. The ground sloped towards the depression from all sides, as indicated in plan *b b* by the dotted lines. A very little labour could have made this a valuable pond, and added, at small expense, to its capacity. As it was, it was surprising how long the water lasted, and in good condition, although regularly frequented by the cattle. In dry weather its value would have been increased, as the spring supplying the regular trough was a very small one, at the best a mere 'pencil-case spring,' and soon ceased to yield a supply, or of but drops at a time. Such depressions can be easily made of greater capacity by excavating so as to make them slope to a central and deeper point throughout the length, as shown in diagram *d e f*, the dotted line *d* representing original bottom line, *e* the point of depth, the upper part being left undisturbed. Diagram *g h i* is the sketch of a depression in the face of a stretch of land sloping

gently and uniformly from the upper part of the field to the lower, the water coming from the upper part *g*, and shedding when the depression *h* gets full, and over the lower edge *i*, and to another depression at a lower level. Such a disposition of the land generally affords several depressions, the water of which could, at a mere trifle of cost, be led to a larger collecting area at the foot of the slope, a depression for which might probably be found there which, enlarged, would give the capacity required. The surplus water might in such cases be stored up in an underground tank. Generally, collecting areas may be reckoned upon as receiving the whole of the rainfall within a very small limit, so that by knowing this, and adjusting the area and depth of any artificially-made collecting area to the volume of water required, the necessity would be avoided of having tanks larger than otherwise would be required. With a properly prepared bottom, such as that given by the use of Portland cement concrete, indicated in all the diagrams in fig. 2, Plate 77, by the dotted or spotted parts, the rain-water remains good for a very long time. The diagram in *r r r* shows how a very small depression, but placed at a very convenient part of the field, the slope of which, or part of which, generally is indicated by the line *r r r r*, may have its capacity very largely increased by excavating in the direction of the line *r s* and *s t*. The diagram *v v* below, indicates how this depression, artificially deepened, or a similarly or otherwise naturally formed depression in a sloping-surfaced field, may be utilized. An outlet pipe *w w w*, placed at any desired point below the normal level of the water, leads what will thus be the surplus or overflow water to a tank *v*, placed at a lower level. Another pipe *x*, the outlet of which is a little above the line, or what should be kept as the line of silt or deposit, leads the water to drinking-troughs placed at a lower and convenient level, and which may be at any distance from the collecting area *u*. The overflow from the drinking-trough is not allowed to run over the sides and make the surrounding soil the wretched puddle which such places generally are, but is led to the tank by a junction pipe *y*, connected to the pipe *w w* leading to the tank *v*. The diagram *j k l* indicates in cross

section and end view, in *m n o* in side view, the position and general features of a small valley, having on the right side *k* a somewhat abrupt ridge, the termination of a long slope of pasture land, leading up by an incline more or less steep at certain points, and which afforded a watershed surface of great extent. The left side *l* is less abrupt, and the land stretching away from it, although generally sloping towards the valley, sheds, from a peculiarity of its surface, a goodly proportion of its water away from the valley in the sketch. But in rainy weather the water from the combined surfaces on both sides was in volume such as to form what might be called a little stream running down the valley to a meadow placed at a low level. At one point there was a level part, as at *o n*, and here at such times the water collected in such volume that this part was flooded. In dry weather its surface was dotted over with pools formed in depressions, as at *o n*. Not seldom has the district been afflicted with a famine of water, in which not merely the small springs supplying drinking-troughs, but the larger ones supplying wells, have been dried up. The loss, to say nothing of the suffering entailed upon the animals, and, indeed, upon the people in the farm-houses and cottages, was very large. But this might have been avoided had provision been made to collect and store up the rain-water. The district presented unusual facilities for this being done, quite as favourable for cheaply carrying out plans as the case indicated in the diagrams *j k l, m n o*. The farmer on whose land the point indicated in the sketch lies, paid a very much larger sum on one occasion of drought for the carrying of supplies of water to his stock than would have sufficed to have formed more than one collecting area and storing tank, which would have formed a permanent security against future and like losses. These sketches we have given above are nearly all indicative of methods of forming collecting areas in districts with hilly or undulating surfaces. They are more, if not chiefly, suggestive of methods of collecting the water shed upon the surface of the surrounding land, and which slopes more or less directly to the depressions or collecting areas, than such areas designed to

catch the direct rainfall. The sketches, in fact, may be considered in one light as catch-water embankments, though on a very small scale, which we have described in a special chapter in the text. When the land surface is flatter, the system must be a combination of the collecting area and the tank, the collecting area being of dimensions increased in proportion as the land is comparatively flat. When in flat districts, or in those possessing little fall, the collecting areas will reach their maximum surface. But in connection with this department, we must notice the great utility of

Storing Tanks for Drainage-water.—Even in very flat fields there is fall enough naturally, or it is obtained by judicious disposition of the drain-tubes, to make the arrangement of the storing tanks of comparatively easy attainment. Useful as the water may be made for supplying the cattle in pasture fields, it is also useful in those under arable culture, and is likely to become more so. Steam cultivation is extending. To many, the connection between this process and the storing tanks for water will not be very obvious, and by more it will be thought a very trifling matter the supplying of the steam-engine with water. But it is in practice no trifle, being in fact, in many districts, a very large item in the cost of steam cultivation. Now it ought to be a comparatively easy task to arrange outlets from drains or special connections therewith, and also to lead the surface water from furrows, etc. into ponds placed at convenient points in the fields which are to be under steam cultivation. This, in fact, has been done, and done in such a way as to show its great utility, by the Messrs. Howard, on the home farm of the senior partner of that eminent agricultural engineering firm. And as further showing what can be done in the way of water supply from too generally neglected sources open to every one in almost every farm, we may state that at Mr. Howard's farm buildings there is a rain-water reservoir which contains half a million of gallons.

Rainfall Catch-areas or Pits and Storing Tanks.—What we have said as to the pools of water found after rainy weather in fields, etc., gives the key to the plan of what are called collecting grounds or rainfall catch-water areas for retain-

ing the *actual rainfall descending upon some particular spot*. Some may be disposed to look upon this suggested source of water supply as a mere idea or 'fancy,' having nothing practical in connection with it. But they are mistaken; for although we used the term 'suggested source,' we do so only in a limited sense, inasmuch as the plan has been adopted in practice with decided success. Thus Mr. Anson, the well-known London engineer, who has had most extensive experience in hydraulic works, has lately carried the plan out in Somersetshire to supply the mansion. The district or site is flat, the soil alluvial, the catchment area is half an acre in superficial extent. This area is covered over with concrete, so that the surface is water-proof so to say, and it is connected with a tank for storing the surplus water. Mr. Wheeler, who cites the case, suggests, however, that in collecting grounds of this character, and on such sites as there would be no absorption by the soil, the whole or nearly the whole of the rainfall would be available; that of the summer months being thus equally valuable with the others of the year, so that the size of the tank might be considerably reduced as compared with other cases, and the saving effected in this way would go far to pay the cost of forming the collecting ground (see fig. 2, Plate 77,—*p* rectangular collecting ground in plan, *q* in section).

The plan of catch-water areas for direct rainfall is by no means new, although this particular form of it is so, for in certain districts of the country, ponds called 'dew ponds,' from the popular notion that they collect the dew, are made to collect and store up water for cattle, etc. in fields. These, made with very flat sides and almost conical bottoms, the whole surface being puddled with clay and chopped straw, collect the rain falling on the sides, the summer showers being found as a rule equal to supplying the loss by evaporation, so that all the winter rainfall is available for use. But Mr. Wheeler points out that a much more economical system would be that of a collecting ground and tank. Thus, taking the case of a dew pond so called, which cost £40 to make, a tank to hold the same quantity of water would only cost £12. The collecting ground, 26 ft. 6 in. in diameter,

would cost with its concreted surface only some £3 to £5 more; altogether, say £15 as against £40. There can be no doubt of the fact, that in such collecting grounds with attached tanks, there lies a plan of not only adding to the water supply of farms, etc., at present having that only in a limited way, but of securing to certain districts a large and really trustworthy source of supply, where that is at present almost wholly deficient. The rainfall, taking the country as a whole, is almost always greatly in excess of the demand likely to arise. Thus it may be estimated that every acre of ground will yield annually about, say, 50,000 gallons, and this upon the assumption that the yield of 2 inches only of the total annual rainfall is stored up. This is a very low proportion; and when to this is added the fact, that the population in rural districts is to this area little more than one and a half persons, some idea may be formed how very abundant the supply may be per head per day.

Having so strongly advocated the utilization of waste substances, or what in a large proportion of cases are allowed to be waste, it is not likely that we should fail in strongly urging upon those connected with estates to take judicious means to utilize sources of water supply, which in nine cases out of ten are literally allowed to run to waste. To those sources already indicated, others may be added. We have indeed, from what a pretty close observation of various districts has afforded us, a conviction that there are but few in which sources do not exist, which, wholly neglected now, could in the future be made available. These sources lie not only in small streams generally, we might say invariably, of our finest water, and which can be made available in a way presently to be described, but in small lakes or ponds, fish-ponds, reservoirs, marl pits, etc. It will, we feel assured, surprise many to find, as a result of a careful search and survey, that on their estates, or even on their farms of comparatively limited extent, sources of water supply of this kind are to be met with, yielding, or being made capable at small outlay of yielding, large supplies of excellent water; although they have hitherto believed that they were singularly unfortunate in being located where the water sources were few in number,

deficient in quantity, if not indeed nearly wholly absent.

Water Supply by Gravitation and by Power.—Such sources as those indicated in the last paragraph may be made available with comparative ease, and at an outlay varying, of course, in amount as circumstances vary; but still we do not hesitate to affirm, even in the most difficult cases, that with very few exceptions this outlay will be abundantly repaid, and this will be the more decidedly the case the more completely the water-supply system is carried out. This at first sight may appear to some equivalent to saying that the more elaborate the details of the scheme, the cheaper would be the cost of its realization. In one sense so, but assuredly in the practical sense not so. For the more completely the whole farm, not merely the buildings of all kinds and classes, but its every pasture field and all arable land under steam cultivation,—these not supplied or capable of being supplied by the rainfall methods we have described,—is supplied with water, the greater the sources of profitable use. It is almost impossible to estimate the amount of money which would be saved, to say nothing of the anxiety and worry of the farmer, if farms were thus systematically, regularly, and abundantly supplied with water for work in various departments. In availing of sources of supply presented in ponds, small lakes, etc., the gravitation system can be carried out much more easily and economically than one may be disposed to admit as possible on a mere general inspection of the *locale* and other circumstances. Many cases can be referred to in proof of this. The reader will find the point practically illustrated in the Report of the Select Committee on the Public Health Amendment Act of 1878; as, indeed, all the other points connected with water supply in rural districts. When the spring or source of supply is at no great distance from the cottages, the total expense will not average more than is equivalent to a rate of 1d. per week per cottage, a charge which if trebled would certainly be well repaid in the increased comfort of the cottagers. We are very apt to overlook the fact, that cottagers are too fatigued with their day's labour to go far to secure a supply of the water absolutely necessary to have the requisite

degree of household and personal cleanliness. From the absence of this, or rather from the fact that these do not come up to our standard, we are apt to say that it is indifference or a dislike to cleanliness. We suspect that, if put in their place, we should act very much as they do. It should always be borne in mind, as an important factor in any scheme for supplying cottagers with water, that they are physically indifferent, so to say, not morally indifferent, on the subject of cleanliness. At the same time, however, the feeling too prevalent amongst the class, which finds expression in the phrase in the southern parts of the kingdom, 'O, don't bother,' and in the northern, 'I canna be fashed,' influences them in this matter to such an extent, that they will prefer to use water of an inferior quality which can be obtained with less personal trouble, than better water which can only be got by greater exertion. Every effort should therefore be made, in supplying water to cottages, to have it as readily available as possible. This is one of the advantages arising from the system of securing a supply by *gravitation*—the higher the source the greater the pressure—or by *power*, as both are capable of giving not only a constant supply, but of being 'laid on' to any part of the premises most convenient. The same remark applies to the farm buildings; and there a ready facility to give a supply at every point most desirable is of great value—a value which every truly practical farmer will alone be able to appreciate and to pay for. Instances can be cited where, the cost of supply being considerable, the farmers, aware of the numerous advantages arising from an abundant supply of good water at all points of the farm buildings and in the pasture fields, gladly paid an annual charge of five per cent. on the outlay, although that was represented by a sum equivalent to what might be called a 'good rent.'

The more abundant the supply of water the better, but if the source admits of demand being met practically to an unlimited extent, the farmer should see that no waste be permitted, not because it cannot be had when required, but on the principle that waste is essentially wrong; and because he will find that if he permits it even in a case where the 'waste' may never bring its generally

concomitant 'want,' he will be educating his people to waste in cases where want will follow, and where waste will be to him a direct and decided loss.

It is not, however, every locality which is so favourably situated as regards water supply that its quantity is practically unlimited; too often, indeed, the circumstances are such that the amount obtainable is but barely sufficient for the absolute necessities of the cottagers. At the same time, it should be noted that the quantity really required is very much less than that set down by authorities hitherto. We have been so accustomed to hear on every side that an amount equal to from 20 to 30 gallons per day per head was essential, that we may have a difficulty to believe that so small a quantity as from $2\frac{1}{2}$ to 5 gallons is amply sufficient for the ordinary domestic wants of cottagers; not, of course, including what is *not* included in the household arrangements of this class—baths, and, as a rule, *water-closets*. Indeed, keeping these two sources of demand out of view, if any one will take the trouble to measure the quantity *he* takes per day, including an ample estimate for his kitchen, for cooking, and for washing of all kinds, he will find that the household consumes a vast deal less than he has been taught to believe it regularly did. It will therefore, we think, be a very exceptional district where the ordinary sources of supply will not be equal to this demand. But where the supply is really doubtful, we feel assured that it may be supplemented to the desired extent, if not wholly supplied, by adopting the methods we have indicated of saving rain-water. And these do not exhaust the methods available. A hint only is often of use, and the Baroness Burdett Coutts affords an admirable one in a village belonging to her, where her ladyship has taken means to utilize the rainfall on the church roof, and which yields so copious a supply that 'as many as 120 buckets of water were counted as being fetched in one day' from the tank in which it is stored. We too often in daily life fail to find from failing to seek. It will only be in exceptional cases where the extent of the farm buildings, and the population of the cottages and of the superior residences of the estate, will demand a system of—

Water Supply dependent upon Power, so that it will pay to put down and maintain a steam-engine constantly at work. Still, at the same time, we believe that the power of the steam-engine, with which the farm buildings are supposed to and should be supplied, can be made available by only occasional workings to secure a supply *constantly*, and sufficient to meet all demands. We further believe that we have yet to see a system applied by which steam power can be more economized than we have yet experienced, and possibly by the adoption of the system of compressed air on some such principle as that applied to sewage purposes by Mr. Shone, as referred to in a preceding paragraph, and by the employment of some efficient air-compressing machine, as that of Sturgeon, which Mr. Shone, we believe, employs. But it is to the power of *water* that the agricultural engineer must look for the means to gain a supply of water where the sources we have already alluded to are not available. And we believe that we have yet to do as much in utilizing the water power of rural districts as we have done in the way of neglecting it. *Water power to supply water* is available by two systems: first, the 'hydraulic ram;' and second, the 'water-wheel.' Of both systems numerous examples are to be met with throughout the country, all efficient, and all of them economical. Save for such expenses as are required to keep them in good working order,—and these with well-constructed apparatus are very inconsiderable,—and for the small sum representing the interest on their cost, both of these systems may be said in a sense to do their work for nothing. As the 'hydraulic ram' forces up part of the water of the stream which affords its power, it can only be made available where the water is pure. This is often overlooked, to the disappointment of many. One great advantage in the use of the ram is that it can be made available in cases where the stream has a very small fall, so low that it would give very little water *power* for a *water-wheel*. The latter, however, can be worked to advantage with a much lower fall than is generally supposed; and, of course, any stream, however impure, can be used to work it, as it is employed in cases where a source of pure water supply exists at a lower

level than the buildings to be supplied, and which pure water is thus to be forced up. Practically there is no limit to the height to which water can be forced, both by the hydraulic ram and the ordinary water-wheel. Generally, the water is forced up to a tank placed at an elevated part of the building, so that water can be supplied at greater or less pressure to all parts. As an auxiliary power we may note that of *wind*; of which we may remark in passing, we have not yet availed ourselves to the extent we might have done. There are many ways of using a power like this, which is only *occasionally* available, so as to obtain a *constant* supply of water, or a power to work machinery, which can be had at any time required.

We have still to notice the water supply obtained from *wells*. On this point little need be said, only hinting that in certain soils and strata excellent water can be obtained from wells which, from their depth and little cost, may be said to be little more than mere holes, capable of being dug out in a few hours by any common labourer. It is not unusual for a deep well to be sunk to reach a source of water not nearly so good in quality, or so abundant in quantity, as that obtainable from strata very much nearer the surface, and which may have been actually cut or 'tapped' by the very sinking of the well, but yet not thought anything of. Such shallow water sources are worth looking for, the expense of looking not being great, especially in certain soils, as the very necessity of the system is that the trials be shallow. In this trial system, as well, of course, for permanent supply wells or borings, the Tube or Abyssinian Well appliances will be very efficient and economical. Of this system we have only to say, that although, for reasons needless to be named here, it for some time fell into disrepute, or at least into a quiet condition compared with the attention it secured when first introduced, it has, under the new and energetic engineers who now work the patent, taken a new lease of life. There can be no doubt that it is capable of obtaining supplies of water at an expense which compares in the most favourable degree with that of the ordinary method of well boring and sinking. And not the least advantage the system possesses is the extraordinary rapidity with which results

are obtained, nor less the ease with which it can be worked. In fact, the boring, which in ordinary well-making is merely preliminary to the true well-sinking or digging, forms the 'Abyssinian' system, the well of supply itself. So that, apart from the amazing quickness and cheapness with which the 'tube-well' boring is performed, it must in itself and from this circumstance alone be economical.

The following may be useful as concluding our brief notes on the important subject of water supply:—In using hydraulic rams, a fall of 1 foot is required for every 10 feet of height to which the water is required to be raised; the results will be more satisfactory if the proportion be 1 to 7 or 8, in place of 10. One well-known maker states that he expects, with an ordinary ram, Nos. 1 to 3, to raise one-twelfth of the water ten times the weight of the fall, this ranging up to one-seventh; and at six times the height, which is the best proportion. One hundred feet of $1\frac{1}{2}$ -inch lead pipe will weigh 4 cwt. 1 qr. 12 lbs.; the same length of 3-inch cast-iron pipe and $\frac{3}{8}$ in. thick, will weigh per yard 1 qr. 14 lbs., and will stand a pressure of 1000 feet.

The maximum quantity of water a man can pump with a well-pump is as follows:—With a pump 2 inches diameter, a height of column of 170 feet, the weight of which is 230 lbs., and number of gallons 120; with a diameter of $2\frac{1}{4}$ in., 114 feet, 240 lbs., and 187 gallons; with a diameter of 3 in., 80 feet, 240 lbs., 292 gallons; with a diameter of $3\frac{1}{2}$ in., 57 feet, 234 lbs., 375 gallons; with a diameter of 4 in., 40 feet, 232 lbs., 495 gallons. A Gwynne's centrifugal pump, costing £18, and with a lift of 70 feet, raises 150 gallons per minute; diameter of discharge pipe, 4 in.; of suction-pipe, 5 in.; diameter of pulley, 6 in.: for each foot of lift it will take 0.65 horse-power of a steam-engine—say a trifle over half a horse-power per foot.

Horse or Live-Stock Drinking Ponds (see chap. vii., Division II).—The condition of the horse ponds of too many of our farms is a disgrace to the farmers in whose occupation they are. We have known the drainings of the cattle byre and fold to be passed into the ponds, and have not seldom seen the cattle drinking the

water, which was absolutely highly coloured with the foul admixture. Certainly we did not envy, however much we pitied, the mental condition of the man who could suffer his poor cattle to be so treated. 'The merciful man is merciful to his beast.' In our frequent quotation of this, is the converse of it at all thought of? In all cases, no matter whether the drainings of impure liquids pass into the pond or not, in view of the fact that dust and other impurities, cattle droppings, and the like, are almost sure to be passed into it, we should commend a small filtering tank to be made near it, from which the drinking troughs for the cattle can be directly supplied. In fig. 1, Plate 3, we give a sketch of an arrangement of this kind, in which *a a* represents part of the pond, from which, by a pipe *b*, the water is led to the filtering plate *c*, in the small tank or trough *d*. The filtered water passes through the perforated plate in the drinking trough, the level of the water in which is the same as that in the pond *a a*. The trough ought to be paved for some distance beyond and all round it, either with pebbles well set in puddle-clay bottom, as *f* in the plan, or with small flagstones set in cement. These should all incline to the outside from the trough, and lead into or terminate at a small drain surrounding the trough, and which should incline towards a point, as at *g*, at which a drain-tube *h* should be placed leading to the nearest ditch; in some cases it might be led into a distant part of the pond, although we by no means approve of this arrangement. A section of a part of the trough drain is shown at *g*; the tube *h* leads to the ditch. We give two sketches of forms introduced in the United States, the farmers of which are paying considerable attention to the procuring of supplies of pure water, both for household and for farm stock purposes. In fig. 2 we give an illustrative sketch of one of these, in which *a a* is the filtering tank, supplied with spring water, or with the rain water from the roof by the pipe *b*; it proceeds by the pipe to the receiving tank *c*, from which it is either pumped out by a pipe, or withdrawn by buckets from the man-hole or cover. The filtering material on *d* is made up of several layers of sand and gravel. But in fig. 3 we give a modification of this, in which *a a a* is part of the

filtering tank, supplied with water by a pipe at *a*; from this the water passes through an aperture, *b*, in the tank at *c*, into the space *d*, and upwards through the filtering material, and from thence into the large receiving tank by the pipe *h*. The advantage claimed for this arrangement is that the sediment, which in fig. 2 collects upon the top of the filter, would in the arrangement in fig. 3 settle down, so that the bottom of the filter would always be clean. The filtering material in fig. 3 rests upon the perforated board covered with flannel. In place of using sand and gravel alone as filtering materials, we would strongly recommend charcoal to be used. Peat charcoal can be made very cheaply, and when foul with use, it can be removed from the tank and added to the manure heap.

Utilization of Waste Water Spaces.—When a marl or clay pit has been exhausted, it is generally allowed to become filled with water, and to remain in this condition for years—indeed, in perpetuity, in some fields and districts. Where the marl has been found in a scattered condition, with greater or less intervals between the pits, a field is sometimes seen dotted over with numerous pieces of water. As these pieces of water serve no useful purpose, rather, indeed, the reverse, and are assuredly so many patches or pieces of land lost either to pasture or arable culture,—as this waste is unnecessary, and as there is no great practical difficulty in the way of getting rid of these pits, they should be emptied of their water and filled up with soil, if that can be obtained. In some situations, where soil is very difficult to be had, and where an artificial piece of water would be an ornamental addition to the park, etc., the numerous small pits might be joined into one, and a good-sized pond made out of the series. If this was planted judiciously, and one of the solid pieces left partially untouched, an island might be formed, and thus a really ornamental addition be made to the property. We have known excellent fish-ponds (see chap. vii. Div. II. p. 336) made out of old marl pits, where springs were the chief source of the water supply. Where this is simply rain or drainage water, it is apt to become stagnant, thus affording another and a good reason for getting rid of the pits and forming their surfaces into land.

The same remarks apply to exhausted clay beds which have been used for brick-making, etc., and which, like old marl pits, too frequently disfigure the landscape, and add often to the unhealthiness of the immediate neighbourhood.

Plantations, chiefly of Waste and Neglected Land (see chap. iii., Division III.).—Much has been done for many years in this department of landed property improvement. Many tracts, which at periods dating not so very long ago in the history of our country were bare and sterile, have been planted with trees, which, while they have added to the beauty of the landscape, have also improved the climate and the soil, and, what is thought most of by some, and legitimately enough, have contributed largely and directly to the exchequer of the proprietor. Yet, notwithstanding that so much has been, a vast deal more remains to be done, before the true limit of planting will be reached. But in view of what has been done, many will be inclined to ask the question, How, and in what direction, is planting to be increased? The answer is in one sense not far to seek. Just as, in certain departments of other branches of national industry, sources of great wealth and what may be called the establishment of new and important callings have been created simply by the utilization of products which for long had been looked upon and were treated as waste substances, so, although in another way, in connection with landed property there are doubtless many neglected opportunities, which, if availed of, would add materially to its pecuniary resources. No doubt these, in some districts, are very limited in number, and many also are not extensive when met with. Nevertheless in other districts they abound, and in all could be made to produce something where they are now producing nothing. Independently of the fact that every opportunity to add even in but a small way to the income of the property is obviously so much new and extra gain, there is this to be said in connection with the taking advantage of such opportunities, that other important benefits follow, and still further add to their value. This is specially true of planting operations, now under consideration.

Planting of Waste Lands.—Very few of those whose duties take them through extensive dis-

tricts of the kingdom, and who are closely observant of, and in any way interested in, agriculture, much more so if directly connected with it as a business, but must have been struck with one thing, the endless succession of patches of land, varying in extent from a perch, rood, or pole or two, up to acres, which are in the general sense of the term waste. True, many of these patches may be specially waste—that is, so far as is generally understood, and under our known methods of culture, are not really capable of producing crops of any kind whatever. They are truly in every sense of the term waste, and will be so till we can find out some method of making them otherwise. Of that at present there seems, however, but little chance. But a large proportion of such neglected areas are beyond a doubt capable of growing some kind of crops, which would in more than one way repay the labour bestowed on them. Moreover, it is very hard, of even the acknowledged waste lands, to say that they cannot be in some way utilized. It is only the most utterly sterile of soil which is incapable of growing something, and this, fortunately, is not very extensively met with in this country, although the proportion is higher than is popularly supposed. Many waste lands now lying idle are capable of growing something, and it will be odd if the produce does not pay the cost of the work, even if only by ameliorating and preparing the soil for the reception of a higher and more profitable class of vegetation. Moreover, we have yet to learn much in the way of finding out what is best adapted for planting on certain waste lands. For it may be accepted as true, that what in one place is a weed, in another is a valuable plant. Abundant evidence already exists in proof of this. As in physics or natural philosophy there is no waste, and as also in other industrial branches what was long thought a waste and was a nuisance was by research found to be valuable to a high degree, so we do not hesitate to express our belief, that for many a so-called sterile spot there is the means to be discovered, by patient research or by close observation, by which the sterility is to be changed into its opposite. The point is suggestive of most important considerations. The field of nature waiting for our ex-

ploration lies wide and boundless before us ; it holds within its rich domain things useful for every place and for all circumstances. But, however much some may be disposed to cavil at this view in its wider application, it admits of easy proof that, on at least a very large proportion of the waste spots of our land, there are trees of one kind or other which could be grown, and grown profitably ; and what profit would be got from them would, as matters now stand, obviously be 'money found.' And although each patch might yield a sum trifling as it might be deemed by many, the aggregate would form an amount not to be despised. The lesson the proverb teaches us, 'Many a little makes a mickle,' is too much neglected in some branches of agriculture.

It does not require the exercise of much of that observation so eminently useful to those connected with land, to note that much more could be made of its resources than is now made. If it be true,—which, however, may well be doubted as a statement of general application,—as stated by a high authority, that by a better system of culture the produce of our land might be increased fifty per cent, it is no less true that there are in the aggregate large tracts of land which could yield much which are at present yielding nothing. Sum up the stretches of land now lying idle, and in many cases worse than idle,—as they are productive of sanitary and agricultural evils,—which run along the margins of lakes, of marshy grounds, of peat or moss ; the patches, not seldom considerable in extent, of land, and good land, on the banks of rivers, tidal or inland ; the still wider tracts of soil, in its very richness inviting the efforts of farmers, which form our sea margins and the deltas at the outlets of tidal rivers to the sea ; and we may also name old and disused harbours and coves. As we pass this for press, we find a practical illustration of our suggestion in the instance of an old harbour, thoroughly silted up with the rich deposits brought down for centuries probably by the river of which it was the port. This has been enclosed and the soil worked by aid of the steam-cultivator, this apparatus being especially adapted to the soft and yielding character of the silted soil, which for horse-working must have lain for years longer to get

sufficiently consolidated to have borne the pressure and poaching. In this case, from the peculiarly rich character of the silted soil, crops may be taken for years without the addition of manure ; but by its judicious use, it may be kept in a high degree of fertility at little cost for an indefinite period. There can be little, indeed no doubt but that the enterprise will richly repay the enterprising adventurers who have undertaken the reclamation. There are other places of a like kind waiting for the like far-seeing financial and administrative skill, and with a like probable result. The area of British farming, and the profits arising from its skilful exercise, are not yet extinct, although the pessimists, ever true to their name, are always prophesying the worst fate for it,—not extinct, if to practical skill be added sound and prudent enterprise. Add to these the much less areas, mere patches in point of fact, which are to be met with on every estate or every farm, by brook, or rivulet, or pond margin, in odd corners where the plough cannot reach, but which might, if useful in no other way, be useful if planted, as affording protection to the crops from biting blasts ; to say nothing of the enormous acreage of road and railway embankments—cuttings of the latter may be excepted ;—sum up all these, and some idea may then be formed of what would be the aggregate produce if all this land was yielding even what under the least favourable circumstances it would yield, in place of lying idle, utterly unprofitable. Nor need it be said that all this is merely visionary, that it cannot be reduced to practice. This utilization of waste places has been done not once, but often, and what has been done by one can certainly be done by another. Better, indeed ; for the latest worker in a new field has all the benefit of the experience of those who have gone before him in the old one. Nor need it be said, as has been said, that such patches or tracts of land as those we have noticed are composed of soil which is so poor that it will not repay the labour bestowed upon it, and the cost of the plants grown upon it. It may be taken as an axiom, that wherever there is soil, however poor, it will grow something, with the added and great advantage that the mere culture and growth improve the soil, and fit it to bear a higher and

better class of produce. But the practical fact is, that in place of the soil of all such places being utterly poor, as is said by so many,—as if they were eager to find an excuse for their neglect of them,—in many it is good, and in some few exceptionally rich, and requires only to be placed under culture to make it productive more or less highly. But even the poorest soil has some tree or plant so peculiarly fitted for it that the produce is paying almost at the outset; and it makes all the difference between the truly scientific cultivator, who finds out what that plant is, and the one who is careless in the matter, and simply uses what he has. This is at all events better than using or doing nothing.

The Willow and the Pine for Waste Land Plantation.—But it is not the truth that the plants or trees to be grown on and fitted for those soils are difficult, or, as some say, impossible to be had. They lie, in the majority of cases, ready to our hand. There is, for example, the willow. For the timber, or rather the shoots or wands, of this, there is a never-ending demand; and we put it to any truly practically-minded farmer or proprietor, whether it be better that the stretches of land he may have on his farm along river bank or marshy pool should be growing willows, as grow there they will readily and profusely, or that they should present, what to a well-ordered and orderly mind they always do present, mere eyesores and rural nuisances. Then, again, in the pine tribe we have at command trees suitable for any climatic condition in our country, for any locality, and for almost any soil; to say nothing for the present of the wide range of minor trees or shrubs, and of plants, not a few of which are specially fitted to grow on the poorest soils, and to bring them into a condition fitted for a higher culture, and all of which can be cultivated with profit, varying according to circumstances. Taking only one class of waste and now unprofitable lands, and only one class of trees, we confess that it says little for that practicality of which we hear so much as the characteristic which never fails the English, when we sum up the tracts of land at present useless, but which could all have been for years bearing one or other of the vast range—for it is nothing else than this—of the different varieties of pines. We shall presently draw the

attention of the reader to the *Eucalyptus*, the extensive planting of which is now being so widely recommended, not merely as a valuable timber tree, but as a singularly effective agent in draining, so to call it, marshy soils, and further still as directly remedial of the malarious influence of such tracts, in virtue of its aromatic exhalations. But there are, as we shall see, grave doubts whether this tree—at least the variety hitherto recommended—is fitted for our climate. But it is worthy of note that the coniferae of all species, with but few exceptions, act very powerfully in the above-named sanitary way. The *Pinus sylvestris*, better known as the Scotch fir, is peculiarly valuable for these and for other useful qualities. Adapted for nearly every range of climate and locality, suited to make the best even of the worst soils, waste tracts of land might be planted with it, for its ‘varieties’ may be said to be endless—practically improving the soil, removing superfluous moisture, and by its aromatic exhalations rendering their malarious influences innocuous. One habit of its growth, or rather the result of it, our readers must have observed frequently, namely, the surface of the ground under the trees. The decaying mass of leaves falling from deciduous trees, in moist climates and a moist soil, become during the process of conversion into vegetable mould a positive source of unhealthy exhalations. Not so with the sharp-pointed, thin, and hard-surfaced spines or pins; these, as they fall, form a species of floor, thoroughly dry, open, yet still so close set that moist exhalations from the soil below have a difficulty to arise; or if they do, they are no doubt rendered comparatively harmless by the aromatic exhalations of the spines, and in their passage upwards still more affected by those emanating from the larger branches and ‘foliage’ above. These peculiarities of the firs are just so much the more valuable in the reclamation of marshy soils, as, by a singularly fortunate circumstance, to use a writer’s words, our ‘native fir seldom exhibits itself in a more lavish, rich, and picturesque growth than by a pool, or dyke-side, or a peat moss.’

Here, then, we have two trees, the willow and the Scotch fir, specially adapted for the reclamation of waste land in undrained, or marshy, or

mossy districts. The willow will likely be the first to be planted. This, growing quickly, and yielding a succession of cuttings, always in demand at a good price, drawing large supplies of moisture, rapidly drains the soil, which is thus prepared for the planting of the firs; and these, again, improve the soil, and ultimately tend to that stage of improvement in which the still higher classes of ordinary crops, always in demand, can be grown with increasing profits as cultivation proceeds. And as regards waste land districts of quite another class, as distinguished by their dryness and poverty of soil as those noted above are for excess of moisture, they may also be planted with advantage. On the details of this we have enlarged in its appropriate section in a preceding Division.

In all such cases this great advantage is obtained, that after the first work is done, the trees will do their work without further trouble. No doubt, as we have elsewhere shown, trees, like other crops,—although many seem to overlook the fact,—repay with interest all after cultural care. Still they keep quietly going on improving in many ways the soil in which they are grown. There is a fine lesson conveyed in the saying put into the mouth of one of the numerous characters so well handled by the author of *Waverley*, 'Be aye stickin' in a tree here and there; it'll be growin' while you are sleepin'.' As concluding our remarks on the willow, we would draw attention to a point not seldom overlooked in its cultivation in watery soils, for which it is so specially suited. The willow lives on damp, and, in fact, thrives best in a damp, even in wet soil. But the water, as in such situations as river banks and margins, should never be allowed to rise above the roots to flood the stoles. Invaluable at the roots, water above them is, on the contrary, a source of loss. Arrangements should therefore be made to have the land on which the willows are grown such as will favour this requirement of their successful growth.

The Eucalyptus as a Tree adapted for Marshy Districts and Unreclaimed Waste Lands.—Under the head of plantations there remains to be noticed a subject which has attracted very great attention since the period at which we concluded the special section on this important

department. The *Eucalyptus globulosa* is better known as the 'blue gum' tree of Australia, which continent is its native habitat. The tree has been long known, having been first discovered, at least first described specially, by the French naturalist Labillardière, who visited Van Diemen's Land, now Tasmania, in search of La Perouse, and there met with this remarkable tree. We will name it so, for it possesses several characteristics fully entitling it to this name. It grows to a gigantic height, not so marked, perhaps, as a rule, as that of the gigantic Wellingtonia of California, but falling not much short of it, and in many instances far exceeding it, and it gains its great height in a very short space of time. Its rapid growth is indeed one of its most valuable characteristics, as, while—unlike the quickly growing plants and trees which we have—the increase in height and growth is so quick, the quality of the timber is very high. For constructive purposes it is specially valuable, for it is very little, if any, less hard and durable than Burmese teak—that timber so highly prized for shipbuilding purposes, etc. So dense or ponderous is it, that a bulk of it will not float even in sea water, but sinks; while its capability to bear even a transverse stress is such that it is used largely for railway purposes as a substitute for iron girders. While its density ought from analogy to render it comparatively fire-proof, at least difficult to be set on fire, the same property should also make it capable of resisting decay. On these points no positive observations or experiments have been made and recorded. While an English oak takes several decades to mature, the Eucalyptus will show as great a girth in seven as the oak will in three times this period; and the later stages show a still more valuable rate of growth in the Eucalyptus, for when it reaches the age of twenty its girth is far in excess of that of an oak planted 'a hundred years ago.' This characteristic of rapid growth is therefore *equivalent to a great saving of land*. But the Eucalyptus is no less remarkable for other valuable properties; it is a fine and gracefully growing tree, its foliage is fine, and it bears flowers in abundance. But the most striking characteristic of the tree, apart from that which renders it so

valuable when cut down, is the aromatic odour continually exhaled from stem, branches, twigs, foliage, and flowers alike. Labillardière was particularly struck with this; but he does not seem to have pursued his observations and inquiries so far as to ascertain what, if any, were the results of this grateful feature of the tree. It was suspected for long that the aromatic odour exhaled by it was a healthy one. This is now proved to be so beyond a doubt, and that to a remarkable degree.

This peculiarity recommended, therefore, the cultivation of the tree as specially adapted for unhealthy, especially marshy and malarious districts. From its quick-growing habits, and its large surface of timber and foliage, it presents, from its unusual height, girth, and the extent of its wide-spreading branches, a means of taking up a large volume of water from the soil in which it grows, and thereafter exhaling it into the atmosphere. We could cite here some very striking facts as to the evaporative, or, as it may be said, the 'drainage' powers of various trees and shrubs, through the medium chiefly of their leafage. Some of these facts display such powers of the plant in this respect that many are disposed to withhold credence from them. The point is one to which too little attention has been paid, closely connected as it is with agricultural operations. The Eucalyptus, then, gives a tree which, while it takes up an extraordinary amount of the water which gives to marshy districts all their malarious evils, sends it forth to the surrounding air through the expiratory powers of its leaves, not merely innocuous, but laden with odours and peculiarities precisely fitted to purify the surrounding atmosphere of the district. Still more singular does another characteristic appear, that while it is such a powerful, natural, and 'thorough' drainer of over-wet soils, it has the power of attracting rain—a characteristic which our practical readers will at once see the value of. The abundance of malaria-breeding water, and the supply of the pure rains of heaven, which no doubt are the primary source of the unhealthy moisture, are by no means so contradictory as some might suppose. Here we have a remarkably fine exemplification of the combination—

and mutual interacting—of opposites, calculated to bring about the very effect desired.

The practical point to consider, however, so far as the planter on landed property is concerned, is its adaptability to our climate. A tropical or sub-tropical tree, our climate at first sight does not appear likely to be suited to its habits of growth. There are not a few points of extreme interest to planters, and indeed to agriculturists generally, in connection with the climatic conditions of trees, shrubs, and plants, which we should have wished for space to allude to; but briefly, although the point is by no means a settled one, from our very limited experience in cultivating the tree with us, it would appear that it is not suited for our climate, not, as some suppose, on account of its severity and changeableness,—for more delicate plants withstand severer weather than we as a rule have,—but because we lack the sustained high temperature of a certain period of summer and early autumn to push on the growth of this most interesting and valuable tree. Fortunately, however, there is another variety of the Eucalyptus which, possessing all, or nearly all, those characteristics we have already noticed, possesses also, according to some authorities, the great one of being well adapted to our climate. Indeed, so far as a counteractant to or destroyer of malarious exhalations is concerned, it is very much more valuable than the *Eucalyptus globulosa*. This other species is the *Eucalyptus amygdalina*, so well known as the 'mountain ash' of the Victoria colony in Australasia. This is even, moreover, a grander and finer-looking tree than the *Eucalyptus globulosa*. What we have said, therefore, in favour of this, may be considered as said in favour of the *Eucalyptus amygdalina*, with the above extra valuable features, and this still greater one,—the one affecting us,—its thorough adaptability to our climate, according to those who are considered authorities on the subject. In view of the importance of the subject of plantations generally, and now that it is daily growing a more and more vital point that everything should be done which can be done to raise the value of landed property, we trust that efforts will be made to test practically the acclimatization of a tree which presents so much that is

highly valuable in other countries, and is well worthy, therefore, to have some trouble taken to know if it can be made in some degree valuable in our country. To hope to make it equally valuable is apparently vain; but if we cannot get all we wish for, we may by patient labour and observation get much, perhaps more than we expected. These are certainly not the times—when all things conspire to show that they will for long be at all events critical in more than one of their aspects for the farming interest—to spare labour when labour may result in some gain.

As stated above, it appears to be most probable that better results will be obtained by trials with the *Euc. amygdalina* than with the variety to which the greatest attention has been directed amongst us. Close observation of the peculiarities and habits of the tree is required in trials which are only just now passing through the preliminary stages; but the plants grown from seed brought from Australia by a friend for our special experiments, have one very striking feature, that although an evergreen plant, the leaves are as thin and delicate in structure as even the most delicate of our deciduous trees—almost as much so as the generality of our annual garden flowers. This, however, is a feature which only characterizes the earlier stages of its growth, for in later ones they assume the thickness and hardness, at least, of the leather-like substance so well known to shrub growers as met with, say, in our holly and laurel. In the delicate stage of leafage, the plants are peculiarly liable to the attacks of frost; but in reaching the later leaf development just noticed, they are then capable of standing severe frosts, or at all events moderately severe frosts; and, of course, the older the trees get, they stand hard frosts the better. Hence, till the hardy period is reached, it may be advisable to 'mat' the young plants up on the approach of winter. This, of course, only applies to those planted out in the open. As we have said, it is a tree of remarkably rapid growth; of this we have had very striking evidence in the plants we have at present under experiment; but it appears to us that this, in our climate, should rather be checked than encouraged, in order to harden the leafage and the wood generally. From this also

may be gathered the probably great importance of the suggestion offered by the correspondent of a public journal, Mr. C. Roberts of Rotten Row, Mayfair, London, who has paid great attention to the acclimatization of the tree in this country: that the tree should be planted not in a damp, rich soil, calculated to promote its rapid growth, but rather in a poor and dry soil, care being taken to expose the tree to the direct rays of the sun. 'With me,' says another correspondent, 'the *Eucalyptus amygdalina* is ultimately sheltered specially from the south.' The temptation to plant the tree in damp (and rich) soils arises from its known value as a drainer or absorber of moisture, but to secure this kind of draining—which in ordinary circumstances can be attained by other means—the future value of the tree may be sacrificed. We have been thus particular in describing a tree which certainly offers to the landed proprietor many valuable peculiarities, as not a few of our best authorities believe that its extensive growth would add largely to the income of the estate, and it is one which may yet possibly take a high place amongst the trees of our estates.

New Crops for the Farm (see chap. v. Division VI).—In the body of the text we have devoted a section (named above) to the importance of adding in every possible practical way to the crops of the farm. We have there endeavoured to point out that this department has been greatly, indeed as a rule almost wholly, neglected; although evidence was not far to seek of the true economy of the system, and how it enabled the farmer to add to the means by which he could feed his live stock, and that at a rate much lower in some instances than by the use of those crops which alone he has too often depended upon. We have also shown that it afforded him the great advantage of having some crop to fall back upon in seasons when his main crops have wholly or partially failed. Apart from the fact that a variety of crops as affording a change of rotation is good for the land, many of those which are cultivated elsewhere with singular success demand cultivation of the highest order, so that by this means the land is further improved; while to many the practice is beneficial, as requiring care and attention not

always given, as the foul condition of the land and crops too glaringly attests. But there is surely another reason why attention should be paid to increasing by all practical means the supplies of food for live stock, for it is to these that the additional crops we here specially refer to are applied. We live in times singularly trying in their unfortunate aspects to the welfare of farmers; so trying, that it is not matter of fear, but of painful certainty, that many will be compelled to succumb to the severity of the trial, and add to the list of those who, willing to work, and who do work patiently and persistently, cannot yet work to profit. Important at all times as it is to add to our available resources, it is immeasurably more important now, and is likely to be so for some, if not for long, time yet to come. If it be objected that the systems of leasing and letting of farms, and their restrictions upon their cropping, do not admit of this extension of crops, the inevitable and common-sense reply is, 'So much the worse for the system.' All the more common-sense and all the more certain that the system will be widely if not universally changed, when the fact is considered that by the extension of cropping the land itself is improved. All experience goes to prove this; the fact is indisputable, and no one need fear the result of any challenge made to meet the point on this ground. The facts can be proved quite as clearly as can the steps of a geometrical problem 'which was to be done,' or of a mathematical theorem which 'was to be demonstrated.' And it is more than what is called a merely fortunate circumstance, that of the crops which can be added to a rotation for the purpose of increasing the food supplies for the live stock of the farm, the great majority are such that they may pay best when they are cultivated best. This alone is an exceedingly strong argument in favour of freedom of cropping, for such crops demand and must have the highest style of cultivation given to them, so that the more widely their cultivation is extended, the more widely is the improvement of the land itself extended. The number of crops in every way useful and readily available to the farmer is already so great, that one can have no difficulty to choose what will be most useful to him. Close and careful consideration will, how-

ever, be necessary to suit those to the circumstances of his soil and climate. But, keenly alive to the closeness of the battle which he has to maintain with all those antagonistic circumstances, more numerous now than ever, which tend to change what ought to be his profit into a loss, or at the best but a very poorly paying matter, he is not seldom on the look-out for what will be useful to him. And it is a fortunate circumstance that there are not a few who are regularly devoting themselves to the discovery of crops grown, and grown with success, in other countries, and applicable to our soil and climate, and to the finding out of the best means of cultivating them. Every day, therefore, so to say, brings out something new; hence the advantage to the farmer of being a close student of the agricultural papers. Hence it is that, since writing our special section on the subject of extension of crops, one or two have been brought forward for the favourable consideration of the farmer. The latest introduced of these is the 'Soga bean' (*Soga hispada*). This is a Chinese vegetable, and is known also as the 'hairy bean.' Its productive powers are singularly and unusually great, not one, but three and four hundredfold being not an uncommon, rather, it may be said, the average yield.

Nor is this obtained when the climatic conditions are such as would favour this exceptionally good produce, for the crop is said to be capable of withstanding the effects alike of such frosts and long-continued droughts as would materially injure our ordinary leguminous crops. Neither is this large yield the result only or always of superior or the best soil, or, indeed, of the extra or high cultivation of the same; for the crop succeeds well with almost any kind of soil, and is apparently independent of aspect or sun direction. The quantity of seed required per acre is smaller than that of our ordinary bean crops, thus adding to the economy which its great productiveness places at the disposal of the farmer. Nor do the advantages of the crop end here; for, while its actual yield is so far in advance of our usual bean crop, its nutritive properties are so high that it virtually adds to the yield. Thus its flesh-forming constituents are so unusually high as 30 to 40 per cent., while those of fat-formers are as high as 18 to 20 per cent. Putting

this point in another way, the Soga bean is at least double the feeding value of beans, pease, lentils, or lupines, or any of the wide varieties of those hitherto introduced, and now forming part of the regular seeding of our lands. The value of the straw is also for feeding purposes equal to two or three times that of pea straw, so appreciated by those who waste nothing. A result often met with, when a new crop is introduced from its original habitat to one more or less different in its character and soil conditions, is that it deteriorates rather than improves. The Soga bean seems to be an exception to this, so far as present experience proves, for it has not only held its own, but it has actually improved. With all these striking advantages, one is apt to ask how it is that it has not been introduced before now. It is difficult to answer this question. We have instances enough of the kind to fall back upon. But we may note that he has observed to little purpose who has not noted the fact, fortunate for us, that new things, likely to turn out good things, are introduced often—so often that it may be said to be a rule—at the precise period when they are almost sure to be required by the exigencies of the time.

Amongst the special crops named at the commencement of chap. v. Division VI. was that of the Prickly Comfrey, otherwise known as the Caucasian Comfrey. Our readers know but too well how new crops are met with singularly contradictory statements as to the experience of those who have tried them; so contradictory, that he who may be contemplating the trying of a new crop may well be justified in pausing before he does so, till he gets information which appears to be reasonable and trustworthy. But, in truth, no one need wait for this; he can best find it out for himself, as he has his own circumstances of soil, etc. to suit. With those of others he may concern himself but little, and with little loss. It is, indeed, simply because those circumstances have differed that the different parties have given such widely different experiences with the new crop; for what will suit some soils and climates will not suit all. If those who detail their experience with new crops would, with the circumstances of success or failure, as the case may be, add clear information as to the soil, in fact

all the points of cultivation, they would render a service highly valuable to practical farming. We should thus be in a position to know the reason why success was met with in one case and failure in another. But more than the details of mere cultivation is required; the after condition of the crop, the period at which it was used as food, its peculiarities at different stages of its growth, how it was given to stock, are all points which are essential to be known. The Prickly Comfrey is no exception to the rule we have just alluded to—has, in fact, given rise to our remarks, which may be found to convey something of practical value, or suggestive of it. According to some, the plant cannot be too highly praised as a valuable one for the stock-feeder. According to others, it can scarcely be too strongly denounced as worthless. The truth lies between these two extremes, as truth generally does, while the circumstances are of necessity influenced by those which we have just now noticed. Taking, however, the evidence before us, there is more of the usefulness of the plant than of the opposite. And those distinctly in favour of it have claims to be considered as authorities—some, indeed, of the highest rank. As it does not lie within our province to enter into the minutiae of cultivation, we must refer our readers desirous to know about them to other sources of information. In one sense it is new, in another not, it having been introduced into this country about one hundred years ago, and been used, and is used now, for purposes other than a forage plant, under which aspect we are alone interested in it. It is grown like potatoes from 'sets,' and the best time to cut it for green forage is when the flower-buds appear on the stems. It can also be made into a species of hay. It is right to warn our readers that there are many poor or spurious kinds in use, and we fear it is from the results of the cultivation of these that much of the prejudice against the plant has arisen. The only way to guard against this is to get the 'sets' from a 'house' whose reputation, to say nought of higher points, does not permit them to dispose of anything but the 'true variety' of Comfrey.

We believe that many valuable crops are lying waiting, so to say, to be made available; so that we may ere long, if it be not actually in

some degree begun, witness a revolution, or at least as great a change in the farm practice of cropping as was brought about very many years ago by the introduction of the wide variety of crops from the Low Countries or Flanders, to which we indeed owe all, or nearly all, the crops we now cultivate in farm and garden. As already hinted at, we have now, as likely to bring this addition to the crops of the farm in a quick and practical way, many travellers who are continually on the look-out for things likely to be useful here. And the extended efforts of these will now be rendered more effective by the systematically conducted series of explorations and researches which will be carried out by the new Geographical Society established recently in Manchester. This, amongst other points, aims at directing travellers or residents in foreign parts in the best way to discover plants and materials likely to be useful here. Such an association comes very opportunely to help the farmer in doing battle with the difficulties with which he has now to contend, by placing within his reach much that may enable him to do so with effect. They, with others, must move in unison with the characteristics of the time—characteristics which, in many of their aspects, seem likely to be made permanent. But while some of our advanced farmers have for a comparatively long period availed themselves of all new and good things, there are, in truth, a very large body who have not even taken advantage of what has been ready to their hand for a long time. We have pointed out in the body of the text that a good amount of produce can be raised by sowing down crops which, as a rule, are thought very little of by the majority of farmers, and do not take place, therefore, in those which form part of their regular system. Some are just as eager to take to a new thing because it is new, as others are eager to keep to the old because it is old; with this difference, however, that even the old or known are embraced or discarded simply because they have not, either by their predecessors or by themselves, been looked upon as valuable. It never strikes such that it is worth while to test their value, nay, that it is a prudent thing to do so at all times, but infinitely more so in times like those which we are now passing through, and which not a few

of the wisest think will be that for many years to come, so far as farming is concerned. The practical outcome of all this is, that the farmer should not conceive that it is any way beneath the dignity of his calling to make all things, however minute, every detail, however by some or by himself deemed trivial, subserve the general purpose of his profession, the providing of the people with the first necessities of life; nay, quite the reverse, that nothing is or can be undignified which ministers to the welfare of oneself or that of others. The whole tendency of the present time in other industrial callings is to make the most of everything lying to hand—to utilize waste, and to extract gold, so to say, from the very dust and refuse of the earth. To do this, our most learned chemists and others do not think it beneath their dignity to wrest value from what is now valueless, to make that a source of future income which is at present a heavy loss, and, in fact, a nuisance. If farmers generally will work in this direction, *and be left free to work in it*, we have no fear but that the work will be thoroughly well done; for of all the classes of workers in this working community of ours, we know of none who carry out so well the principle of the text, '*Whatever thy hand findeth to do, do it with thy might.*'

Heavy Land Cultivation (see chap. i. Division VI.).—On the subject of the cultivation of heavy land, some little may be added with advantage to that which we have given in the special chapter thereon. This will enable us to glance at one or two of the points connected with it to which attention has of late been and is now being attracted, as, for example, the repeated and continuous corn-growing on the same soil. As in all the other departments of farming, so in this, the greatest diversity of opinion exists; an average, or perhaps, as some will call it, a striking illustration of this being met with in the most recent exposition of farming opinion, on the occasion of the reading of a paper before the Central Farmers' Club, on 'Heavy Land Farming,' by Mr. F. Street, of Somersham, St. Ives, Hants. Here the widest and the most contradictory opinions were expressed. Of these, where the practical men engaged in the after-discussion differed, and some might reasonably be

said to be wrong, it may yet be stated that all were right. Nor is the solution of this apparently strange anomaly far to seek. It lies in the fact, which cannot be too strongly impressed upon the minds of all who are interested in the progress of agriculture, that diversity of practice arises from diversity of circumstances, of soil, locality, and climate, and the variety of the minor, yet all of them important ones, intertwined, so to say, and connected with the chief circumstances. This matter is perhaps even more required to be known and remembered by those who, not practically concerned in the business of farming, yet take it upon themselves to give utterances, more or less public, on the features of farming in general, and to read lectures to farmers as to what they ought to do in particular. Nor are practical farmers always mindful of the above truth, which lies, in fact, at the base of all their practice. If more frequently remembered by some, it would render them less liable to fancy the practice of others wrong while theirs alone is right, and to believe it as a possible thing that, if they were placed under the circumstances of those whose practice they condemn, their practice would then be almost, if not quite, precisely similar.

It is circumstances which chiefly dictate the practice; and the difference between the farmer who is successful in his treatment of heavy land and he who is not so, lies chiefly in this, that the successful farmer has closely studied the circumstances under which he is placed, and brings the results of all the most modern and approved appliances and scientific methods to bear upon and make the most of those circumstances, while the unsuccessful farmer pays no attention to these, nor does he think study in any way necessary. Farming is, in fact, largely a business of observation; and this does not preclude, rather, indeed, favours the application of all the outcomes of modern science. Observation, in fact, and that acted upon, forces one, so to say, to aid it by those very outcomes.

One point the most recent and most carefully conducted practice makes very clear is this, that whatever be the system of the actual working of the land preparatory to cropping it, it is worse than waste of time, it is waste of the vital

forces of the soil, to work it while wet. One of the most eminently scientific and yet practical farmers of modern times has declared that great injury is done to heavy land, and its generally successful treatment has been more than hindered, by the practice of sending the plough or the cultivator, whether horse or steam worked, on to the land when it is wet. The proper degree of dryness will soon be learned if looked after. If this opinion be not altogether right, it is far, very far, removed from being wrong.

Another point on which there seems to be a general consensus of opinion amongst the most advanced farmers, is that the subsoil, while being carefully stirred, should not be brought up to mix with the surface soil. And when brought under the operation of cropping, in cases where shallow working has been the rule, it should be brought up to mix with the upper soil gradually, and in comparatively small bulk. Heavy land is generally rich in mineral constituents. And if, by continuous working, the part which has been long the upper or cultivated stratum gets more or less exhausted of these constituents, they may be added in sufficient quantity to keep the soil in good heart, by bringing up small portions of the subsoil at a time. Care must be taken, however, to have this subsoil put into proper condition for this mixture with the old upper soil. This is done by so working the land that the subsoil is deeply stirred but not raised. And this we take to be one of the great advantages of the cultivator or grubber for working heavy land, that it stirs the soil without raising it so much as the plough. So marked are its beneficial effects, that we should doubt the propriety of putting the plough at all upon such land. The best we have ever seen was land in which the plough had not been worked for years, the whole working of the soil being done by the grubber. And now that steam can be so effectually applied, there is really no practically useful limit to the depth to which the subsoil may be stirred. A bank, so to say, or a reserve fund can thus be formed of soil rich in mineral constituents, below the upper cultivated stratum, upon which drafts can be made from time to time by which to enrich the partially, or too often almost wholly, exhausted cropping soil above.

Drainage.—A vexed question on the subject of heavy land is its drainage, opinions being brought forward ‘wide as the poles asunder.’ As our readers are well aware, the old system, by no means done away with yet, of ploughing the land, was to throw it up into high-backed ridges or *steches*, with open furrows between. This, in fact, was the drainage system of the olden times. They could not easily, if at all, at times free the land from the water; so the farmers did the next best, indeed the only thing in their power—they raised the land out of the water, at least as much as they could of it, and this by the high-backed ridges. The crowns of these and but a small portion of the soil on either side really constituted the growing soil, for as the plants descended the sides of the ridge and approached the furrow, they began almost in exact proportion to decrease in height and productive vigour; and the reason was or is not far to seek. The furrows between the ridges were always more or less waterlogged, and the soil on either side was, it may be said, perpetually wet. Now, with improved systems, water is no longer led, or tried to be led—for the trial rarely was thoroughly successful—from the surface by open furrows, but is taken as it drops upon or reaches this, and carried through and downwards till it reaches the drains below. The necessity, therefore, of keeping the land free from excess of moisture by means of the high-backed ridges no longer exists. Some, however, think, if not for drainage at least for other reasons, that it is best even with all our modern systems of working the land to retain them. As well for its scientific soundness, as it appears to us, as for what one might call its common-sense principle, we heartily endorse the opinion of Mr. James Howard, of Clapham Park, Bedfordshire, on which his own practice has been so successfully carried out. We give Mr. Howard’s own words at the recent meeting (May 1879) of the London Farmers’ Club, in the discussion of heavy land farming. ‘He held that water should *go down where it fell*’ (the italics are ours), ‘which was the practical result of having small ridges. A large quantity of water ran down by the furrows to the lower parts of the field, and there a hundredfold more water had to be

absorbed or taken off than there otherwise would be. . . . He never had an open furrow or a gutter upon his farm; it was broken up with a steam cultivator, and laid perfectly flat. And, challenged to do so, his neighbours could not say that they had ever seen a drop of water standing on a field belonging to him.’ Close observers of facts in farming must have noticed that the soil lying in the furrows or open gutters between the ridges is composed almost wholly of very fine particles. Mr. Howard maintains, and the opinion cannot well be gainsaid, that this arises from the facility afforded by the high ridges for the rain to wash the finer particles of the soil down their sloping sides.

Thoroughly sound as this theory of Mr. Howard’s appears to us to be, it must be carried into practice with all due consideration of the circumstances. Analyzing, so to say, the soil of ridges and that immediately underneath, which Mr. Howard, by the way, very graphically describes, a good reason will be found for following his advice in getting rid of old high-backed ridges, that it should be done ‘judiciously.’ Every success in sound practice lies in this single word, the lessons of which are so often forgot. Again, it must not be overlooked that there may be, and indeed are, circumstances of soil, locality, etc., which necessitate the high-backed ridges. Thus Mr. C. S. Read, M.P., at the discussion above named, stated that he had got rid of high ridges, laying his land on the flat, but he ‘found to his cost’ that the work did not pay, so he returned to the ridge system. And Mr. Read is one to whom, if to any one, the term ‘judicious’ may be safely applied.

As regards depth and distance of the drains on heavy land, there is again a wide diversity of opinion. Deep drainage is assuredly necessary, but this phrase must be taken with reservation,—deep, but not too deep. Moderate depth—3 feet to 3 feet 6 inches—with comparatively narrow intervals will be much more effective than very deep drains with very wide intervals. Here, again, no ‘hard-and-fast line’ can be drawn; all depends upon circumstances, and of these the occupier or landlord, with a thorough knowledge of them, is the best judge. Carried out to its widest limits, Mr. Howard’s theory, that water should go down where it falls, would indeed

point out as the perfection of draining a series of drains almost if not quite touching each other, placed at the depth which would allow of the deepest stirring of the soil capable of being done by steam power; in other words, an arresting and absorbing medium causing the whole of the area of land to be drained, which medium, as it received its rain-drops from above, would in fact carry it away to the outfall with the maximum of quickness. This, of course, is imaginative, but it serves to illustrate Mr. Howard's theory, and the principle upon which the practice of drainage should be carried out,—a principle which we are strongly inclined to believe will yet be generally taken up, and lead to what may be fairly called a revolution in draining. And one immense advantage of the principle is that it is in no sense a 'Procrustean' one; it lays down no hard-and-fast line, but admits of circumstances being attended to, and in fact of the work being, to use Mr. Howard's word, 'judiciously' done.

Repeated and Continuous Corn-growing on the same Soil.—This system has had special attention drawn to it, chiefly by the experiments of Mr. Lawes, referred to below, but also by the public attention being drawn to the farm of Mr. Prout, on which it has been carried out for a period of many years. As the quality of land best adapted to give the system a fair chance is the heavy land or the 'clays,' it has been deemed best to notice it here. Indeed, this continuous corn-growing system is one of the methods recommended by some to make clay-land farming more profitable. It is this aspect to which we shall principally confine our remarks. Mr. Lawes, to whom both the science and practice of agriculture are so vastly indebted, amongst other points which he has subjected to the same painstaking, patient, and accurate system of experimenting for which Rothamstead is so famous all the world over, has devoted much time to the question connected with repeated growing of corn on the same soil. It has been one of the peculiar circumstances attendant upon the practice of agriculture, that experiments made, or inquiries instituted, by some eminent scientist with some important and definite end in view,

have been made as it were pegs to hang opinions on, or to give rise to what some one has called a 'craze' or two. Now it may not have been the experiments of Mr. Lawes above alluded to which set at work one or two to attempt a system of continuous corn-growing on the same soil on the Lois Weedon system, which was not, by the way, as is generally supposed, the same, but only a close approach to it. But it would appear to be so, and of late we have heard and read a great deal of two or three systems, of which, however, the greatest prominence has been given to that introduced by Mr. Prout on his own property (Blount's Farm, Sawbridgeworth, Herts). Not that we should be deemed so discourteous as to call Mr. Prout's system a 'craze.' He has conceived it with a truly patriotic purpose of benefiting the country, believing that it would go far at least to solve a difficulty as to corn-cropping which has long been before the farmer. And he has carried it out with a perseverance, patience, and with all the marks of a persistent plan, which prove his own belief that it is a sound system, based on scientific reasons. But we think he has overlooked the fact, which so many have overlooked who are ardent believers in some particular system, that what may and does suit his soil, climate, and circumstances, may not, will not indeed, be likely to suit others differently placed in these respects. This necessary consideration of circumstances runs through the whole of agriculture, and the neglect of it, as it has in past times given rise, will we fear in the future for long time to come lead to many and to grievous disappointments, and, as a necessary consequence, to losses, which can be ill spared at any time even by those who have abundant means, but may be ruinous to those who have but little. In times like those we live in, it behoves every one to consider well what he is about.

The soils best calculated to give what in popular parlance is called fair play to the system, are those deep and heavy ones—*par excellence* 'corn soils,' which, again, best show their capability under thorough deep cultivation by the steam plough. This consideration excludes a most extensive area of soil not by any means fitted for the style of cultivation which the system demands. And it may be more than

doubted whether, even by the addition of manures, however carefully and judiciously designed and applied, the soil will under the system keep on producing crops which will pay. The Rothamstead experiments of Mr. Lawes may be cited in proof of the opposite; but it is questionable whether the precision there displayed in cultivation would or could be given by the general run of farmers. But Mr. Lawes himself has come forward quite recently to show that even should this precision of practice be followed, there is an inherent fallacy or weakness in the system of Mr. Prout, which makes it, in his opinion, certain that it is not capable of growing corn crops continuously up to a paying point.

We can only find room for the following extract from the letter of Mr. Lawes to the *Agricultural Gazette*. We premise that in Mr. Prout's system its success depends upon the soil furnishing a certain proportion of its constituents to be carried away in the crops, or, to put the matter in plain language, upon the gradual exhaustion of the soil. Now it is only heavy soils—of which clay is the best in this respect—and heavy loams, which is the soil of Mr. Prout's farm, which can furnish these, and they are not inexhaustible. But to replace what is thus drawn from the soil, it is richly manured:—

'We are told that Mr. Prout spends about 50s. per acre in artificial manures, that he mixes bones with superphosphate of lime, and also uses nitrate of soda. There can be little doubt, therefore, that while he supplies to his soil fully as much, and probably more, phosphate of lime than his crops remove, he is drawing upon his soil capital for both nitrogen and potash.

Two questions will here arise—1. Is this a legitimate form of agriculture? 2. Will not such a process, if carried out, end in the exhaustion of the soil? The answer to both queries must be in the affirmative. Any substance, being a constituent of the soil, if carried away, must exhaust it, unless it be restored from some external source. It is quite evident that Mr. Prout trusts to his soil to furnish the greater portion, if not the whole, of the potash removed in his crops. Of the nitrogen he supplies a portion, possibly one-half; the remainder must come from the soil,

unless it can be shown that it is supplied by the atmosphere. His corn and straw together, as removed from the field, may be estimated to contain about 1 per cent. of nitrogen; the removal of from two to three tons of produce per acre would carry away 50 lbs. to 60 lbs. Mr. Prout may probably supply one-half of this, but the other half must come from the stock of 8000 lbs. or 10,000 lbs. per acre; some considerable period would therefore elapse before a sensible diminution of the available stock would be apparent. . . .

'The remarks I have made upon Mr. Prout's system of farming must not be accepted as expressing an approval of it. Not being a farmer by profession, or devoting his whole time and attention to agriculture, it is quite probable that the almost exclusive growth of corn crops, and the sale of all the products, may have given a better return than could under the circumstances have been obtained by any other process. At the same time, while my experiments prove that corn, and especially barley, can be grown with profit more frequently than has hitherto been thought consistent with good farming, they also show that the profits of the farmer must depend more and more on meat and other products derived from stock.'

But even apart from this, there are other points which every practical farmer knows must be taken into consideration. What these are may be gathered from the statement that what constitutes the peculiarity of British farming, and sets it apart from any other, is its mobility, if the term may be employed. Change is the very genius of British farming—change of cropping to meet changes of soil and of climate, and changes to meet not only localities, but changes to meet the ever-varying wants and necessities of the population. There is little fear, therefore, that this, or, indeed, any other system which is to stand alone, and be that to which the farmer is only to direct his attention, will form a striking feature of British farming for many years to come. We may safely predicate that this change will never come unless a change in the whole circumstances of the country precedes it. Of the likelihood of this the reader may judge.

The Change of Arable to Grass Land (see

chap. iii. Division VI.).—Little requires to be said here in addition to what we have given in its appropriate Division, so far as the mere practical details of working are concerned. But from circumstances but too well known to many, and which have been, and may yet be, more specifically alluded to, the subject has gone on increasing in interest, till at last, it, more perhaps than any other connected or considered to be connected with the future of farming, attracts popular if not farming attention. The points involved in the question as it now stands are so important, and carry with them so much that is of the greatest interest, that it is deemed essential, therefore, that some notice be here taken of them. That by the change from arable to grass-land culture a corresponding change in many, if not all, of the conditions of farming as hitherto conducted will be introduced, is beyond a doubt. After the change has been once effected,—and we presume it to have been so scientifically carried out from the beginning that it will be successful,—the new order of things begins. The very first feature it introduces—and it is vastly more important not only in its immediate but in its ultimate issues than is generally supposed—is that the demand for labour is lessened to a very great degree. The necessity for the same proportion per acre which characterizes arable farming does not exist. Pasture fields, to a large extent, take care of themselves, and will long remain in what may be called a steady normal condition; totally unlike the series of perpetual changes which land under arable culture is compelled, so to say, to submit to. The cost, therefore, of keeping up a staff of men to carry arable culture out is to a large extent done away with in the case of pastoral; so also, secondly, the large expenditure incurred in the mechanical appliances necessary to work arable land, and, under this head, the heavy and risky item of horse labour to work them, supplemented by steam power in certain departments. And, lastly, even with such falls in the price obtained for animals from the butcher, there is much less anxiety on the part of the farmer, inasmuch as he has not to contend with such a competition as in the case of corn—a competition which threatens to do away with every chance of the farmer growing it with any

prospect of profit. However, competition has of late set in even in the live-stock department; but we have shown in the Seventh Division that there is, to say the least of it, this reasonable hope,—we use the word as indicating not so much our own wishes, as those of the large body of farmers who live by that department,—that this, if it does not ultimately die out, or be killed by the trade circumstances there alluded to, will, at all events, be so lamed as not to be worthy of being taken much into account by our own farmers who breed and rear live stock for the butcher. However, as we have also shown in the Seventh Division, the farmer in this country has an enormous advantage in his favour, not merely from the adaptability of our climate to the rearing of live stock, but in the taste, or prejudice, if it be preferred by some to be called, maintained by our own population for our own home-raised meat.

It is not at all to be wondered at, therefore, that the tendency of late years has been to lessen the area of land under arable culture and to increase that under grass; nor, considering the circumstances by which the farmer is surrounded, that that tendency is increasing daily, and increasing rapidly. It is, however, as a rule which has few exceptions, a wise course, on being induced to adopt a new system, to consider well all its pros and cons; indeed, to give more heed to the arguments against carrying it out, and this on the principle 'that a man forewarned is forearmed.' Many a one has had bitter reason to regret that he has rushed into some new venture without considering its various conditions, and counting the cost of realizing those which were essential to success.

Changing arable land to grass is, in the majority of cases, a costly process and a slow. Fine pastures are not produced, as arable crops are, by the labour of a few months or weeks. In the case of some soils, especially the heavy ones, not only is the slowness of formation such as sorely to test the patience of the farmer, but in many cases to test the power of the purse. For it is a matter of absolute necessity that his return for outlay be quick as well as good. Further, the change is, even in the easiest of cases, by no means an inexpensive one; while

in the difficult, as the heavy lands, it is in fact very costly.

Nor, while the farmer is suffering from the losses he has sustained, not merely by the competition of the keenest kind he has had to contend with, but in the diseases and climatal difficulties which the corn crop is subject to and influenced by, must he conceive that all connected with grass-land cultivation is plain and profitable. He will find in connection with it, on the contrary, enough to 'vex his soul,' to test his patience, and try to the utmost his scientific skill. There are bad times and seasons with grass as with corn, and not seldom will he find that his best endeavours are made only to result in disappointment. Further, all lands and all districts are not adapted for grass-land cultivation. Some lands, despite the best efforts, will only grow the poorest, that is, the least nutritive grasses; others will scarcely grow them at all, even of the poorest,—that is, grow good or rather heavy crops of even such grasses as they are made up of. Again, some lands for a short period will seem to do well; but the good nutritive grasses, which look well at first, gradually disappear, being 'edged out' by poorer plants, which may be said to be native to the soil. This point, that there is a limit put to growing grass universally—that is, grass worth growing for feeding, is one somewhat too generally overlooked. And its neglect has already given rise to disappointment and loss, and will yet give rise to much more, if the 'craze,' as some call it, for grass-land culture increases as rapidly as it seems likely to do.

Notwithstanding all this, there is abundant evidence around us to show that there is more hope for the farmer in paying attention to that class of cultivation which will enable him to produce the supplies of meat demanded by our population in an ever increasing proportion, than in continuing to grow corn chiefly, with all the difficulties he has in so doing to contend with. Still it must not be overlooked that the change is not, as many think, so thorough and complete as altogether to do away with the necessity of having a portion of land under arable culture. In point of fact, the most advanced thinkers believe that the real change yet to come will not

be that of land now growing corn into that growing grass only for live stock, but that it will be rather an increase of arable culture, still, however, with the great end in view of breeding, rearing, and fattening stock for the butcher, and of maintaining cows for dairy produce.

This change is foreshadowed in the soiling system, with all its variations and modifications, by means of which it is maintained by many authorities (see Division VII.) that advantages are obtained which cannot possibly be secured by any other. Pasture lands, which soil, locality, and climate all point out as the natural arrangement in the distribution of the earth's products, will still hold their own, as they ever held it, even when the 'corn craze' was at its height, and the very antipodes of what is now farming opinion was existent. But in districts with soil and climate fitted for the growing of corn, a wide variety of crops can be grown. And in some districts it may be the best interest of the farmer to devote himself to the production of the meat; this being done by having abundance of food in the cheapest way, and with a degree of success which those accustomed to keep to the old lines have no conception of. It is in this way that our most advanced thinkers believe that the coming change is to be made which will make the present bad times future good ones. And just as this wide variety of cultivated crops gives, or will give, the farmer the power here stated, so also will it enable him to widen the variety of the live-stock produce he has to send to market. Here, also, a change is confidently looked forward to, at all events hoped for, by those who had both scientific position and practical skill as farmers.

We have said that the change from arable to grass-growing land is by no means the easy work which some suppose it to be. This would be so if from nothing else than the time which must elapse before the land well under corn becomes a first-class pasture or meadow-grass field. Men talk as if the change now so much spoken of can be made at once, so that the field which this year is at harvest-time glad with the wave of the golden corn, will next year refresh the eye with an expanse of rich and luxuriant grass for meadow hay, or as pastures have its feeding

cattle or cows. No doubt this is the popular view, and much of it arises from those connected with various branches of manufacturing industry, the changes in the character of many of which can be made with considerable facility. But the same view is held, although, of course, in a decidedly modified way, by many practical farmers; these, of course, being more numerous amongst the class with whom grass-land management is a department with which they have had but a very limited experience. It is well, however, that such should be impressed with the importance of what is involved in the dictum of Mr. Lawes, that the process of converting certain soils which have been devoted to the ordinary courses of arable culture into grass land is 'the work of a lifetime.' Those are weighty words, and come from one who gives no utterances on agricultural matters but those which are well considered in all their bearings, and are, moreover, based on an experience to which few, if indeed any, can lay claim.

This element of time is one altogether independent of the costly work which conversion of arable into grass land in many cases involves—work not only costly, but difficult; so much so, that the skill and knowledge, to say nothing of the patience of the farmer, will be severely tested. But the practically important point which this consideration involves is this: if the future prosperity of the farming of Great Britain is to depend upon the change of corn into grass land, as is reported on all sides nearly, that prosperity cannot possibly be immediate. It is impossible to overrate the importance of this consideration. This is not realized at present, and will likely only be so when the expected results are not forthcoming with the rapidity which the nation, generally at least, now expect. The disappointment will necessarily be great, the loss to the nation greater. Even under the most favourable circumstances of soil and climate, the conversion of arable into grass land cannot possibly be a quick one. To grow what will be even but a 'poor bite' for cattle or dairy cows, or what will yield a miserably light crop of hay, will take time; and what is wanted is not poor but good food, not light but heavy crops of hay.

There are not a few, and we confess to be of the number, who question the propriety, the prudence, and wisdom of attempting to carry out on an extensive scale, and that quickly, a change so radical as the one we are discussing, and a change which is not likely to be carried out generally with all the skill and painstaking care which is necessary to its success, from the very circumstance that rapidity is an element considered to be essential. It would be well to consider the simple principle involved in the old saw, that 'while the grass grows the steed starves;' or, indeed, that other, which, like the first, savours so much of practical wisdom, that 'work done in a hurry is work done poorly.' If prosperity is to be brought back to farmers by this change, the quicker it can be made the better; but, as we have seen, quickness and goodness in the change are not compatible.

It is therefore, we conceive, of the highest possible importance for the 'situation' to be very calmly considered in all its bearings, to see—if this can be seen—if there be not some other system which can be adopted with greater chance of success, and possessing the essential element of being able to be quickly carried out.

The position is simple enough, however grave the issues of it are, and graver they cannot well be. The grass land, so much talked of as the main hope of the farming of the future, is required for what? We fear this question is not always considered in all its outcomes. If useful for anything, it is to enable the farmer to rear and feed greater herds of cattle and flocks of sheep, to supply the home markets with that food for which there is such a demand, and to meet, if met it can be, that competition with other countries under which they increasingly suffer. But not only so; it is, by those farmers who look farther a-field than do some of their brethren, considered valuable as enabling them to supply a wider range of products, such as milk, butter, cheese, and pork. In brief, the object of this change in cultivation is to produce food for live stock of the widest possible range. It is not to produce grass alone, or, as we take leave to think, it ought not to have this only for its object.

Now education, however complete it may be

in some of its departments, is obviously very incomplete if it has not taught the farmer the high pecuniary value of observation, and of the necessity to exercise it. If it be exercised in this particular case, he will find examples enough to prove most satisfactorily to him that there are other feeding substances, and those of higher value, than grass alone, whether that be eaten off in pasture, or as a house food in the form of hay. Many of these foods of the highest possible value are what are called 'artificial,' and have, as a rule, to be purchased. Many of their ingredients, however, can be grown upon our farms, and the number of these can, we feel assured, be considerably increased. But of what may be called the 'perishable' foods of the farm valuable for live stock, many are already at the disposal of the farmer; and, as we have shown in another section, their number can be largely increased. It is one of the happy circumstances attendant upon that method of doing business which incites one to be on the perpetual outlook for new things, that these new things turn up much more frequently than is expected, and not seldom from the most unexpected quarters. Agriculture, when this principle of business operation is more extended, will be found to be no exception to the rule. Nor should the highly valuable fact be lost sight of, that the great majority, some of our best authorities, say that very nearly all of those foods which can be cultivated by the farmer are as valuable as grass or hay as feeding materials. Many of them are unquestionably higher in value. Indeed, it has of late been a rapidly extending opinion that grass is a comparatively poor food. Certainly some grasses, grown under the miserable system of grass-land cultivation carried out by some, are scarcely worth the trouble of cutting, so poor are they in feeding value. And unless hay be of the best quality, made from good, the best grasses indeed, and 'got' well and 'kept' well, it is certainly not worth the money it costs. Such considerations are but too often lost sight of by graziers, cattle-feeders, and dairymen. And Mr. Jenkins, the Secretary of the Royal Agricultural Society, has done good service in the little pamphlet he has lately issued, by drawing the pointed attention of dairymen who trust

wholly to grass and hay as the farm foods of the cows, that they would do wisely and well to supplement these by good artificial foods. Mr. Jenkins had, however, a capital opportunity to give some advice as to grass and hay cultivation and production, as bearing most closely on the subject he had in view. It is to be regretted he did not, as anything issuing from the 'Royal' has a weight which but few other authorities possess.

A wide range of foods valuable for live stock can be had even now, and may be said to be daily increasing in number, and all of them capable of falling within the range of the general knowledge of the farmer as a cultivator of crops. It is in this fact that there lies great hope for his future, if that is to depend more on his being a producer of meat and milk, butter, cheese, and pork, than of corn,—that is, wheat. For, as we have already stated, oats and barley will still hold their own in soils and climates suited for them. No small element of this hope arises from the fact that these crops can be cultivated at once; the arable land—the corn land now talked so lightly of by many, as if it could only grow corn—being at once available, and the tedious and costly process of its conversion into grass land, in many cases at least, being avoided. Everything, therefore, we think, combines to show that if the true position be carefully studied in all its issues, it will be found to be something like this,—that the complete doing away with arable culture we hear so much of is so far from being likely to be the case, that the great probability, nay, the certainty is that it will be maintained, nay, in many cases increased, including within its range the grasses, artificial or natural, as well as a much greater number of food plants than now grown generally. And this will also, as a natural sequence, bring with it, moreover, many improvements in the mere way of using the food and all its details.

But as pasture land for grass, and meadow for hay for feeding purposes, will form an important department in British farming, it behoves the farmer to pay more attention to the grass lands he now has, than he has in too many cases hitherto done. Better this, we feel assured, for many farmers, especially those with limited

means, and for whom it is simply a necessity of their position that they should as quickly as may be regain the lost prosperity they deplore,—better far this work of improvement on such old pastures as they may possess, than that of quickly rushing into the conversion of good arable land into grass. Dearly-bought experience may, and indeed often will, lead him to conclude that it would have been wiser to have delayed where this latter step is taken.

It is not taking an exaggerated estimate of what can be done in the improvement of old grass land, to say that by proper attention to its cultivation, one-third may be added to the produce. But improvement of old grass land is by no means a one-sided matter. It is not enough to attend to the land; for, however carefully that be done, unless attention be paid to what the grasses are which it is to produce, the result will be unsatisfactory. We have said in the appropriate section that there are grasses and grasses, for proof of which new rendering of an old proverb we refer the reader to that part of the text.

For the rest, as regards the details of the work to be done in effecting the changes indicated in this section, the reader may be referred to chap. iii. Division VI., to which but little can be added.

The Reclamation of Waste Land with a view to the Formation of Grass Land.—The subject of reclamation of waste land generally, is too wide to be again taken up. Enough has been given in the section devoted to it in the text for our purposes, although examples can be multiplied to a great extent. But, as bearing at once on the general subject, and specially on that which we have just discussed, and our interest in which can scarcely be overestimated, we devote a paragraph to the notice of a system of reclamation now going on. In this, steam power plays an important part, just as we have described it, in its appropriate section in the text, as doing in the universally-known land-reclaiming works undertaken by the Duke of Sutherland at Lairg. The estate on which the improvements we refer to are being carried out is in Midlothian, N.B., the district so famed for its splendid farming, the farm being that of Outerston, near Gorebridge, not far from Edinburgh, the whole being carried out at the suggestion and under the superintend-

ence of Mr. Stein, Broomhouse. The extent of land put under reclamation is about 100 acres, and is thorough moorland, its surface covered with heather and benty grass. For bringing this tough and, to the ordinary implements, so unkindly and indeed almost intractable soil, if so in its natural state it can be called, into cultivation, new implements are used. These are adapted to the new power, and are in general design and construction the same as made by the Messrs. Fowler of Leeds for the work of reclamation carried out on the estate of the Duke of Sutherland in the north, certain details being different, to suit the different circumstances of the land. After the surface is cut with the revolving knife, it is laid over at the side, inverted with the heather and bent grasses under, the soil, such as it is, being left uppermost. The slice thus placed is pressed into its place by wooden rollers of large diameter which follow the action of the knife. To the action of the circular knife-plough succeeds that of the harrow. This has proved, like the plough, a remarkably efficient implement, doing its work regularly and uniformly even on land so uneven and rough on its surface as this kind may easily be conceived to be. The circular knives are also adopted in the harrow, but they are more numerous, and disposed differently in the framework. Two engines of twelve-horse power each are employed, and their power gives, with a steam pressure of 90 lbs., a regular speed of two miles per hour to the implements. On the harrowed land the first crop is rape, on which ewes are folded in the autumn. This makes an excellent green food for sheep. Pretty well manured and consolidated by the folding, the land is to be left till spring, when it is put under grass, a good dressing of lime being first applied after the sheep have left the ground. The cost, including draining, may be put down at £11, 10s. per acre,—this being made up by 35s. the acre for the steam ploughing and harrowing work, £4, 5s. for the liming, and £5, 10s. for the drainage. With this expenditure there can be no doubt that the work of reclamation will pay well. In the usual condition of the land, two acres barely supported a single blackfaced sheep, and the feeding at the best was but poor; when once the reclaimed land

is in good heart, and well ground down, it will keep a large number of sheep in good condition. When all the rough surface is fairly got under, the soil is found workable enough. This arises in part from the large percentage of peaty soil present. It would be well for the agricultural and, of course, for the general interests of the country, were land of this nature, of which there are thousands and thousands of acres lying at present absolutely waste, put under some such system as well considered and as energetically carried out as that of which the above is but a very brief notice.

While on the subject of reclamation of waste land, it will serve as a medium of throwing out a few suggestions, and giving a few facts as to working and cost, if we give a few details as to the work of reclaiming such as wet, marshy, or mossy lands. The example is from the district of Chat Moss, on the line of the railway from Manchester to Liverpool. Of this every one has heard; but what every one does not know is, that it is perhaps the most strikingly successful, as it certainly is the most extensive area of land of this kind which has been reclaimed. An example the more encouraging to proprietors who have on their estates land of a similar character, for it is difficult to overstate the difficulties which had to be overcome; such difficulties, although in another direction, but the same in principle as at one time nearly baffled the daring yet practical genius of the first and the most celebrated of our railway engineers, George Stephenson. From his practice in securing a firm and dry roadway for his railway, farmers who undertook the after reclamation of the unpromising quagmire—for it was nothing else—obtained lessons of great value. The example we here give, although it may not have a direct bearing upon grass-land culture solely, will obviously be applicable to such land as may be devoted to grass. For grass, whether sold in its natural condition to be used as green food for dairy cows, or in the form of hay, always possesses high value in the neighbourhood of towns connected by a railway.

As stated in the text, draining is the first operation to be carried out in such lands, and it is, under the best class of the soil, some of which scarcely deserves this name, a tedious

and an expensive process. When the soil is very wet, the drains are, in the first instance, very shallow—indeed, they cannot be made deep. The depth is gradually increased as the consolidation goes on. The ultimate average depth is four and a half feet, a depth reached after, say, four years of patient working. The drains are so cut, intersecting each other, that areas of land averaging one hundred yards square are enclosed by the deepest drains or ditches, as they may be called, while the area is still further cut up by smaller drains and shallower, the width between which varies according to circumstances. The cost of drainage varies also, say £3 to £3, 10s. on the average. This figure, low compared with other classes of soils, arises from the comparative ease with which the ditches or drains are cut in the soft soil. It is only after the land gets consolidated by the open drains that tiles or tube drains are put in; if put in earlier, they would simply sink into and be swallowed up by the moss land. The next operation is the marling, costing about £7 the acre. Then follows the digging or turning over of the now consolidated land, which is done at a cost averaging £4 the acre, thereafter the first cropping.

Transplanting Mature Trees as useful in the Reclamation of Cold and Marshy Lands, and in the Improvement of Grass Land.—In the reclamation of the cold marshy lands which stretch their dreary expanses over such extensive areas in various parts of the kingdom, plantation has yet to play a much more important part than it has yet done. In these, especially when they are exposed to cold and cutting winds from the east and north-east, but little hope exists for their thorough reclamation till shelter is secured. The warmth which is thus imparted to and retained by the soil is something very striking; and when this is secured, the comparative ease with which crops can be raised is no less so. But the critical difficulty is to get the plantation shelter so desirable, indeed essential in such cases, established in the first instance. For the cold winds are such that, in conjunction with the wet and unkindly character of the soil, they render it a difficult, often an impossible thing, to rear young trees. And if they are

established, their growth is so slow that it is years before they can give the shelter they are planted for. Hence the transplanting system is strongly recommended for such cases. It has been carried out, and with striking success; such, indeed, as to give rise to a hope which seems in every way reasonable, that in the extension of this system lies the future of reclamation of such waste lands as we have named.

Wherever it has been done the results have, we believe, been uniformly successful; and these have been specially noteworthy in the case of lands under grass. Where such land has been under good grass, and for some reason or another the shelter at one time afforded by trees has been done away with, the grasses have rapidly deteriorated. The good plants have died gradually out, and their place has been taken by the coarse and innutritious grasses so well known by farmers, or the grass has utterly disappeared. When, however, the shelter has been restored, the good grasses have gradually reappeared, and the whole surface has assumed a healthy appearance. Apart from the high value of trees as affording shelter simply as shelter, and to which in the text we have drawn attention, some authorities seek for other causes affecting its value. One writer suggests that the trees act as arrestors of the minute spores or spawn of lichens, mosses, and other low-lived plants, which are borne by the winds blowing over the land. The deleterious influence of such plants is well known. And it is a circumstance curiously corroborative of this writer's suggestion, that where in such regions a belt of trees surrounds a district or plot, the trunks and branches of those on the windward side of the belt are covered with lichens and mosses, while those of the landward or inner side are free or nearly so from them. The suggestion is certainly worthy of consideration. At all events, as affording some shelter, there is little doubt that the planting of trees would be as highly valuable to grass lands, as we know it to be to those under arable crops.

But the lands under notice, moreover, are in districts 'generally afflicted' with peculiarly cold and harsh winds, while the soil over which they blow is as cold and harsh in its turn. These

two causes prevent, or would likely prevent, young trees from growing, but would have less effect—certainly not a wholly killing one—on mature trees. All would depend upon the way in which the transplanting was done, the great point to be arrived at being the placing of the trees in a way as closely approaching their original position and condition as possible. For if this were not attended to, trees would be all the more readily liable to succumb to the new and trying circumstances under which they would be placed. This would clearly involve some preparation of the trees previous to being transplanted, as well as careful placing in the new ground, and careful nurture thereafter. Although an old plan, it appears from what recent writers have said, that the one introduced by Sir Henry Stuart is perhaps still the best. This system was largely adopted at one time, and with signal success. The chief feature of the first operation, before the transplanting was actually carried out, was to cut off all round the long underground branches—so to call them—which the mature tree had sent out in all directions. The rapid and most extensive growth of young, fresh, and vigorous rootlets which thereafter took place was looked upon as the immediate source of strength for maintaining the vigour of the tree when put in the new soil. In transplanting, the tree was placed in the new soil as nearly in the same position as it occupied in the old. Trees transplanted on this system 'took root' very quickly, and so thoroughly that very little propping and staying was required. An important part of Sir H. Stuart's system was the machine for lifting, transplanting, and replacing the trees transplanted. This was so well designed that it rarely, if ever, failed to do its work efficiently, and by the aid of few attendants. Sir H. Stuart wrote an account of it in a volume published by the Messrs. Blackwood of Edinburgh, which is well worthy of a careful perusal.

Increasing the Produce of Land—High Farming.—There are many ways in which farmers have been recently told that they may turn the tide of fortune, which has been so long and is now specially running against them. Some of these we have already pointed out, others are yet to be glanced at; but perhaps the one to which

most attention has been drawn, and from which the greatest and the most readily realized results will be obtained, is that indicated in the double title of the present paragraph. Nor need this be wondered at, so far as its popular aspect is concerned. For it seems such an easy thing to do, certainly an easy thing to say. 'Increase the number of your improved methods of working, or double the extent of those you have already proved to be so, and you will double the produce. Do as our manufacturers do, who put down a great amount of spinning machines, throstles, mules, or the like, and who double, therefore, the rate of their production.' It is easy for those who do not know to say this; but it is easy for those who do know what farming is, to prove that the cases here cited as parallel are not so. Rather they are parallel, for, like parallel lines in geometry, however far extended, they will never meet. They are diverging, not converging lines of argument.

This, briefly, we shall presently endeavour to show; meanwhile, and as preliminary, clearing the ground before us by stating as accurately as we can the position of the case. We have been told, and by high authorities—high in one if not in the more practical sense—that the produce of our land could at least be doubled. We have had occasion to quote this 'deliverance,' and so far approvingly. But a distinction must be made between what it really means and what it does not mean. Whatever the authorities who have quoted mean by it, it certainly does not mean that the produce of *all* land at present under cultivation can be doubled by proper methods of working. We shall try to show the fallacy of such an opinion. We take it, that its truth lies in the following direction. *First*, that of the land already under cultivation, *all* cannot possibly have its present produce doubled, scarcely increased at all, as a large proportion of it is already farmed up to the highest possible point. But, *secondly*, that of the land at present cultivated, there is no doubt a large proportion—too large, unfortunately—at present badly farmed. Of this, a large proportion no doubt could be, by the highest style of farming, made to produce double that which it at present yields. The remainder, probably the greatest proportion, while it could by the best

farming give a higher produce than at present it yields, certainly could not give a doubled produce. *Thirdly*, the increased produce to be hoped for, while it rests in the land under the second head now named, rests, we take it, also as much in the making of land available which is not at present yielding anything. This may, from what we have shown elsewhere in this work, be classed under two divisions—neglected land and waste land. Of the first of these, the term is not to be taken as meaning that the best farming was neglected to be given to it, but that, as we have said, it is wholly overlooked and is not farmed at all, or made to be productive of anything. We have tried elsewhere to show that there is more of this land than is generally thought of. Of the waste land so called, what we have pointed out should be remembered, that a large proportion of it is likely to remain for ever 'waste,' so far as farm produce is concerned, no known or at present conceived method of cultivation being able to make the yield pay the cost of producing it. The farmer is, of course, blamed for all the deficiencies of produce, and he is gravely lectured on his folly in not making them good by many who are scarcely entitled to take the role of teacher. His overlookings are sufficient, both in number and importance, to shield him from being blamed for those of which he assuredly is not the cause.

Certainly the farmer at present farming in the best possible way, giving to his land all that is comprehended in the term 'high farming,' is not to be blamed for not doubling the produce of his land; blamed especially by those who do not know what 'high farming' is, and what it involves.

'High farming' has been largely practised by many more than is generally conceived. It is based upon a sound principle, and where that has not been departed from, the practice has been singularly successful. Popularly defined, it may be said to be the antipodes or the opposite of that system which grudges or stints the land both of good and careful working, such as ploughing, stirring, weeding, and cleaning of the after crops, and, what is perhaps worse, of manure; in some cases—these the *worst*, no doubt—giving the latter only at long intervals, and even then with very

sparing hand. This 'starving system' is brought about by many causes, the chief probably being really want of capital to purchase manures and to employ the labour—steam, horse, and manual—necessary to do the work. But from whatever cause arising, it has been, and is largely still, a powerful means in keeping farming down at about the very lowest point of production which it can well reach. High farming, the opposite of this, may be popularly defined also as the 'feeding system;' and with all the mistakes made by those who have advocated and practised it, to it, nevertheless, is owing all the great advances in farming which have been witnessed of late years.

But, like many other good things, it may be overdone; and its essentially sound principle, when departed from, brings the usual result of individual loss. And what is perhaps worse, as influencing more or less prejudicially a very wide circle of practical men, it raises their prejudices against it, and thus prevents their trying to carry it out judiciously. And these results, as usually is the case, are laid to the blame of the principle rather than to departures from it. Just as, in the case of feeding live stock, the starving system, or, as it is called more euphoniously, the 'economical' system, is anything but economical, so is the high or feeding system, when properly carried out, the best paying one. But when it is carried to excess, the extra food given is lost not merely in the sense of not being useful, but it is too frequently lost in the worse sense of doing harm.

In fact, the common-sense principle applies to both cases,—high farming in the cultivation of land, high farming in the feeding of the stock kept on it. This principle is, that there is a limit—the true scientific limit—up to which the system in both cases pays, beyond which loss is inevitable. So true indeed is it that extremes meet, that, paradoxical as it may appear, it is to a large extent true that the high farmer, after incurring all his expenses in giving excess of manures, etc. to his land, and food to his stock, will equally, at least in large measure, with his neighbours who farm on the starving or low-farming system, find that he has gained a loss.

Errors of the gravest kind have arisen, and are

likely to arise more frequently in the future, if by what is now being said many are induced to carry high farming to an extreme, by holding what is not the truth but the semblance of it. This semblance is the notion—the popular notion—that if the expenditure of any given material yields a certain increase, the expenditure has only to be doubled to secure a twofold yield. It is therefore not to be wondered at that fallacies in this part of high farming should have arisen, and be so much insisted upon as facts. A little thought, however, would save much disappointment and loss.

The point is so clearly put in a letter in *The Farmer*, that we cannot do better than quote it here as conclusive in the whole matter:—'Let us suppose the normal fertility of the soil to be equal to 20 bushels of grain per acre, and that 4 cwt. of artificial manure will increase it to 40 bushels. It does not follow—in fact, it is not true—that on the same land 8 cwt. will produce 80, and 16 cwt. 160. It is clear that only up to a certain point the increased expenditure pays. Every additional expenditure, if not an absolute loss, means a lower percentage of returns. . . . Beyond a certain limit, every bushel of corn and every pound of meat costs more to produce than that which has preceded it.' These are truths which cannot be refuted, being based upon sound theory, and can be corroborated by the numberless facts of experience. Unfortunately, these facts have not always been, too seldom indeed, recorded at the time they arose; they cannot therefore be referred to with all the precision of time and circumstance so desirable. But every scientific and observant farmer—and he cannot be the one without the other—can give *viva voce* evidence on the point. It is to be hoped that hereafter more attention will be paid to the due recording of such points as experience tends to make clear; making this, as suggested in a succeeding paragraph, a regular part of what is generally called the 'book-keeping' or accounts of the farm.

But, in addition to the point we have just considered, there are other points of great importance which must be considered in high farming, as embracing both land and stock. The elements to be dealt with in the management of

these are numerous. And it is wholly unscientific to consider and treat them as independent agents, each standing by itself and exercising only its own peculiar influence. Grouped or thrown together as they are, they act and react upon each other, producing combinations, some of which are known, others are but partially so, others are only guessed at; while the most advanced thinkers—and these are generally the most modest of men—believe that there are combinations the effects of which we do not know, cannot at present even conjecture. Such elements as those we refer to, and the combinations brought about by them, when forgot or not known, give rise to many of the fallacies, already alluded to, promulgated on this subject of high farming. The one fallacy named in the first paragraph in this section is peculiarly striking, all the more that it is likely to do great harm from the apparently irresistible nature of its argument, or rather the premises demanded by it. This is, that land and stock are just so many mechanical media, or materials and machines;—that these, in fact, can be operated upon in the same way, and be made to yield the same or like results, as other materials and machines. The textile manufacturer has his cotton, his wool, or his silk, and he makes the most of it, working it up so completely that there is no waste with him. Or if waste there be, even that is utilized, and to some good purpose, as the fortunes made by not a few ‘waste dealers’ in Lancashire can testify. ‘Why,’ it has been asked, ‘can you farmers not do the same with your land, make every grain of it produce something? And more than that. Manufacturers can tell to a yard, an inch, or a fraction of an inch for the matter of that, how much yarn can be spun out of so much cotton, or how much cloth woven out of so much warp and weft. Why cannot you farmers calculate with the like precision and accuracy? You tell us that manure produces crops. Well, if we want more yarn or more cloth, we either alter the speed of our spinning-machines or our looms, or give more power or increase their number; and we can always tell what will be the actually increased produce. Why don’t you farmers do the same? Put in double the manure,—you are always grumbling, yet always

purchasing,—and you will double the produce. And as to your cattle and sheep, why, you never know what you are going to make of them. It’s your own fault! Why don’t you increase the food you give them, and keep on increasing it? If one good feed gives so much beef, give two and you will get double, and so on. Why, it stands to reason! We can tell all this about our stuffs and machines; you can do the same if you like.’ But, however closely the case as thus put, and so persistently put, seems to ‘stand to reason,’ unfortunately it does not stand to facts. ‘Land,’ the farmer may reply, ‘is not like cotton, wool, or silk, of which everything is known, each of which is a single agent acted on by no wide variety of substances. Land, on the contrary, is acted on by a number of agencies, in a way known in some, unknown in other cases. The last pound of cotton produces the same length and fineness or “counts” of yarn as the first. The last ton of manure does not or may not produce the same effect as the first. We cannot tell. Your cotton, *in actual process of manufacture*, is *not* subjected to the attacks of an almost endless host of enemies, *atmospheric, insect, and animal*, till it is deteriorated in value, sometimes wholly destroyed. Corn and other plants do not unfortunately possess the same fortunate immunity, as even some of you who so lecture farmers do know. Our cattle are not spinning-mules or looms. They are like yourselves, and possess physiological peculiarities which in their action and effects often puzzle the wisest heads amongst us. We may keep on increasing the amount of food given them, as you so frankly suggest; but going, to use one of your own expressions, “into an ill skin,” it sometimes does not produce a corresponding increase in the weight and quality of the beef or mutton we get. Often it does immediate harm, and kills the animal by inducing disease; always, when carried to excess, it is food thrown away, for double rations do not give double yield. Far from that. You have to deal with known quantities, and to work with known forces, and it would be a shame if you could not, as you do, calculate the results with unflinching precision. We farmers are placed in precisely the contrary position, and we cannot blame ourselves if we

fail in our calculations. In fact, we have not the data to calculate with.’

When one thinks of the conclusions arrived at in arguing upon such false premises as we have given above, it is scarcely possible to feel surprised that so much popular ignorance should exist on the important subject we are considering. The surprise is not that popular opinion has gone so far wrong, but that it has not got farther in the wild mazes of such an intellectual wilderness. Some may think that it matters but little whether such erroneous notions popularly exist. But this is a mistaken view. The more correct one is that it is important, inasmuch as it influences beyond all doubt the relationship existing between agriculturists as a special or particular body, and the public generally,—influences it so that it tells in a too wide variety of circumstances, with which the farming community are unfortunately compelled to be well acquainted.

But the evil of such false notions so widely prevalent as those just noticed does not rest here. For, strange as it may appear to some, not a few farmers are themselves given to the same kind of reasoning. And the result is far from satisfactory, as but too many of them have found out to their cost. Money has been just as uselessly expended as if it had been thrown into the sea, in the vain endeavour to make increased produce of land and live stock alike exactly proportionate to the manures and the foods they have expended. They have, however, never found what they sought. The play has not been worth the candle. But wiser actions will come from more accurate reasoning. And Mr. Lawes has again done good service to farmers of the class now alluded to, by giving them the basis of such reasoning. When first the letter of Mr. Lawes appeared, there were many who foresaw that it would *not* be generally understood by many of those for whose benefit it was written, and that it would, moreover, be grossly misrepresented by those who care more for their own opinions than the real interest of the farmers. So also was it probable that Mr. Lawes himself would be made to take a position wholly unlike that which he occupies. All this, and more than this, has been justified by the

result. Many farmers have misunderstood what Mr. Lawes meant; the ‘party’ alluded to has misrepresented him in his views; and many have held him up as an enemy to agricultural progress. But truth is great and always prevails, and these things will come right. And in the interests of agriculture, we trust it will not be long before all farmers understand precisely what Mr. Lawes *has* said, and have their practice modified accordingly.

But while all that Mr. Lawes has said is absolutely correct, where the warning he gives is taken and acted upon, it will do a vast deal of good. It is to be hoped that many will not take the whole as an excuse for not carrying out ‘high farming’ at all. Such a result is by no means unlikely; indeed, in considering what human nature is, it is more than probable. This is not the time for anything to be advanced which will tend in this unfortunate direction; all the more if it be advanced by those in high position as scientific agriculturists. We may feel perfectly assured that Mr. Lawes did not forget this important fact; assured also that it was, in fact, the very reason why he issued words of warning at a time when warning was by many in every sense required.

There are, of course, always two sides to a question; and keeping out of view the wholly unscientific ones we have noticed, it is right to give place to the opinions of those who, upon scientific grounds, take exception, if not to the facts, at least to the conclusions of Mr. Lawes. Not a few, indeed it is maintained the great majority of practical agriculturists,—of course we mean those of the advanced or improving school,—believe that some of the views held by Mr. Lawes are far from correct, certainly, they say, not applicable to the general range of farm practice. Mr. Mechi, who after all may be taken as the exponent of the advanced school of practical farmers, although, oddly enough, he is not by many of them looked upon as a practical man at all, lost no time in taking notice of Mr. Lawes’ letter on high farming. The views therein expressed, of which we have only given one part, are calculated, Mr. Mechi maintains, to throw cold water on agricultural progress, which, he says, ‘is already far too slow;’—a truth which, taken generally, cannot, we think,

be gainsaid. Mr. Mechi also thinks Mr. Lawes has made a mistake in confining his criticism or theory to the 'mere matter of artificial manure *versus* artificial feeding-stuffs as a manurial power.'

Mr. Mechi, however, overlooks the fact that the argument of Mr. Lawes embraces feeding as well as manurial principles. That Mr. Lawes had this in view is, we think, obvious from the general tenor of his letter. That he did not specially point out the application of the principle he laid down to feeding practice, arose, doubtless, from the fact that the application would ultimately be made by his practical readers. One cannot touch upon every point within the limits of a letter.

The whole question is one involving, beyond a doubt, the gravest possible issues to the nation at large, and of course specially, and in the closest way, to the owners and occupiers of land. It is one, moreover, not to be considered from a single point of view, or to be disposed of in consequence of a single isolated fact in the various farms of the kingdom. He has taken little note of what agriculture really is—how many and how complicated, how baffling and often confusing, the various points which it involves are—who does not see that each particular case is to be fought out, so to say, on its own merits. Each one has, and must therefore consider, his own special case, and decide for himself. We have already alluded to the uncertain and often greatly puzzling elements with which in his practice, both in the cultivation of crops and in the breeding, rearing, and feeding of live stock, he has to deal. But this uncertainty should and will not, with well-balanced minds, act as an incentive to cease the making of inquiry, pursuing of investigation, and the close observing of facts and circumstances. Rather will it urge them to make new discoveries, to note and register new facts. Such puzzling elements are an incentive, and of the highest kind, to go forward. And of the science in which our readers are so much interested, this may safely be predicated. The more our agriculturists become highly educated, and the more they devote themselves to close, careful, and consistent observation of what is around them, thinking carefully as to what may be its outcome,—the useful, practical outcome,—the brighter

will become the prospects, the more solid, lasting, and beneficial, alike to themselves and the people, the actual position of the farming of Great Britain.

Stacking, Storing, and Saving of Grain Crops.—In the First Division we have described the most approved methods in use under this head, and the latest of them in an early section of this the last Division. As regards the stacking, we have shown, from what practical men have of late been doing in it, indications of their belief that some improvement at least can be made on it. Up to within a very recent period, the matter was supposed to be so simple that improvement could not well be effected. As regards the storing of the thrashed-out products of the stacks, there are also some who think that improvement is also required, and may not be so difficult of being arrived at. They think that the granary system of storing the grain in bulk or masses is not the best way to resist the ravages of the enemies which attack it. These work their will too often throughout the whole mass, although, of course, they begin at first to attack small portions. From this circumstance it would appear that the best course to be taken is to resist the enemy in detail or detachments; as in warfare, cutting off contingents which are coming up to aid in the general attack. Those who have devoted themselves to the subject believe that the 'underground tank' system, used for many generations back, if not, indeed, for centuries in foreign countries, contains the germ of, if it be not, indeed, the very system required. Those curious in the matter, by referring to a paper we wrote for the *Journal of Agriculture and the Transactions of the Highland Society of Scotland*, may find something which may at least be practically suggestive. Written some quarter of a century ago, it ran over all the points of the question as it then stood, describing the systems which had up to the time been proposed to secure them. The points are, of course, now as they were then; and so little has been done in the way of their practical application, that the schemes of that period comprise nearly all those of the present. Two or three systems have certainly been introduced, but calculated only for working on the large scale. But so eminently successful

have these been, that they show an unmistakable desire, on the part of those having grain to keep for varying periods, to have it so that they can keep it properly; that is, capable of resisting the attacks of damp, and also those of the various insect and animal pests to which grain stored in mass or bulk is so subjected.

It is more than matter of a mere passing regret that an enormous amount of valuable farm produce is lost to the country which might, or at all events ought to be saved, if saved it can be. There is no doubt that crops in many seasons up to a certain point are all that could be desired. These seasons have been in every respect propitious both for the filling or maturing of the grain, or for the growth of the grasses, and for their almost perfect ripening at the proper period. Yet after being cut a change of weather comes on, and produce, then so valuable, every day deteriorates from the almost incessant rains. And often in some seasons the high temperature which accompanies them causes the grain to sprout, etc. Here the average yield of the harvest fails, not from the adverse weather before but after cutting. In other seasons continuous rains are not experienced, but that kind of weather than which perhaps nothing more tries the temper and tests the patience of the farmer, and which is known as 'catching weather.' From one or other of these causes, or both combined, losses arise of a class altogether serious from the enormous amount of money they represent. We do not require to go farther back in our farming history than the present season, nor to consider any other crop save one, to prove this. That crop is the hay one. Now it is the simple statement of the fact, that millions only must be named in estimating the loss which farmers have this year (1879) sustained. And yet, as a rule, the grass when cut was excellent, in many districts of the highest value for hay-making. All that was wanted was continuously good weather to make it in. That weather in but a few, a very few districts, fell to the lot of the farmer. Grass cut in the finest condition lay for weeks till it was only fit for bedding purposes, or more fitted generally for the manure pit than for aught else.

Now it is not at all necessary to prove how

valuable in a national sense would have been any method by which all this stock of fine grass could have been made into good, sound hay. 'But it can't be done,' some readers will say, as so many practical men have said not seldom, and not without great decision. To which is this reply: It has been done; and what has been, can be done again. Moreover, it has been done not in a loose, perfunctory sort of way, but thoroughly; and so done that even out of most unpromising grass, which was pronounced almost hopelessly ruined for haymaking, hay has been made so sound and good that it has sold as first-class, naturally-got produce. But the objection may be made, and it is not a new one, that although it might be so—that the gold, so to say, was got out of the quartz, yet that it was got at such a cost as made even the gold dear. To which again the reply is favourable in a high degree. Not so; the hay, in place of being by the process produced at a cost prohibitive to its selling, was cheaply produced. Cheaply, taking only the actual expenditure and the time saved, not considering the high quality of the produce.

Although we have not, as a rule, embraced the description and illustration of farm machinery within the scope and scheme of our work, still we venture to make an exception to this by giving here a brief notice of a corn and hay drying or saving apparatus. And we do so, conceiving it to be a duty we owe to those of our readers who may not be well acquainted with the principles upon which this hay and grain saving machinery is based, and the easy way in which it is carried out. Further, because we have made it a special feature of our work to notice methods of utilizing the materials, etc. which are classed as 'waste,' and which under ordinary circumstances would prove really to be so. Treated properly, they become sources of income. And we believe that those who do utilize such waste materials value them in many cases possibly at a higher rate than those which come under a totally different class. The reason for this is not far to seek; they represent, to use a graphic phrase, 'so much found money.'

The machinery now to be described is that invented and patented by Mr. W. A. Gibbs of

Gillwell Park, Sewardstone, Chingford, Essex. The ultimate results, as now shown by the working of the most recent machines, have been realized at a great outlay. This not merely by an expenditure in cash equal to what is in reality a fortune, but of patience and perseverance under difficulties of no ordinary kind, and for which Mr. Gibbs deserves praise and success far higher and wider than we can give or command. The following description is part of a report on the system which we prepared some time ago for Mr. Gibbs. We adopt it here, as it embodies not only the mechanical features of the system, but the principle upon which it acts.

In describing the apparatus and the features which distinguish it, as I think, from all other forms of apparatus for drying artificially hitherto introduced, or with which I am acquainted, I shall begin, first, with a brief notice of its mechanical features and arrangements, as these have a close connection with its special characteristic, which shall last claim my attention.

With inventors of drying apparatus, it has always been difficult to keep the substances to be dried in motion. The object is to present continually changing positions to the action of the heated air, or to the surfaces by which or upon which the drying was effected. And a 'host of contrivances' has been introduced to overcome it, but with varying, and for the most part only comparative success. Many schemes have, however, totally failed.

'But if I was struck with one mechanical feature of your apparatus more than another,—and there are in it several noticeable or notable ones,—it was with the way in which you have overcome the difficulty of opening up the grass so as to present, as far as the closest examination of the working would permit of my seeing, every part of every fibre thoroughly to the drying medium.

'The value of your machine is obviously increased in proportion as it is able to operate upon grass of the most matted and wetted condition. To open up the matted grass in the first instance, you adopt a combination of mechanical movements capable of any degree of adjustment as to speed and angle, and of continuity or of intermittance of movement. This opening up

is effected by long spider-like tines or "stirrers," having each a long and a short leg, and placed upon a horizontal cranked shaft very much after the fashion of the three-throw pump. The tines thus placed at certain intervals on the shaft are loose, so as to give a certain amount of "play" from one side to the other, the value of which will be presently noticed.

'By the "reciprocating" horizontal movement given to the floor or table on which the grass rests, and along which the grass is propelled while being subjected to the drying influence. Whilst, therefore, the grass is—to use an appropriate farming phrase—"tedded" or opened out by the "lifting-tines," it is, at the same time, by reciprocating action of the floor, moved alternately for a short space, first in one direction, then in another. The combination of the two movements causes the grass to move along from the end at which the wet grass is fed on to the floor, to the other at which it is delivered in a dried condition. This progressive motion of the grass is further regulated by the peculiar action of the "tines," now to be noticed, and by the angle of the floor.

'This movement is perhaps one of the most novel and curious in its action yet introduced into mechanical motions. It is only recently that attention has been drawn to the value of the "diagonal" movement or oblique arrangement of certain parts of machines, which have either motion in themselves or are in relation to other parts which have. The adoption of this diagonal motion has in many instances overcome difficulties which were before almost insuperable, and is being daily more and more recognised for its value. I have for many years availed myself of every opportunity to draw attention to it, especially in connection with agricultural machines. I have already noticed that the tines are not fixed on the shaft, but the "boss" or eye which carries them, and which is connected to the shaft, has a certain amount of "play" given to it. The tines are connected to cranked parts formed on the shaft, the cranks being all placed at different angles, so that a very curious, almost grotesque movement is produced by the tines working in different directions, and with the diagonal movement to be now

noticed. By a very simple arrangement, as ingenious as it is effective, when the tines are lifted by the revolutions of the cranks, they finish off with a diagonal or side movement. This gives to the termination of the long legs, which are in contact with the grass, a movement in the direction of the delivering end of the machine. This, of course, causes the grass to move along the table on which it lies. I have called the tines "legs," and although the application I make of it is somewhat grotesque, it is in keeping with their movement; for this movement which they give to the grass possesses one of the capabilities of some legs, inasmuch as the grass is gently "kicked" forward by the tip, which we may call the "foot," of the long leg, as it receives its diagonal action. There is throughout the whole working system of the "tines" something so peculiar and novel as to give a "character" to the apparatus altogether its own.

'The result of the three motions is, that grass fed in at one end in the most tangled and matted condition in which it can be, or wet "half-made" hay, which is worse, comes out at the delivery end quite loose and opened up. I never yet saw the machine fail to do this, however hopeless appeared the work of "disentanglement." The action of the tines is peculiarly delicate, and yet forcible. Nor is the extreme simplicity of the mechanical movements and fittings, by which the whole is effected, the least noticeable feature of the apparatus. There is nothing of importance "to go wrong." Any labourer can work it, adjust its parts, and repair them instantly. No small advantages these in farming machinery, as those who are acquainted with it well know.

'I now come to the chief feature, the *drying part*. In all forms of drying apparatus the great difficulty has been to get a very high temperature by means of simple appliances, and inexpensive in working. Now in many processes air of a very high temperature is required, and in yours much of its success depends upon it. And I have grave doubts whether your apparatus, with all its ingenious arrangements, would have had any but a very partial success if it had depended upon the supply of hot air being obtained from any of the usual forms of apparatus. One can judge of the loss sustained in heating apparatuses by

comparing the temperature of the air produced by them with that of the products of combustion of a steam-engine furnace as they escape to the atmosphere, at or near to the damper; or, in fact, with those of the fuel used in the furnace of some heating or drying apparatus itself. The difference even in the best forms of steam-engine furnaces is indeed so great that the question arises, How does the loss arise? And yet (in spite of this knowledge of the high temperature of the air which escapes from the chimneys) very "roundabout" ways of obtaining at a dear and slow rate heated air of a *low* temperature have hitherto been invariably followed. No one apparently had thought of adopting the direct method of arresting the intensely heated products of the fuel-combustion before they pass, or are about to pass away, and use them for drying purposes.

'It remained for you boldly to grasp this idea, and though running, as it does, counter to all pre-established ideas, to carry it into effect, and with distinguished success. The only point which seems to go against the plan lies in the question, "Would not the soot and smoke spoil the substances to be dried?" You avoid this by using *smokeless fuel*, as coke or anthracite coal.

'Some, however, might object that the gases from the fuel would act prejudicially on the grass, and I confess that it was at first an objection which arose in my mind. But I am convinced, from what I saw of, and from the abundant evidence you gave me as to its working, that these fuel-gases have the effect rather of bringing out the fine, fresh, meadow-hay smell, than acting in getting rid of it. So marked is this influence, that the gases seem to restore this delicious odour to musty, wet hay, which only a farmer or one who has made hay knows is the best test of its superior quality.

'How to account for this effect may be difficult; but if I might hazard a conjecture,—for it is only an able chemist and vegetable physiologist who can do more than this,—it may arise from the influence of the sulphurous acid gas—not sulphuric acid vapour, a totally different thing, though the two are popularly supposed to be identical—present in the products of combustion. Sulphurous acid gas, it is well known, has a

potent action as a deodorizer, not only removing with unerring rapidity all bad smells, but also bringing out their original odour, and this so powerfully that they are often better than before being subjected to it. But, further, sulphurous acid gas is a powerful *antiseptic*—preservative of organic substances—from which latter property I am inclined to conjecture that hay treated by your process will be less subject to fermentation, and will keep longer, than hay not so treated.¹

‘But I have also previously stated that you drove this highly heated smokeless air through the grass in a peculiar direction. My estimate of the value of this may be wrong, or I may be *overvaluing* it; but I nevertheless look upon it as at least one of the many valuable points your apparatus possesses, and which makes it, as I think, such a singularly successful one. In brief, you here again adopt the diagonal principle. And in place of driving the air from the furnace at right angles to the line of motion of the table on which the grass lies, you have the hot-air ducts placed at an angle to this table, so that the *air is driven through the grass in a direction the same as that in which the grass moves along the table*. Now I would point out here one effect of this simple arrangement which constitutes, as I think, its chief value. By the action of the reciprocating table on which the hay or grass lies, as it is moved along and subjected to the heated-air currents, and the stirrers in conjunction with the tines, the grass gets opened out with its fibres placed longitudinally in the direction of the motion of the table. And as the angle of the hot-air ducts is also in this direction, the heated air is driven through the fibres the long way, in place of the short way, which it would be if the hot air was driven in the direction of right angles to the motion of the table, so that the grass is subjected to the hot air in the best possible position for obtaining the maximum of drying effect.

‘Concluding, then, my description of your

¹ ‘Professor Voelcker’s conclusions strongly confirm Mr. Burn’s conjecture. Both in his *Treatise on Hay* (reprinted from the *R. A. S. Journal*) and in his analysis of artificially-dried grass from Gillwell Park, this eminent chemist found a larger percentage of nutriment and a less percentage of woody fibre when grass is dried rapidly than in ordinary hay.’—Note by Mr. Gibbs.

machine or drying apparatus, I look upon it as combining a number of mechanical arrangements and one or two chemical principles, which renders it the most thoroughly successful of all the forms of apparatus I have yet seen, or which have as yet been introduced for the purpose of drying *farm produce*. And of those arrangements and principles, the most original is the plan of using as the drying medium the heated products of furnace combustion *directly, without the intervention of any obstacle between the air which is being heated and the fuel which heats it*. It is like getting a supply of high-pressure steam without the use of an expensive boiler. This, as I have stated already, is an entirely original mode of obtaining air heated to a very high temperature at a very cheap rate, and in the easiest way; and by using coke as the fuel, I apprehend that you obtain other advantages of a very valuable character.

‘I might, were it not that I fear to lengthen a letter already far too long,—for some reasons far too short, considering the importance of the subject to which it refers, on which I could say much more,—refer to other ingenious contrivances you have adopted; amongst others to the one by which you economize the heat of the furnace by “jacketing” its exterior surface, so that the air drawn in by the fan is raised considerably in temperature before it is driven into the grass. This has other advantages to which I cannot further allude.

‘I conclude by expressing my belief that there is a future of utility before, and a potentiality of application to a variety of purposes, in your apparatus, which will yet be availed of for many processes other than that for which it was originally designed. I wish heartily that this may be the case, and that you will shortly see its realization.’

At all times it is best to arrange work, much of which, from the necessities of the case, has to be done under circumstances which may cause loss both of time and material, that one may be prepared for the worst. But it is specially wise and forethoughtful, if one may coin a word for the nonce, to arrange for this when there are around us indications of a somewhat too certain character that this ‘worst’ will happen. Nearly

every season brings this before us very forcibly. But certainly the past few seasons, and specially the last season, have given enough to make the most careless thoughtful. And beyond all doubt it is difficult to gainsay the statement, that as there is nothing so valuable to a people as the food upon which it depends for existence, so there should be nothing so important to their interests as means by which such food should be so dealt with by all classes that none of it shall be wasted. In dealing with the food which our own fields produce, it is obvious that the first work of doing it, either carefully or carelessly, rests with the farmer. That too much of the dealing comes under the category of 'waste' is a matter unfortunately of too much notoriety. But while the farmer ought to exercise the utmost care in this vital department, and avail himself of all appliances by which this can best be ordered, we do not overlook this fact,—that the bad seasons, in which, while he may be not only willing to do, but actually does all that personal care and labour can do, are precisely those in which he has not the means to purchase these appliances, simply because the seasons are those of loss. Hence, in view of the importance of the department, it is to be hoped that something may be done to help him in this direction. Not spasmodically, but systematically, as by the adoption of the hiring-out system so specially successful in the case of thrashing machinery; or by the establishment of public companies, who themselves would act either as the suppliers of these appliances to such farmers as desired them for the season, or who would do the work at so much per acre. An extension of the work of such companies might lie in this direction. In many seasons, and this one in which we write (1879) offers but too many and too striking examples not to be put down on the black-letter calendar of farming history. There have been tons upon tons of produce so spoiled by long-continued rain, that under ordinary circumstances the produce was only fitted for the manure-heap. So far from being useful as food, it cannot now be made so for litter or bedding-down animals with. Yet such is the efficiency of the apparatus we have described, that what is thus worthless may be made highly valuable. Of this efficiency we

could, if need be, offer evidence in abundance. In the one district alone in which we write, so great a weight of spoiled produce lay on the hands of the disappointed, almost despairing farmers, that any one with a good 'dryer' would have netted a very handsome sum. Nor under such a system would the farmer be deprived of all its benefits. There are more ways than one by which this can be done. To name one only, the farmer may so make his bargain with the company, that a certain proportion of the resulting good produce may be given him at a certain moderate cost, covering merely that of working, wear and tear of the machinery, etc.

Of course, it would be considered as Utopian, altogether absurd, to suppose that some such scheme as this could be carried out: the Government to purchase or make at their works a goodly number of these machines, and to send them out to distressed districts where produce is lying rotting on the ground, the farmer hopelessly knowing that *he* can do nothing to save it. This produce is dried and handed over to the farmer good and sound. Would this be charity? paternal government or *mis*-government? Or would it be wiser, and a little more like the practical people we so pride ourselves to be, than one or other of the many ways in which Government help has been given in times of great distress?—help which, even though it may have in some cases done good, has in others left the recipients with their working morale much lowered, certainly not raised. There are some—shrewd business men withal—so silly as to think that there would be worse ways of giving Government grants for public works than by lending out—good interest could well be paid—sums for the making and hiring of machines fitted to save the food of the people, otherwise lost beyond 'recall.' It may look as if we had a purpose to serve in thus putting so strongly the case of this apparatus and the work it can do. It is surely unnecessary to say that we have no such purpose,—no other than that of doing what little we can to forward the general use of an apparatus so well fitted to do such vitally important work.

We have deemed it right, therefore, to be somewhat particular in our description of the

apparatus; and to make that more complete, and as giving an item or two of the evidence of what it has done, we append the following:—

‘ TO THE EDITOR OF THE “ FIELD.”

‘ SIR,—On Tuesday in last week I lent one of my hay-dryers to Mr. Ashcombe, of Sewardstone, a practical farmer of long experience and large “ holding.” He started it at 9 A.M., and in ten hours had dried and stacked the produce of 10 acres, estimated at one and a half loads per acre. This was unripe, rank, weedy grass, which had been mown about twelve days, and left on the swath quite untouched; it had been rained upon more or less every day, and the condition of the weather and the land prevented all possibility of dealing with it in the field. The drying process was carried on, without any instruction or guidance from me, by his own men, under the direction of his son, who had had no previous experience in the matter. The hay-dryer was wholly uncovered, and heavy showers fell at frequent intervals upon the hay as it was brought in from the field and whilst it was being dried; it was furthermore exposed to the same showers whilst being carted to the stack, which was also uncovered. I think it will be admitted that these conditions were as unfavourable as they well could be, and that this season is as bad as we are ever likely to have again. The cost of saving it thus is as follows:—

Engine and man, as hired . . .	£1 5 0
Hay-dryer and stoker, ditto . . .	1 10 0
Coal for engine—6 cwt. at 1s. . .	0 6 0
Coke for dryer—22 cwt. at 1s. . .	1 2 0
Two men to feed in and one to take away, at 8s. 6d.	0 10 6
Extra man in field to pitch . . .	0 3 6
Extra man in field reloading . . .	0 3 6
Extra carting—1s. per acre . . .	0 10 0
Total	£5 10 6

110s. for 10 acres—11s. per acre.

I am told this is rather less than it would have cost to make it in the field, even had that been possible; and by working a long harvest day of fifteen hours, this cost would be still further reduced to 8s. per acre. I have letters by every post from noblemen and gentlemen farmers saying that they have large quantities of hay, ranging

from 20 to 90 acres, cut and spoiling in the field, and all wanting to borrow hay-dryers; but what more can I do? . . .—Yours very truly,

‘ W. A. GIBBS.

‘ GILLWELL PARK, CHINGFORD, ESSEX, July 16.

‘ P.S.—The sole remaining objection urged against the general adoption of this process is that it would not be wanted in fair average seasons. Against this is the concurrent testimony of all *large* hay-farmers, who tell me that in *every* season they lose a pound or thirty shillings a load by the inferior quality of one or two of their stacks, averaging fifty loads each; here, then, is from £50 to £100 to be saved as interest on the £350 first outlay. And when it is remembered that this same machine will save all damage to the corn crops, and finally to the “ aftermath,” it will be admitted that there are very few seasons indeed in which it would not pay for its possession.

‘ This form of hay-dryer has been adopted by the Duke of Sutherland, Sir G. W. Broke Middleton, Sir William Bagge, H. Strickland Constable, Esq., R. H. Ainsworth, Esq., and is in constant use by Messrs. East & Co. Similar machines have already been ordered by the Duke of Manchester, Lord Ashburton, Colonel Buchanan, J.P., and G. F. Fuller, Esq.’

The Administrative Departments of the Property.—Since writing the Division in the body of the work under this head (see Division V.; also Introduction, chaps. i. and ii.), sundry suggestions have come to us as to additions which would render it more complete, and therefore more useful. Amongst others, one has been pressed upon us with all the authority due to high position and a thorough knowledge of the wants of agriculture. This is a full exposition of the education and practical training of the various parties concerned in or connected practically with the working of the estate. While readily conceding the value of details in this department, the limits of the work will prevent our carrying out this suggestion, however willing we are to do so. The line of limit must be drawn at some point, and this we have at last reached. But the scheme and scope of the work, no less than

its limits, prevent this in itself valuable suggestion being carried out in its entirety. Moreover, the general subject of the primary education of the various parties connected with an estate has met with the fullest and the ablest discussion in works in which they are in every sense appropriately dealt with, and to these we refer the reader. For some information on this subject we may be permitted to refer to our little volume on the *Outlines of Landed Estate Management*, and also to a forthcoming work, now at press, on the subject of *Outlines of Farm Management, and the Organization of Farm Labour, the Farm-house and Cottage*. In the latter the whole subject will be found detailed. Both works are published by the Messrs. Crosby Lockwood & Co., London. What we purpose now to give, so far as the various parties employed on an estate are concerned, is not an exhaustive statement of all the details of their preliminary education and practical training, but rather, on the understanding that the various parties have already had these essentials, to give if possible a fresh aspect to points in their practice which may be useful to them; to draw again to recollection sundry points of importance which, under the pressure of business, they may have almost forgotten, or at least frequently overlooked; to bring forward prominently points which the ever aggressive and advancing spirit of the times has given rise to, and which are likely to exercise an important influence upon the future of estate management as a whole and of farming in detail; and finally and chiefly, to point out the new relationships, brought about by the new circumstances of the times, which exist between the various parties employed and the work which they have to do,—relationships in many, perhaps the majority of instances, of a character wholly different from those of former times, or of times rapidly passing away, and which owe their existence to a wide variety of causes. Many of those points have been already discussed, and fully so, in the text; and what has been deemed essential as supplementary has been given in the present Division. Of those points which remain to be noticed in carrying out the suggestion alluded to at the beginning of this paragraph, the first place is given to a

notice of some closely connected with the acquirements of estate agents. This will consist chiefly of a brief consideration of the relationships to which we have just alluded as now existing, or almost certain soon to exist, between those interested in agriculture on the one hand, in their various positions of landlords, tenants, and labourers, and the general public on the other. It is not easy to discuss several of these points without in some way coming across what some call prejudices, but which we prefer to believe are principles. Those who maintain them conceive them to be of the highest importance. We shall therefore endeavour to give them all due and candid consideration.

Agents for the Property.—It is not too much to say that almost all that affects not merely the material interests of the estate, but the welfare of those who make their living out of it, originates with and is carried out by the *Agent*. The connection which exists between the various parties employed, from the rich tenant farmer, who in many respects maintains a social position but very little different, so far as its external aspects are concerned, from his landlord, down to the poorest labourer, is such that conflicting interests are sure to arise. It would be vain to hope that this will ever be much different from what it is now, despite all that is said as to the march of material improvement and increase of intellectual knowledge. For human nature is not likely to be changed, and what has been in the days of old, and is now, is pretty sure to the end of time to be.

Those conflicting interests, and those specially individual, result from a social system which more now than ever, notwithstanding all that has been said to the contrary, compels each one amongst us, like 'Hal o' the Wynd' in the *Fair Maid of Perth*, 'to fight for his own hand.' It need not, therefore, be wondered at that the agent of the estate is not, as a rule, the most popular person connected with it. With no breach of charity, we may, indeed, go farther, and say that he is the most unpopular man in it. This fact is but too well known, however much it is to be deplored. If one seeks for the reason of it, one is met with the very vaguest of statements and conjectures. But it

is not difficult to find when looked for; and when found, it will, we think, be seen that the agent, as a rule, is in this matter unfairly treated. We do not say designedly, but unfortunately, and this because too often unthinkingly so. It is good for us, in discussing the merits of an individual, to project, or try to project ourselves into the position he occupies. If this were done in the case in point, we venture to say that the opinion generally held would be very materially and favourably altered. We should find that much of the unpopularity of the agent arises not so much from what he ought to do in the true interests of the estate, and all concerned in it, but from what every one on the estate thinks he ought to do. The two are very different, although they are, as a rule, considered to be one and the same thing.

If this view of the case were considered in the case of agents, it would be found, in the great majority of instances, that his position is a most difficult one to maintain, and to maintain with the result of pleasing all parties, who do not know all the circumstances of every case. It is also possible, we suspect it is more than possible, that much of the unpopularity of many agents arises from the fact that they belong to the legal profession. We need not, of course, disclaim having any prejudice against lawyers. Popular opinion is not favourable to them; it remembers too vividly all the evils which the unprincipled amongst them have done, but it forgets too easily the vast services those—and they are the great majority—who are at once conscientious and able have done to the community.

No one who knew the conditions of the case would ever dream of calling in question the abilities of the agents of the latter class. These abilities are as a rule of the highest, and those who know them best, know best their wide and comprehensive range. Even with all their ability, the wonder felt by those who know them is not that they do so many things well, but that they can do many of them at all. But it is nothing derogatory to one who is able in one department, which he has made his own, to be told that he is not able in another which is not his—that, in fact, he knows nothing about it.

No man of common sense would feel that such a charge detracted in any way from his value in his own department. Quite the reverse result would be the case so far as those connected with him in business were concerned; for the less pretension he made as to his knowledge of them, the more highly would he as a business man be esteemed.

Now this lies at the root of the prejudice, which prevails amongst so many farmers, as to legal gentlemen being agents or managers of estates. They are not prejudices, as such are called, but real objections founded upon what the farmers deem to be a sound principle, and one which regulates all well-conducted business. And farming, they say, is no exception to this rule—the very last, indeed, fitted to form an exception if one were needed. And they feel that they can scarcely with reason be blamed for conceiving that their business interests cannot possibly be managed, certainly not managed well, by gentlemen who plainly confess that they do not profess to know what farming is in all its details. In other departments of business, they argue, it would certainly not be considered a fair passport to the conduct of its details if at the outset the applicant confessed that he did not know what those details were; or, knowing them but slightly, could not see them carried out efficiently by others. This is, however, or may be taken as a somewhat exaggerated view of the real position occupied by agents who belong to the legal profession. For amongst their varied accomplishments, it has to be confessed that they not seldom number a knowledge of agriculture which surprises many, even of those practical farmers with whom the agents are not as agents favourites. Landlords as a rule are fairly alive to their own interests, and great advantages, therefore, must have arisen, it may be presumed, from a system so long and so widely adopted. Nor is it very difficult to make out many reasons in favour of the system, under circumstances in which there is so much to be done requiring a sound knowledge of law. And assuredly lawyers have as a body, by their knowledge of human nature, their habits of observation, their general ‘quickness of wit,’ and their special knowledge of commercial law, made out on the whole a splendid right to the title by

which they are more generally known than by any other, that of 'men of business.' And it may well be argued by those who employ them on estates, 'Surely, where there is so much business to be done, we do rightly in employing "men of business."' Even in a jocular remark like this there may be much serious wisdom.

But, as we have said, the prejudice against agents of this class exists; and it is a prejudice which exercises beyond doubt an influence of one kind or another on the relationship existing between agents and farmers. It is illustrated by the other equally well-known fact, that the most popular agents on estates are those gentlemen who are in fact farmers by profession—'one of themselves,' as the farmers phrase it. That much of the prejudice can be overcome there is no doubt, and overcome it is in many instances by admirable tact, indomitable good nature, right feeling, and pluck; and the possession of this latter attribute alone tends mightily to make a man a favourite. But there is also no doubt that the prejudice would be more quickly and generally overcome, if agents as a body were known to have made farming a special branch of their study. And it might be well worthy of consideration whether a special 'chair' in our universities should be created, by which legal gentlemen could add to their acquirements those connected with estate management. There are even now, however, many sources from which this knowledge could be drawn. There are many gentlemen who, following the legal profession, have also a decided taste for rural work. These might do worse things than add to their strictly professional study that which would qualify them, in a specially practical sense, for taking the responsible and influential position of estate agent.

Those who now occupy it live in times which give abundant reason for at least anticipating great changes in all matters connected with land. And it will assuredly be nothing lost, where agents have hitherto neglected it, to begin to consider in what direction these changes are likely to be, and how best they can be made in the true interests of all concerned. The relationship between the several parties connected with estates also deserves, and indeed by the force of circum-

stances demands, attention. The mere knowledge on the part of farmers, etc., that some points are being considered by the agent, and this with an earnest desire to carry out changes which are suggested and desired by many, is almost certain to act beneficially. There is nothing in social and business relationships tending so immediately and strongly to raise bitter feelings, which bode no good to any of the parties concerned, as the feeling on one side that the other is absolutely indifferent. The majority of men will bear disappointment cheerfully, at least they will take it quietly, when they know that their claims have been at all events considered; and with still more of contentment if the reasons are given why the claims have not been conceded.

Changes in landed property are likely to be made. They are, at all events, loudly and widely demanded. It cannot be lost time to consider whether they should be conceded. Concession may by some be considered a loss; but, on the one hand, time may prove, and that speedily, that it has in some cases at least been a gain; and certain considerations, on the other, may prove to the satisfaction of both that concession would not be in the interest of either.

Take, for example, the question of 'restrictions in farm cropping.' This for long has been discussed, but the peculiar circumstances of the times have given it such very great prominence that everything points to the necessity of having it decided one way or another. This, then, is one of the subjects which will repay the careful thought of the high class of estate agents we have chiefly considered. For even if the demand for freedom of cropping be considered as too much to grant, 'covenants' or 'contracts' will still be required, and on some points of these change may be deemed desirable.

Farm Managers.—As to the education of the farm manager, much could be here said if the scope of the work admitted. To all the theoretical knowledge derived from a sound scholastic and a judicious course of study, either when taking courses of scientific lectures or when attending a university, there should be added as an essential a thorough practical acquaintance with farming and estate management in all its branches. On these points we direct attention to some re-

marks given farther on, when considering the education of the farm bailiff, a manager of a lower grade than the manager in chief.

But in addition to those elements of education which are of course essential to the farm manager, there are other departments the careful study of which is not less essential; none the less so that they have hitherto been considered as lying quite beyond the limits of what is considered to be estate and farm management. While, however, circumstances have been for long gradually drawing attention to their importance, it is only of late that they have assumed that position which places it beyond all doubt that they are in reality essential factors in solving the many problems connected with the land.

The general condition of the labourer, his cottage accommodation, his wages, mode of doing his work, and his recreations, using this term in its widest sense as comprising all concerned with the employment of his spare time, require close attention. These were not so long ago almost universally looked upon as wholly social and moral, not practical questions affecting and affected by the interests of the estate as a paying investment. There are others immediately connected with the estate, comprising such as leases, tenant-right, freedom of cropping, compensation for improvements, and small farms. To all these the most earnest attention is directed. And the circumstances too obvious to all connected with the land question now render some solution of the various questions connected with these points a matter of primary necessity. They cannot now be placed aside. The farm manager proper, with his previous practical education, will come to the consideration of these questions fully impressed with their importance as thoroughly practical elements of farming.

Farm Bailiffs.—Dwelling for a very brief space on the farm managers of a lower status, those generally designated as *farm bailiffs*, it is only necessary to state that a much higher range of qualifications is now, under the changed and rapidly changing circumstances of agriculture, demanded from them than formerly. In addition to what has been already given, the following from a good authority will be useful. Some, if not much of it, applies to the education of all

those connected with the estate, either as farm managers or as farmers:—

‘A good plain education is the first requisite for a farm manager. He should be well versed in figures, so as to be able to keep accounts correctly. A well-kept book is something to be relied on, but a badly-kept one is worse than none, and can only tend to render confusion worse confounded. He should have a knowledge of land-surveying, levelling, and making plans and sections. I do think he should have a session at college, to teach him something of natural philosophy and agricultural chemistry. A little knowledge of farriery would also be useful to him. With all these at his finger ends, the theoretical part of his education should be pretty complete. The next, and I think more important part, is a good sound practice; and before he can acquire that, he should have several years under the best stock farmers in the country, and the like period under an improving farmer, where all sorts of the most modern improvements in agriculture are carried on. I do not mean him to serve those apprenticeships, as many young farmers do, without participating in the labour, but to learn to work properly at every branch of the business, and to have his hands well hardened with the plough and the dung-graip. He can never know the why and the what for, unless he can do the thing himself. With such a course of theoretical and practical training, well picked up, the young farm manager may be considered sufficiently acquainted with his business. But his practical knowledge should be before his theoretical; a third of the latter to two-thirds of the former would no doubt make an excellent proportion. Beyond what is above mentioned, his further qualifications need be few and simple. He should be honest, steady, civil, and obliging, and scrupulously punctual to all his appointments—even-tempered and firm to his purpose—seldom in the way of changing his plans. He should also be a man with a natural turn for business in marketing all kinds of farm produce; and last, although not least, should have a due share of that valuable commodity, common sense.

‘The powers with which a steward should be entrusted should always depend on the integrity

and qualifications of the man, which, with the training already referred to, ought to be of a pretty high cast, unless he happens to belong to the class of scholars spoken of by the Scottish bard, "wha gang in stirks and come oot asses." And in that case his powers should be limited indeed. It is quite clear, however, that no farm manager, even with good abilities, can conduct his business with propriety without a wide latitude of discretionary power. The safest way, perhaps, is to limit him at first, and give him powers by degrees, as his merits deserve.

'Most proprietors farm partly for the convenience of their family, and it is the duty of the manager to see that convenience attended to, in so far as the farm produce is concerned. Hay, corn, meal, milk, mutton, pork, and poultry, with other little odds and ends, are always wanted in a gentleman's establishment; and it is part of the manager's duty to supply them, when wanted, of the best sorts. Everything about the farm should be kept neat and in good repair, the roads frequently cleaned, and the farmyard swept with a broom twice every week.'

The Farmer.—As to the education of the *Farmer*, a treatise could be written, as, indeed, more than one has been. So numerous are the points it involves, that to these we must refer the reader. Several of the remarks we have just given in connection with agents, etc., are obviously applicable to farmers. But to those given, we would merely add a few sentences on one or two points of some importance. Those are chiefly connected with the financial department of the farmer's business, and specially on the importance of systematically keeping his books, and on capital, a department which has not as yet received the wide attention which its importance demands. That a knowledge of 'accounts' or of 'book-keeping' has been imparted to the young farmer in the course of his preliminary education is a matter of course. In common language, when he finishes that education he is said to be familiar with accounts. In one sense, and that too much of the scholastic, this may be and is likely in nearly every case to be true. But it is a familiarity which concerns itself more with a theory than with a practice; as a rule, certainly not a familiarity with the sound principles which

underlie all useful practice. Few, indeed, comparatively of those at present in business, for example, have a clear knowledge of a complete system of accounts as an essential feature of a soundly conducted business. At least we may judge of this from the perfunctory way in which the accounts of the farm are kept. For, as we shall see, it is not merely that good account-keeping enables farmers to see at any time precisely 'how they stand;' but it brings other advantages, of a kind which, if more generally thought of, would be secured by the adoption of a well-conducted system.

Many consider that all that is necessary to be done in this way is 'lumping,' as they call it, the receipts together on one side of the account, and the expenditure on the other, and striking the balance between them, and are satisfied or dissatisfied according as this rough-and-ready process shows a profit or a loss. But a very little consideration will show that this system is not that calculated to give what may be called, if the phrase be allowable, a plan or chart of the farmer's position. He should be able to tell precisely the condition of any one department of his farm, so that by making a comparison of one season with another, should it happen that there was a deficiency in its produce, he would be able to decide what should be done to bring that produce up to the paying point. Every department should have its own particular position in his books. Thus a very brief inspection of the whole will enable him to take out any particular one and see precisely the amount expended in connection with it; the opposite side showing the cash he has received for produce or stock sold, or the valuation of that which remains still on hand. But he should not be satisfied with this general statement of the condition of leading departments, such as crops, live stock, etc. He should have the system so complete, that the subdivisions or classes of each department shall have their accounts also stated with the like precision. Thus, for example, it is not enough that he 'lumps' stock just simply as such, and be satisfied with the mere fact that the disbursements are so much, and expenditure so much. He ought, for example, to know precisely what his fattening stock have yielded as against the

amount which has been expended on their account. So also with all the other classes of live stock he has to do with. In addition to detailed accounts of the separate classes, it would be well if another account was opened for stock as a whole. This should begin with the value of the animals at the commencement of his business, with columns for additions made to it, a fair valuation of such food as the farm itself has produced (which, of course, will be deducted from the crop or produce account or balance-sheet), with cash given for purchased food, and for such other items of expenditure as may have been required. On the other side of the account will be shown the credit for sales of animals, for milk and dairy produce sold off the farm, with a fair valuation of that consumed by the family; together with a like valuation of the stock on hand. Nor will the results be less satisfying should the farmer, not content with the forms of accounts thus briefly described, add another giving a summary of the results of what may be called the 'daily work-tables' of each department of live stock. Thus, to take the dairy department, this work-table will show in detail what may be called the individual history of each cow, including the feeding system employed. This would have its own stall indicated by its own familiar name, and also by its special number, and the daily produce of which is duly registered by the foreman. The same detailed style of keeping the accounts of the arable part of the farm should be adopted, each field having its own particular history registered, the cost of its working, and the value of its produce. So, in like manner, all the departments should be gone through. And if it be objected that such an elaborate system of account-keeping would involve labour which no farmer could be expected to give, it may be met by the statement that, if farming is to be conducted as a business, this account-keeping is just as much a part of its work as that of any of the departments which are looked upon as those of pure farming. For it would be just as reasonable to hear a merchant complain of having his various books to keep, in which every department, even the most minute, has its place. Now this work every one expects a merchant to do, otherwise he would be held to

be anything but a good business man. Just as reasonable would it be for a farmer to object to keeping his accounts in the same methodical way upon the ground that doing so was troublesome.

But in addition to the mental ease and satisfaction given to the farmer by having a system of accounts so elaborated that he knows precisely his relation to the outside public, from whom he derives his revenue, and to whom he may or may not be indebted, we maintain this,—that farming in all its details, and in the highest sense of the term, cannot be carried out satisfactorily without this detailed system of account-keeping, which gives him the history of each department and each separate section of it. By this system he knows at once where faults exist, through losses incurred or through deficiencies in produce, and is thus enabled to decide how best to overcome and remedy them. It acts, in point of fact, as an incentive to him to make the most of his farm. For it may be taken as an axiom, that the more intimately one is acquainted with the history, so to say, of each department of his business, the more likely is he to take that practical interest in its conduct and management which will best tend to bring about its highest pecuniary results. Indeed, if there be one business more than another which demands a carefully detailed system of account-keeping, we should say it is that of farming. Some kinds of businesses there are which have only one department, the details of which are also simple, so that account-keeping is reduced to a matter of comparative simplicity. But farming, at least in several of its classes, may be said to be the conduct of various kinds of business constituting a general whole; each business requiring its own particular account, while the results of the whole are summed up in a general balance-sheet.

In conclusion, we would note that the family and personal accounts should not be omitted. There are many who think these unnecessary, satisfying themselves with the general statement, 'If we have had them, and used them, and paid for them, there is no more to be said.' But this should not, and will not satisfy any one who takes a right view of the matter. Indeed, it is more than probable that carelessness in this

department is the very rock on which many split. How often do we hear the remark made, 'I have received a deal of money this year, but I can scarcely tell where it is gone to!' And, blame being often attached to members of the family not deserving of it, unpleasantness is likely to be the result. We have known farmers' wives making every effort to be economical, and yet to be blamed for an expenditure over which they had not the slightest control. To an ignorance of where the money goes which he receives, how and in what departments it has been expended, not a few farmers have had to attribute their ruin. Lastly, to meet the objection as to the trouble which account-keeping involves, we could say, for the comfort of the farmer, that it is surprising how small an amount of time is actually required to keep even the most elaborate system of accounts. When the work is done with unvarying punctuality, the entry of each item does not involve much labour, and the items as a whole are not very numerous, so that a few minutes are only required for their due entry. Moreover, by a very little teaching, the overseers or foremen of the different departments can be taught to make the several entries in their books in such fashion that the farmer will only have the general results of each day or other period of time to look over and to enter in their proper place.

On the value of keeping a system of accounts as part of the organization of farm labour, the following brief remarks by Mr. C. O. Perkins in a paper on the *Elements of Success* (in farming), published in the fifteenth annual report of the Board of Agriculture of Massachusetts, U.S., are so pertinent that we give them here:—'I think an accurate account kept by the farmer of all farm transactions would put him on a track of thinking which would do more to raise the standard of farming than any other one thing. You may say you cannot afford to go through all that process. Allow me to say, there is not a farmer in this house who can better spend ten minutes of each day, and one whole day at the end of the year, than in just such business. Just try it, and at the end of the year compare notes; review your accounts, and see which pays the best; see where you would have saved money where you did not; see where you have spent

money that you need not. Farmers have no business to be guessing at conclusions all their lives. There is an old adage, that "figures won't lie." One reason why farmers are so little inclined to keep accounts is, because they have not been educated to it. Book-keeping should be a branch taught in all our district schools. Its study would be vastly more useful than the study of algebra and higher mathematics. To be able to add, subtract, multiply, and divide rapidly and correctly, and a knowledge of keeping accounts, together with a knowledge of fractions, is of vast importance to the practical man.'

The Capital of the Farm.—This is a subject so fertile of points for consideration that a treatise could be written upon it, and yet, even if fairly voluminous, it would scarcely exhaust its discussion. Nor need this be matter of surprise. For capital is the very foundation of all farming, as it is of all other business. Yet trite as this saying is, it would seem to be often overlooked, immensely important as are the interests involved in it. For not seldom are opinions held which run counter to it, as if farming was a business unlike other kinds, and could dispense with capital; or, greatly dispensing with it, find ways and means—other than the true ones—of going on, and that successfully. What these ways and means are, but too many know to their cost. The system of banking is now so widely extended, that even the remotest of our rural districts are brought within its influence. No doubt this has its advantages, and most valuable are they for farmers who carry on their business on thoroughly sound principles. But it has its disadvantages, if in nothing else, in this,—in frequently indoctrinating young or restless farmers with the idea that the bank is a never-failing resource in time of need, when cash is scarce, and credit in the outside world not very readily, if at all, available. This may, and does, arise from the facility with which at an earlier stage of their career such farmers may have received an 'advance' from the bank manager. To a thoroughly prudent man 'advance' is often essential, and it is always valuable if it be obtained under legitimate circumstances. For it by no means follows, because an 'advance' is required by a prudent man, that he is therefore without means, and only gets the advance to

stave ruin off for a time. The bank manager knows that this is not the case, and knowing it, advances. It is very different, however, in the case of the young or careless farmer, who, at the time when he gets his advance, does not act wisely and use it like the prudent man; but who, either from reckless indifference, ignorance of his true position,—which a thorough system of accounts would have given him a knowledge of,—or from the lack of careful business habits, finding himself soon again in need, fancies that he has only to apply again to the bank manager for help in order to obtain it. Fortunate for him—certainly for others with whom he is connected—should the bank manager refuse the advance. But it is not always easy to predict what bank managers will do, or to know the reasons why they do; so that an advance may again be made, and that even be followed up by other advances. The end is easy to foresee: there can be only one, the fatal terminus of the road to ruin, which *this* system of bank advances is in reality. It will be well if the young farmer early learns the lesson which the proverb teaches, ‘He who goes a-borrowing, goes a-sorrowing.’ It may not be so at first, but assuredly he will find that visits to the bank manager’s room will not always be pleasant. Thousands can date their ruin from the first pleasant visit they have made to it.

No business can be begun and carried on without capital. Capital is needed, and capital must be had. The young farmer without it of his own, may, if of the ‘right stuff to make a successful man of business,’ be taken in hand by some rich friend. And many a fortune has been made by timely help of this kind. But wherever and however obtained, cash must be had. If, from this source or from sources of his own, the young farmer finds himself possessed of a capital but only of moderate extent, there are two ways of using it. Only one of these can lead to ultimate success. This way is to be content with such a small farm that the amount of his capital will not only stock it well, but leave him a surplus, which he will find as useful as in fact it is absolutely essential in carrying its work out. This brings with it another advantage—he will be better able to farm the small holding thoroughly than if he was perpetually harassed

through want of means. For a small acreage thoroughly worked pays infinitely better than a larger one half worked. The usual estimated amount of capital required for farming land on the mixed husbandry system is £10 to the acre. But this will better be exceeded than reduced, which, of course, is in the supposed case done by having fewer acres to begin with. The true system is to begin with small things, and keep on adding or extending as God blesses one’s efforts with success. It is fashionable to sneer at the old-fashioned ways of our forefathers. They passed on their way, ‘*creeping* up the hill of difficulty;’ but always up, rarely *falling* down. The sooner this fashion is revived, the better for us as a people. It is, after all, easier to ascend than descend. We need no well-known classic saying to remind us of this. One gains in self-respect by going up, loses it by going down; and many a farmer has bitter reason to regret that he began in too large a way. And so beginning, finding it a hard matter to come down and to show his neighbours that his castle was but a child’s card-built house after all, he began to prop it up by the system of borrowing, getting advances, which ended, as it could only end, in his ruin. One word more. Limited capital, however, will require unlimited labour and painstaking care. This is too often overlooked, and with disastrous results. No ‘sleep to the eyes, no slumber to the eyelids,’ when work is to be done; and endless work his farm will find him. We should be the last to deprecate recreation. But this must, with the beginner with small capital, be legitimate; and it is not uncharitable to say that much, too much of the recreation of the present day is not so. It may not be wild, reckless dissipation, but if it be any one of the ways, or more than one of them, in which now-a-days young men spend their time in amusement, though morally not wrong, it will be none the less illegitimate. It is hard to do, and duty is always hard, but success can only be gained by the patient, plodding system of farming practised by our forefathers, so sneered at by many of us their sons. Such a hard-working life brings with it solid satisfaction, secures friends, and, better than all, the friendship with oneself—the friendship founded on self-respect. We should perhaps hear less of

the 'badness of the times,' certainly of fewer individual losses and failures, if the good system of carrying on business we have briefly advocated was more in favour than in many quarters it is.

Specialty in Farming.—This is in close connection with the subjects we have been considering. The system of mixed husbandry farming is, as our readers know, the most extensive, and is largely carried out when the locality, soil, etc. are favourable, if for no other reason than that it is an unusually safe one, in so far that it does not risk the success of the season upon one branch only. As a system it embraces nearly every branch of farming; it takes up, under the head of arable culture, the cultivation of almost every crop grown, the management of pastures, and meadow-grass fields; and under the head of live stock, the rearing of nearly all classes of animals, the breeding, rearing, and fattening of cattle, and sheep husbandry; and in addition to all those departments, that of dairy farming. All these involve, of necessity, not only continual supervision and assiduous care, but the possession of a wide range, not only of practical but of theoretical knowledge. So that it has been questioned whether any one man can find time to acquire these, and at the same time carry on his business to produce the maximum of results with the minimum of time, cost, and labour. At least this is the view taken by many, and it finds expression in the remark of a writer who holds that greater progress would be made in farming, if farmers followed the system carried out in other professions,—that is, of each one having a '*specialty*,' devoting himself to one branch only, or at least having not quite so many branches to attend to.

There certainly does appear to be a good deal of sound business common sense in this view of the matter, for a man is much more likely to excel in any department when he devotes himself exclusively to its practice. He gains a wide range of experience, and acquires a wide variety of facts and circumstances, all of a special kind. These he could not possibly have secured under a general system, in which he would be called away from the duties of one department to undertake those of another. In the special system he may carry his work up to the

highest point of its efficiency. As the writer we have alluded to says, 'farming is a comprehensive term, including many distinct pursuits,' the majority of which we have already named. 'Now the trouble with many,' he continues, 'I might say with most farmers is, they undertake to ride too many horses at once. As science and civilisation advance, there comes a greater division of labour, and consequently greater excellence. . . . If farmers desire to keep up with the times, they must study this division of labour, and by concentrating their energies on some specific branch rise to eminence. We have among us some notable examples of the success attainable by this concentration of effort.' Thus a young farmer is named by this writer, who, making a specialty of breeding stock, and though young, scarcely out of his teens, has made a reputation so high that he stands almost, if not quite at the head of the breeders of shorthorns. So well bred is his stock, that a single animal is worth more than a large herd of the common grade. 'We do not all have the facilities for special farming which this young farmer possesses, but we all have taste, which inclines us to one branch of farming more than another; and I am sure that if we cultivate this taste, and bend our energies in this one direction, we shall have more satisfaction in ourselves, and consequently do more good to society, and stand higher in the estimation of our fellow-men.' Our readers will be able to recollect many similar instances of success in specialty farming, even in departments not generally attended to or considered money-making ones. Thus we know of several who have gained a wide reputation and secured a profitable return by attending to the breeding and rearing of pigs, those despised Ishmaelites of the farmyard; another, out of the still more despised poultry; and so on, for instances can be extended *ad infinitum*. And those men were practical farmers of high reputation, capable of managing successfully any system.

This writer, however, while advocating a system which certainly carries much that is suggestive with it, does not insist upon exclusive attention to one branch of farming, which, as he says, 'would be like putting one's eggs all in one basket.' He merely insists upon the necessity of

having at least one leading branch, to which all others are to be subservient, so that, with common skill and industry, we may excel in this one branch, and make for ourselves a name and a place among our fellow-men. As tending considerably towards the attainment of success in farming, the same writer draws attention to the importance of the farmer taking a *thorough pride in his profession*. There is a great deal in this, more, in fact, than many would seem to think of, for they act as if they were 'ashamed of their business,' which had something degrading about it. Why this should be so it is difficult to understand, for, to our mind, farming, as it is the oldest, is the noblest of all pursuits, bringing as it does one in closer contact, so to say, with the great Creator of all things, than any other; raising thoughts and feelings in all well-regulated minds calculated to elevate and dignify. Any farmer ashamed of his business may, as our author well remarks, 'expect to be an inferior one, and to hold an inferior position everywhere.' A man is valued in society much as he contributes to the good of society and excels in his calling; and in order to the attainment of excellence in any occupation, he must have a love for it. Enthusiasm may sometimes lead to failure, but never to inferiority. 'We cannot all be the head of our profession, but it rests with ourselves whether we wish to rise towards that position or remain satisfied with a much lower one.' These are weighty points, which are well worthy of the careful consideration of practical farmers.

Present Position and Future Prospects of Farming — Pressing Questions connected with Landed Estate Management.—We have thus glanced at a few of the points connected with the education and practical training of the principal parties connected with the management and working of the estate. What has now been given, taken in conjunction with what will be found in the main body of the work (Division V. chap. i.), must be considered more in the way of suggestions on the various points than as their exhaustive treatment. This, for the reasons we have stated, does not come within the scope of this work. In what we have given we have endeavoured to draw special attention to some points we deem of

considerable importance, which in many cases have had comparatively little attention bestowed on them. And, as forming the conclusion of our labours, which, if arduous, have been pleasant withal, we have now some remarks to offer on the various important points of the subjects named at the head of this paragraph.

Although not thought of by many, it is nevertheless true that there are peculiar circumstances attendant upon the way in which farmers are placed in relation to the other classes of the community. This relation in its outcome, and the terms in which this is given expression to by perhaps one class of the general public more than another, is by no means complimentary to the farmer. That which may with all safety be called a 'school,'—accepting one of the terms of a phraseology not the least striking of the characteristics of the times we live in,—has taken farming and farmers, among other things, within its care. Under its teachings and influence, farming and all connected with it has been represented to the general community as a thing of small account. In reckoning up the resources, and in estimating the productive or money-making value and powers of the nation, agriculture is by this class placed in a wretchedly low position. This statement may be considered by many as the merely prejudiced view of those who hold, as may be said, exaggerated views of farming as a pursuit. But it needs only to be corrected or tested by the results of observation, and by those of published opinion through press or platform. And this we may with all becoming deference venture to say, that those who doubt its perfect accuracy, or more plainly aver that it is not the truth, must have lived to little purpose, must have exercised their powers of observation and of hearing in a very loose, ineffective way, if they have not had abundant evidence afforded them of the low estimation in which farming is held by those classes concerned in other callings. Is it or is it not the fact, that on 'Change, in counting-house, in bar parlour, and in smoking-room, farming, as a business adding to the national wealth, is of no great account? To use a question and its ready answer not seldom heard, 'What is farming? A mere flea-bite!' Is all this the fact or not? To those who know the true position of matters,

and who mix with the class or classes who hold such opinions, there can be but one answer, and that we need not say is wholly in the affirmative. The misfortune of the position is that those classes embrace men of the highest business position. They possess all the means which this gives them to influence public opinion, and in a way not distinguished by the accuracy of the facts on which it bases its opinions, or for its logical accuracy.

For the curious inconsistency of the position thus held by so many, crops out in strange and striking fashion, as thus. They deplore in no measured terms, and we confess with cogent reasons, the state of trade, and that it is not worth speaking about, or has gone 'spark out,' to use a phrase familiar to those who mix with the trade classes in certain districts. But yet, notwithstanding, in the midst of all this deploring despondency, the inconsistency of the opinions thus held may be gathered from such a saying as this, almost word for word as we have often heard it: 'Well, if we could have a revival of the *home trade*, all would be right. But what is the use of expecting that? If we could have a good harvest, or even yet¹ but the prospect only of at least a fairish one, then we might expect, ay, and we would have, a good brisk home trade.' And this uttered by the same men who, in the same place and time, gave the dreadfully derogatory estimates of the position of farming as they looked at it, to which we have referred.

Nor need the value of a *home trade* be wondered at. Although that consideration is but seldom given, rarely by the very classes who are so much influenced by it, still but little is required to show the enormous influence of agriculture taken as a mere branch of industrial economy. Although not rich men in the sense in which wealth is considered by those engaged in manufactures or in commerce, although not rich as actually having realized and possessing wealth, still the amount of money passing through their hands is something enormous, far in excess of that popularly believed. The transactions of farmers are very numerous, again far exceeding in number the popular estimate of them. When, therefore, their transactions become fewer in number, and

¹ This was written in the autumn of 1879.

the amount of money they represent very considerably less, the influence exercised upon trade begins at once to be felt, and it is felt severely and by all classes. The farmers in bad times begin at once to reduce their general and house expenditure. This tells upon the tradesmen of the town near the farm; these in turn reduce in time their expenditure, and this tells upon the classes under and largely dependent upon them. And thus the influence goes down the social scale. But, marked and of great value in the aggregate as is the loss thus sustained, it is in one sense as nothing compared to the general farming transactions, which are of a purely business character; and the number and extent of these in which the farmer is concerned, we have said the popular mind has not yet grasped. For these transactions include not only those with trades specially agricultural, but have a direct influence upon almost every branch of trade. For the farmer, it may be said with literal truth, fleets of vessels are continually traversing the seas, and penetrating far into the country by its tidal rivers, —railway trains continually running to and fro, —in a word, all the vast and complicated system of trade and commerce in operation by which products are conveyed and materials of all kinds produced for their necessities. Mixed up thus with all classes of industry, when bad times come their transactions with those classes become less numerous and less valuable, so that all classes feel the influence. The country tradesmen feel it the first, and they in turn give out fewer orders, and have less cash to meet those which have been already given, and which remain unpaid. Of course, like everything else in our industrial system, as farming acts upon other branches, they in turn act upon it; and such is now the involved complication of interests, that a panic or 'uneasiness' on the London Stock Exchange is felt even in the remotest districts of the country. The close connection of farming, and through it of necessity of landed estates, with general trade and commerce, will be seen, although many at first may have conceived them to have but slight connection with each other. It is not so; the bonds are of the closest and the most enduring. But more than this, the low estimate which at the commencement of this section we pointed out as being taken of farming by

certain classes, connected almost exclusively with manufacture and trade, tells upon farming as a branch of our industrial operations in a way most disastrous. Possessed of large social and legislative power, powerful, if from nothing else, simply from their mere numbers, those classes exert an influence on the land question, taking this in its most comprehensive meaning. This, whether it be active or whether it be merely passive, is very great and striking indeed. Did space permit, it would be very easy to give specific examples of this. Analogies from the life we in common lead may be had also, not a few, in proof of it. We hear on all sides that farming is but a synonym for everything that is 'slow'; that it lags behind the times; that it avails itself in no way, or but to a very slight extent, of the advanced state of science; possesses none of the energy, and but little of the speculative go-ahead characteristics of other callings. And although facts are to be had everywhere and always by those who care to look for them, to prove the fallacies upon which such opinion is based, when it is still persistently held, and as persistently made public, it needs but little acumen to perceive the prejudicial influence exercised by all this upon farming as one of our national industries.

Nor less easy is it to trace the character and the direction of the influence brought into play by another opinion generally held, that 'any one can be a farmer,' this finding expression in such graphic if not very graceful phrases as that to farm 'is as easy as winking.' To quote the words of a recent writer, 'Everybody thinks he can teach the farmer. The chemist, the grocer, the broker, the banker, the wine merchant, the lawyer, the doctor, the clerk, the mechanic, the merchant, the editor, the printer, the stockbroker, the colliery owner, the ironmaster, the clergyman, the Methodist preacher, the very cabman and railway porter, policeman, and no doubt the crossing-sweeper, and, to use an expressive Americanism, the whole "jing-bang" could teach the ignorant jackass of a farmer.' This, though an exaggerated way of putting the matter, is in the main absolutely correct. And no matter how numerous the failures are of those who, although not brought up to farming, nevertheless go into it, and fail to be successful, they seem to have no influence

in changing this opinion. And the way in which it is backed up by examples of what those who hold it think farmers ought to do, is certainly not the least striking part of all this.

And the way in which this opinion is so complacently held by the majority of people, as if it was based on incontrovertible facts, is suggestive.

Nor is fault-finding with the poor farmer spared even amongst those from whom a more logical and dignified course might reasonably be expected. From those who so generally and widely talk of farmers as—not to mince matters—'little better than fools,'—for it pretty nearly comes to this,—it is not to be wondered at that amongst other charges made against them, comes the one that they have failed to take advantage of the great advances in science. All the more blameworthy farmers are, they say, seeing how closely our scientific men have devoted themselves to the investigation of agricultural phenomena, and how as a result they offer great help to the farmer. This, it is said, and truly enough, is calculated to make their work infinitely more successful than it has ever been. But it is something more than serious, indeed it is less, for it is ludicrous, when they go farther and say, that what science has done is also calculated to render them nearly, if not indeed quite, independent of natural difficulties, and of the vicissitudes and mutations of the seasons. Not a few of our farmers—not the stolid, easy-going men, whose faults and failings are so popularly dwelt upon, but the most advanced and the most scientific so called of the country—do think it strange that some men of science, by their silence if by nothing else, lend themselves to the propagation and perpetuation of opinions such as these, so wide of the truth as they must know them to be. Not a few amongst our most scientific farmers have thoughts of their own on the subject, if they do not always give expression to them. Amongst these is this one, that some modern scientific men have not the characteristics of the Bacons, the Newtons, and the Faradays. These great men, truly scientific, were characterised by their patient collection of facts, the studious avoidance of all assumptions or conjectures, and the forming of theories which are based upon facts only. To these, the attributes of true science, they

added the graceful modesty which is not always a feature in some of the so-called scientific men of our day. The arrogance—for it is felt keenly by shrewd thinking men to be such—which distinguishes some of the scientists of the present time is not, and never can be, a characteristic of true science, which is in reality, to put the matter somewhat paradoxically, the science of *knowing*, not conjecturing. Science is much, but it is not all; far, indeed, from that. And points although there are—shall we say innumerable?—upon which science can give forth no uncertain sound up to a certain line, but beyond this they are as helpless and as ignorant as babes, every true agricultural scientist knows further that there is no calling so characterised by points about which all we know is that we know nothing, and, so far as past and present experience tells us, about which we shall never know anything. Apart from this fact, which every observant farmer and all really true agricultural scientists know well, there are unknown and most puzzling characteristics in the soils, the crops, and the animals of our farms which baffle and set aside as worthless all attempts to get rid of them or to understand them. If this be, as it is the case, what is to be said of the seasons? It is all very well glibly to talk of the ‘unvarying laws of nature.’ We fearlessly claim for farmers as a class the distinguishing characteristic of being reverent in a manly, thoughtful, not a slavish way. They have, therefore, enough in the everyday of their working lives to tell them that there is One greater than the laws, namely, the Law-maker. Men there are amongst our farmers who, truly scientific, yield to none in their high estimation of the value of the true science, yet know well that there are many points connected with their calling which they would be but too grateful if scientific men would clear up, but which they feel no science of men will be able, certainly as yet has not been able, to do.

Considerations such as those we now give will serve, we trust, in some slight measure to clear up much that has long been and is still puzzling to some of our readers as regards the relationship of other classes to the farmer; and the way also in which that relationship acts upon the estimation in which farming is popularly held,

and the manner in which, as a consequence, it is socially and legislatively dealt with. These considerations are of high importance, and cannot be turned aside—ought not, indeed, till in some way or another the relationship is changed, and for the better. It cannot well be worse. This explains how theories have been advanced of late years through press and platform utterances, which, if attempted to be carried into practice, would be most disastrous to the interests of agriculture. And what is disastrous to this will be so in greater or less degree to all our national interests. Trite as this is to many, it is nevertheless wholly overlooked, as we have shown, by a vast number, if not the majority of the people who hold agriculture to be a thing of no or very small account. This is true, however much some may be disposed to, as we have shown many do, question it. The mere number of the plans proposed by which the condition of the landed interest and farming is to be changed, and changed so effectually for the better, as it is said, that all difficulties are for ever to be removed, is in fact bewildering. Not less so the character of the advice given to, or, perhaps as we should rather put it, the way in which the propositions are expounded and enforced for the special benefit of farmers. Of the style and manner of this advice all we remark is, that it is scarcely that calculated to conciliate, or to win the ear of those for whom it is designed. This more especially, that they have more than a suspicion that those offering the advice are not in all respects fitted by their knowledge of the practical points connected with the very difficulties they are so anxious to free the farmer from. And of more than one of these difficulties it may be said, that they exist in the imagination of the propounders of the various propositions as much as in the region of fact. Their clearly defined forgetfulness of the common-sense principle, that they should know what the difficulties really are before they bring forward their schemes to get rid of them, has in fact given rise to difficulties greater far than almost any of the real ones they have taken in hand to clear off. This way of putting the point seems paradoxical and almost absurd, so commonplace is the principle they have forgotten; but the absurdity rests with, and is

in fact created by them. The mode of treating a subject of the greatest importance to the country at large, simply as if it affected or could alone affect those connected with the landed interests, and by no means those of other classes, has done great harm. It is likely to do more if it be not at once set aside, and a more reasonable and business-like method adopted. The mischief lies not in the way it affects the landed interest, for they know how to estimate it at its real worth, but in the bad influence it has upon the general public, in placing before them wholly erroneous issues. The practical outcome of the matter is, so far as we are concerned, that we may put aside as really not worthy of any consideration many of the propositions made, and much of the advice offered to landlords and farmers. For they lie wholly without the region of practical facts.

The propositions made and plans offered for the consideration of landlords and farmers, by which difficulties really known and felt to be so by both, or by one or other of them, are to be got rid of, will therefore alone concern us. Of these, nearly all have been briefly discussed in their proper sections under the Fifth, along with the supplementary remarks given in the present Division. It remains, therefore, for us to give in like manner a few additional remarks on those not yet taken up. The first to which we refer is

Farm Covenants or Contracts chiefly as affecting Freedom in Cropping.—This subject has been incidentally referred to in the section on 'The New Crops of the Farm,' in this Division. It is also fully described in chap. ii. of Division V., under the head of 'Leases of those classes of which Covenants or Contracts affecting the System of Cropping forms in fact a part.' The terms, indeed, may be considered as convertible, as a lease may be called a covenant or contract, or the converse. In discussing the subject of leases in the chapter above alluded to, we attempted to show that what is now demanded by many—namely, absolutely free farming—is that which cannot possibly be conceded, or is not likely to be conceded, by those owners of land who have any regard for their own just and in every way perfectly legitimate interests. What many mean when they demand absolutely free and unre-

stricted farming is certainly characterised by a charming simplicity. It is simply this, that all that the landlord has to do is to permit the tenant to take possession of the farm, and that the tenant can therefore deal with the land and its produce just as he likes. It is not stated whether the landlord has even the poor privilege left him to 'covenant' that the tenant must give up possession at the expiry of a certain period of time. But, judging from the extreme character of the 'general demand,' it might not be unreasonable to conclude that, within the exceedingly wide range of its claims, the right to go when he pleases is also included. He may go at the end of a year, or of two years, or three years, just as it suits himself; or he may not go at all, but, like the rivulet of which the poet sings, he and his heirs may just 'go on for ever.' It is scarcely possible to allude to this demand for absolutely free farming, with no restriction, without considering it in a ludicrous point of view; for in one way it is, and would be so in every way, were it not for the very grave issues connected with the demand. No doubt, and it is only fair to name it, such a demand is put forward much more frequently by those who, by some strange perversity of belief, call themselves the farmer's friends, than by those who are farmers themselves. And assuredly it is imperatively demanded of us that we should state that, by the very highest and the most practical of our farmers, shrewd men of business withal, such a demand as that we are now considering is not for a moment thought of as either desirable or attainable. Not attainable, for being business men, they see at once that it proceeds upon the assumption as correct of a principle which is wholly antagonistic to the interests of all classes of property.

Certainly we fail to see why owners of property in land should allow that to be occupied and worked without some guarantee that the value of their property should not be reduced by the occupier and his system, or no system, as the case may be. What is good for one class is good for another; and if farmers are allowed to take and occupy land on this principle, the cotton manufacturer and those of other trades would be entitled to take and hold buildings in which to carry on their callings without the landlords having

any security whatever that their property would not be lessened in value either by wanton and wilful destruction or by careless indifference. Such a proposition has never been made, certainly never been publicly put forward as a just claim by tenants. If absolutely free, unrestricted holding of buildings were advocated, it would be laughed out of all serious consideration. The lease for a large mill, for example, is sometimes often of a lengthy, always of a more or less stringent character,— what is not to be done as well as what is to be done by the tenant. The same principle of operation, in fact, goes through every class. What is meant by a 'repairing lease' when a dwelling-house is taken for a term of years? As we have said, we fail to see why, on just principles, owners of landed property are to be deprived of all those guarantees which protect the interests of those who have property of other kinds. But it is one of the unfortunate outcomes of the relationship between some of the general community and the landed and farming interest, that land is now proposed by not a few, and even by one or two statesmen of repute, to be dealt with in an entirely exceptional way. In reading what we are now to give on the subject of farm covenants or contracts, we trust it will be distinctly understood that we consider it purely from the point of view of what the requirements of modern scientific agriculture demand; that we hold opinions very far removed from those who advocate free, unrestricted farming in the way we have been now considering. We may repeat that our views will be found in chap. ii. of Division V.

Considered from this, the scientific point of view, the subject of freedom in cropping is of the greatest practical importance, as it is intimately connected with the future progress of farming. This is the conviction of all practical men and the highest scientific authorities. There is scarcely any of the subjects occupying or likely to occupy the attention of the landlord and his agent, which demands such careful consideration, and, as most men think, immediate attention. It forms for the agent, if he be of the legal profession, one of those vitally important subjects for earnest study to which we have already referred in this Division. It is the

almost invariable experience of practical farmers and scientific agriculturists, that many covenants with certain clauses now existing therein, would never have been drawn up by any one knowing what farming now really is, its requirements and its necessities. That they have a tendency to militate against fuller justice being done to the land, nearly all practical men agree. And so, of necessity, they must militate also in regard to the estate as the source of the highest possible income. We know well enough that the legal agents, in the stern uprightness and sense of what is right which distinguishes them as a body, would do nothing wilfully at all likely to damage the interests of the estate. Why they do that which at least appears on but very slight consideration to be damaging, is to many a difficult thing to understand. The difficulty may easily be got rid of when the circumstances under which the agent acts are considered. Such forms of 'covenants' as we have alluded to were drawn up years and years ago, when agricultural knowledge and practice were alike at the lowest point almost possible to be reached. And such covenants have got stereotyped, so to say, for a variety of reasons, and, being good upon one ground, are acted upon as if good for any other. The same peculiarity in many of such covenants runs through a wide variety of operations in which the farmer is interested.

Without taking in any way an extreme view of the case, it may therefore be set down as certain that there are covenants now existing, the terms of which are such as, when worked out, bring about serious loss to the estate; and this simply because the near as well as the remote influence of the mode of working which the terms of the covenants brought into existence was not understood by those who drew up the covenants,—covenants the forms of which would not have been followed by any one having a knowledge of what modern practical farming really is. We do not ignore the difficulties attendant upon the change of the system of covenants, restricting cropping of the farms to certain methods, nor of the specially great ones which are connected with legal matters. For of all the professions, that of the law is admittedly the most jealous of innovations in principle and changes

in practice. Nevertheless, the interests involved are of such momentous consequence to us nationally, that the mere fact of there being difficulties in the way of changes ought not to bar the way to these being made. And after all, why should important interests be imperilled on account of difficulties, which are but things to be overcome. And even as a matter of policy, it would appear to be the wisest course to do away with a system which by no means meets with the approval (to put it in the mildest terms) of the great body of farmers throughout the country. It may be that they have no sound reason for objecting to the system, but the practical evils resulting from it are none the less existent. We have to deal with facts in this world, and the result is much the same in deciding his action whether one has a grievance or believes he has. And it comes close to the point to say that what is the interest of the farmer is that of the estate; for he is the *raison d'être* of its existence, considered as a source of income. Harmonious working is better for all classes than the opposite. These are not the times to keep up grievances, be they fancied or be they real. And of all the reforms we have had laid before us by various parties, by which a new lease of prosperity is promised to landed property, we venture to believe, and are by no means singular in the belief, that the subject we have been considering may be found, when carried out, not altogether the least practically available and valuable. Connected with the subject of the improvement of landed estates, many circumstances, such as the advance in scientific farming, have arisen of late. These have modified, and are likely still further to modify, systems which, with the advance of farming science and the changes in farming practice consequent thereupon, have been shown to be in many respects antagonistic to this progress being fully availed of. Other circumstances also have come into operation which ought to, and must in time, and probably that very shortly, be the means of modifying much of the relationship between landlord and tenant. These circumstances, it is perhaps scarcely necessary to state, are chiefly those brought into existence by the 'bad times,' from which the landlords alike with all other classes are suffering. Too abundant proof of this has been afforded of

late. Nor will a mere resumption of 'good times' avert the changes in the relationship between landlord and tenant now looming in the future. And of those changes, we have shown that to be of vital importance which will enable the tenant to crop his land as best he deems its interests demand. Certain restrictions are absolutely necessary in the interest of the landlord, and to those in the special section on this subject we have referred. And why the owners of landed property are to be debarred, as some affirm they must be debarred, from the right to look after their own interests,—the right exercised by owners of all other kinds of property,—we have a difficulty to conceive. But however opposed now some landlords may be to the system which enables the tenant to add largely and effectively to the crops useful to him, they will not be long in concluding that what is the interest of their tenants must also be theirs. Observant and thoughtful, and, as a body, singularly anxious to do their duty to all connected with them, to an extent far beyond that which is popularly accorded to them, we feel assured that this will be the case with the landlords. Many, even of those who have hitherto given no practical consideration to this subject, are now giving earnest heed to the matter, with an anxious desire to do what is right. Others, and not a few, have already conceded the change, seeing that to this compromise the class must come at last. As we write, there is an announcement in the journals that a certain landlord has not only lowered his rents, but has allowed his tenants full right to adapt their rotation in what they deem the best way to meet their circumstances. This combination of concession is very suggestive.

We have said that the mere resumption of 'good times' will not do away with the necessity to modify systems of leasing and letting land, so as to enable the farmer to extend his crops and to cultivate his land in any way he deems desirable. The signs of the times we live—have in fact for some years lived—in, have been read to little purpose, if they have not afforded the lesson that the land question in its practical features—we say nothing of its political, though some hold that they are inseparably connected—has entered upon altogether a new phase. And that demands

a change in the routine of farm practice. And this change, again, is rendered imperative by circumstances to which we have elsewhere in this Division referred. The farmer, therefore, may sooner, and more extensively than is at present anticipated, be at liberty to crop as he pleases; always with such reasonable, common-sense bargainings or conditions as we have in another section alluded to. Nor to a large extent is he precluded now from doing so. The truth is, that not a little *now* depends upon himself as to the terms upon which he takes his farm and on which he is allowed to crop it. In the stirring period of agricultural prosperity, there was such a demand for farms that the landlord or his agent had a difficulty, so to say, in his choice, so numerous were the applicants. A tenant, therefore, who desired any concessions to be made him, had little or no chance of acceptance as compared with offering tenants who were ready, nay, eager to take the farm on the agent's own terms, or indeed almost on any terms, so far as cropping or management of the farm was concerned. But *now* matters are so changed that the conditions may be said to be quite the opposite of what they then were; and landlords or their agents, in lack of offering tenants for farms in numbers, will be but too glad to consider those offers made by any tenant proposing which are fairly reasonable. And as new light has been brought to bear on farm management, agents will be much more disposed to look at any alteration in style of cropping, etc., in view of the fact that the best authorities in the science decide that freedom in cropping—but this carried out on scientific principles, be it observed—is calculated to improve rather than to injure the land.

The more deeply one investigates the subject, the more convinced is one likely to become that those are right who maintain that there is in reality no necessity for any violent or stringent legislative measures in connection with this question, or, indeed, any of the other questions now under discussion in connection with agricultural depression; the fact being that the getting rid of any of the difficulties or evils which can be proved to be prejudicial to agriculture is within the power, and easily within the power, of the contracting parties—namely, the landlord and

the tenant. And a very little consideration will show that this is likely to be so, and that it is after all but the common-sense view of the question. Indeed, this is proved by the general condition of matters now existing, and which has been brought about by the action of the landlords and tenants alone, without any direct, immediate, and stringent action of the Legislature. Like the 'law of the road,' the rule or custom of which, referring to land or sea, has all the force of a written law without any of its actual legal power, so also the custom of much that is connected with landed, commercial, and trade interests. The very fact that such visionary and dangerous schemes have been gravely proposed of late as the best settlement of the difficulties of agriculture, has made business men more than ever convinced of the vital importance of maintaining the 'freedom of contract' (see in succeeding section—Revision of the Land Laws).

Hence it is that, in view of the still further extension of the plan of settlement of difficulties and disputed points on the land question by arrangements entered into directly by the two interested parties, all systems or plans which come before the public having the settlement of such points in view are of great public service. Especially is this so when these plans emanate from influential quarters, and to which the advantages of a thorough knowledge of the subject have been brought. We have in the text referred to some of these plans or systems, and markedly to that introduced in Norfolk by Lord Leicester. In this, known now as the 'Leicester Agreement or Lease,' more than one of the difficulties or questions of the day in farming is attempted to be overcome. And specially we have referred in the text to the way in which freedom in cropping is secured to the tenant, while the rights or interests of the landlord are maintained.

This form or system of agreement has created considerable attention, and has done good service in this if in no other way, by suggesting to parties in other districts a method by which their difficulties may also be got rid of. Another system of farm agreement or contract, to which considerable attention has been recently attracted, is that introduced in Scotland by Lord Fife

amongst his tenantry. This is of far too great a length to be given here, and so numerous are the heads and the details under each, that even the briefest *resumé* cannot be here given. Suffice it to say, that its heads comprise the following clauses, some of them, it will be perceived, being what are called the 'burning questions' of modern agriculture. Clauses 1 to 4 inclusive deal with the general features of the leases—duration, terms and times of payment, reservation of minerals and woods. The 5th clause deals with that most vexed of vexed questions, the 'game law.' The 6th to the 10th clauses inclusive deal with the right of the landlord to make roads, resume lands for planting, reclaim marshes, etc., making compensation for losses arising from such operations—this to be in the form of abatement of rent; residence on the farm a condition of tenancy. Clause 11 deals with the important questions of the management of the farm, its cultivation and cropping; while the following clauses, up to and inclusive of the 14th, detail the penalty for breaking through the terms of cropping, the conditions relating to weeding, and with the tenant making clear that he understands the condition of the farm at the time of his entry thereon, and as to its boundaries, etc. The 15th clause deals with one of the claims of tenant right to which we have elsewhere drawn attention, namely, the compensation to be paid the farmer for unexhausted manures. The 16th clause concerns itself with the buildings and fences of the farm, which the tenant is to accept in the condition in which they are at the time of his entry, *unless there be some express arrangement made between the landlord and him as to repairs, alterations, or additions.* The 17th clause embodies the terms relating to ditches and drains, while the 18th concerns itself with the deductions due to the tenant, and how they are to be made; and the 19th is the important clause, of which much has been said, by which the landlord renounces all rights as given him by the law of hypothec, and as preferable to other creditors. After this important clause, referring to a law about which more has been said in Scotland than has been said in England as to the cognate law of distraint, come a series of clauses or stipulations as to fire insurance, damage done by floods,

and various minor yet important details of farm management. Then come, in the 25th clause, the points relating to the delicate and not always easily settled question of the tenant's inability to pay his rent, falling into arrears therein, or, what is worse in every way, becoming bankrupt. Then follow clauses stating how disputes between the landlord and tenant are to be decided by arbitration, and how the document is to be preserved by registration if required by the tenant.

In this statement, giving merely the clauses or heads, it will be seen that a farm lease, contract, or covenant, even when dictated by a desire on the part of the landlord to be liberal on almost every point, and considerate as far as possible to be attained of the wants and claims of the farmer, is by no means the simple document which it certainly, in the interests of both landlord and tenant, would be desirable to see, and which some maintain it ought to and can be if only the parties would consent to it. It is scarcely necessary to say that this latter opinion is held by those chiefly who are not remarkable for their practical knowledge of the subject. But complicated, at least many-sided, as this agreement appears to be from its general clauses, it is when these are fully read that the difficulties surrounding the various subjects are seen in all their number and force. They compel to the conclusion that it is not possible to draw up a farm contract or lease without being at least somewhat lengthy. But it does not follow that, because so, it arises from inherent difficulties in reconciling the claims of landlord and tenant, or that these must necessarily be antagonistic. Some contracts may be lengthy from these very causes; but apart from this, the very nature of farming necessitates a somewhat complicated detail of its work, and the respective duties relating thereto of landlord and tenant. Nor need this be matter of surprise to those who consider what farming is in all its varied and varying circumstances. It will be no surprise to those who practically know what it is, and what the details of its work are.

For, however valuable as are such systems or agreements as contributions to the solution of the difficulties now attendant on the practice of agriculture, at the best they can be contributions

only to the general practice of the kingdom. They may serve as guides as to what may be done in other and special districts, but not guides as to what *must* be done there, unless, indeed, all the circumstances of both districts are similar. For it is only in and for the one district in which they were first established that such farm leases or contracts are valuable, and this because they are precisely suited to its farming characteristics, and all the details have been drawn up with a special view to meet these. As we have said elsewhere, we do not believe in what are called model farm buildings, on the broad ground that the arrangements which suit one class of circumstances—those embracing locality, climate, soil, cropping, and live stocking—will not suit another. In other words, as the wants or necessities of one district differ, or are likely to differ, from those of another, the buildings which suit one will not suit another district. The accommodation required in one may be more than is required in another district, or the reverse may be the case, while the arrangements may be wholly different in both.

Just so in the case of so-called 'model leases' or 'farm contracts,' and it will likely be ever so. For what we have just alluded to should here also be borne in mind, how the farming of any one district is altogether dependent upon the agricultural characteristics of the district, such as soil, climate, locality, etc. It is therefore easy to see that a system or example of farm lease or contract very suitable for one, will not be suitable, without greater or less modification, for another district. But the value of such examples as we have given here and in the text as contributions to the general stock, so to say, of agricultural knowledge in all its details, practical as well as theoretical, must not be under-estimated. If it were possible to collect all the agreements or contracts thus specially made since the agricultural depression has roused men's thoughts to the way of overcoming it, and place them where they could be got at by parties interested, we can easily conceive the practically useful purposes to which such a collection could be put. The store of suggestions they would contain would be very complete, nor would they serve a less practical purpose in showing how what

was conceived to be a great boon was not quite the great thing it might in one district be passed for, as greater privileges under the same clause could be shown to be given by a landlord to a tenant holding a farm in another district. The farm lease of Lord Fife's, which we have just described, is a case in point, for under one clause a smaller concession is made than is made in farms in other districts. A tenant, therefore, who might be disposed to think the concession a great one, if he had the opportunity to become acquainted with forms of leases or contracts in other districts, would in all probability claim a like concession from his landlord.

But, in point of fact, the whole matter resolves into what is explained in a succeeding section in treating of the revision of the land laws, and pointedly referred to a few sentences before this; and this is, that the difficulties as existing between landlord and tenant are capable of being got over by them, and by them alone, without any necessity for legislative enactments. Under other circumstances this was not so easily carried out; however, when 'farms are going a-begging,' as has been said, and tenants no longer come up in numbers bidding one against each other for farms which they were ready to take upon the landlord's own terms, many of them on any terms, so that they got the farm, landlords, if careless before to listen to the claims of worthy tenants, are not so now. Landlords of this class have, we believe, always formed the exception; those really willing to concede claims, if only they could see that these were just, forming even then, as beyond all doubt they form now, the great bulk of the body.

But while the landlord is quite justified in looking legitimately to his own interests, so also is the tenant; only, while the landlord is by no means likely to be ignorant of what his interests are, it behoves the tenant to be sure that he knows what are his. This he cannot know, so far as the farm he proposes to take is concerned, unless he knows something about the farm. The more fully he knows its agricultural characteristics, the more certainly will he know what privileges he ought to have in order to avail himself to the full of those characteristics, so that he will make the most of them; and in so doing,

while he ministers to his own prosperity, he will do so to that of his landlord. On this point we have already offered a few remarks. But if, on the contrary, the tenant be ignorant of the farm, and of the farming of the locality, he is not likely to know what privileges he ought to have, or what concession to claim from his landlord, nor likely to farm so completely to the satisfaction of himself or his landlord,—certainly not so well as he would do if he knew all the circumstances thoroughly. Such common-sense views are too frequently overlooked, and not seldom do we find cases of a farmer—sometimes one only in name, not in knowledge or experience—here and there failing utterly, and blaming as the cause of his failure what he talks of as the ‘landlord’s influence,’ or the ‘operation of our land laws.’ He need not have gone so far afield to trace the cause; he might have found it nearer home. It surely is not unreasonable to say that a man ought thoroughly to know what it is he is undertaking. On the other hand, the landlord generally will do well by timely concession, and the kindly consideration which so many have given, to retain tenants who really know their farms and what farming is. Under such conditions there ought to be no practical difficulty in overcoming most, if not all of the difficulties which now oppress, or are said to oppress, agriculture. In the one case they will get rid of them; in the other they will find that they are the mere creations of the fancy of those who seem to have a delight in raising difficulties where none exist.

The Position and Prospects of the Farmer in relation to Improved Covenants and Freedom in Cropping.—This points to his doing his best to extend the number of his crops, to which we have already referred. And further, to a due consideration on his part, whether with greater freedom of cropping he could not give greater scope to his farming, to supply products now supplied by others, of whose competition he complains. In this forgetting sometimes that it cannot well be a competition in any sense with him, seeing that his farm does not yield the produce sold by others. And there is more than one direction in which our farmers could extend their productions, and thus secure markets which are now occupied and

monopolized by others. At present the answer to this is, that they have not freedom to do so. It might be easy to show, what with a little consideration on their part they know well enough, that, even under their present restrictions, they could do more in this way than they do. But it behoves the farmer carefully and candidly to ponder over the new circumstances which new systems, such as those we have been considering, will place him in. He will make a sad mistake if he conceives that success has been wanting from lack of certain things only. But we scarcely fear that this mistake will be made by farmers as a body. They know well enough that it is not in merely getting what they wish that will bring the success they have so long and are still patiently waiting for. They know that if the landlord will do his part, they have none the less to do theirs. And their duty carries with it interests of the most momentous character to the nation at large, and to the future position of their profession, as one paying, and paying well, for the labour its work demands. But although this work will, when the real necessities of the position are fully comprehended, be wider in its scope and more complicated in its details than it is now, we are of those who believe that it will be successful in the highest business sense. We cannot force our minds to the conviction that the determined energy, the enterprise, the patient and painstaking care to do the best of work, which has ever characterised our people, are now to fail; nor that the success which has as yet invariably been given to them, and which has assuredly raised us to the first rank of peoples, is now to depart from us. We have all along preferred to hold the opinion that the ‘glory has not departed’ from our grand old race connected with the land. Not because we held lightly or have thought little of the depression which has so long and so seriously affected them. Rather, indeed, because, taking this in its gloomiest aspect, we felt assured that its gloom was precisely the condition calculated to bring out the best features of the English character,—characteristic features which have always as yet secured the successful combating with difficulties of the gravest kind. It would be absurd to suppose that but few only have all along held such views.

That a very large number have held them, we believe; the only matter for regret being, that of this class who have position and influence at command, many have not availed themselves of these to make their opinions widely and publicly known. But this grave error is now being atoned for. A healthier and, if we may say so, a manlier view of the position is being laid at intervals—all too wide, unfortunately—before the farming public. And this will have a specially good effect. Hope is the mainspring of action, and all legitimate means of increasing and strengthening this bond on legitimate grounds, it ought to be the duty of all who can to aid.

This is being done, it is satisfactory to note, in the case of perhaps the greatest difficulty which has been agitating the farming mind. This is the competition with America. Serious as it has proved in its actual work, it has been thought almost universally that it was certain to become more serious still as the work was more fully developed. Here again we took a more hopeful view of the case. What the main elements of that view are, the reader will find in the first chapter of the Seventh Division of this work. The careful reader will have gathered from these that we considered the competition as based on wholly exceptional circumstances. We pointed out that the carrying or transport department of the competition was a very important factor in estimating what the competition would likely be. Up till now this has been, for the reasons we stated, no difficulty with the business. But we felt that we had good ground for holding the view that the difficulty would soon arise. It is rising now as we write. And it will be, in the circumstances of our usual or normal Atlantic carrying trade, such a difficulty as even it, with all its influence and wealth, may not perhaps be able to overcome. Not for a trade like this—a trade with the low freights which the steamship companies, in lack, and only in lack, of other and their usual business, have accepted,—not for this trade are these companies building those magnificent 'floating towns,' which as we write the journals of the day are so fully and so complacently describing as enterprises to be proud of, as indeed they are.

But there is another difficulty, we believe, yet

sure to come up in the carrying department of the American competition, and it is to come from amongst the Americans themselves. The steady and in many respects wonderfully quick travelling, so to call it, of farming from the east to the west, necessitates a long transport of the farm produce by *railway*. The farther the farmers go west, the longer is the transport to the seaboard towns of the east, and, of course, the greater the expense and cost of transport. Hitherto, at least for a considerable period, embracing, be it noted, the period during which American competition has come so much to the front, this peculiarity has distinguished the railway transport: it has been done cheaply—so cheaply that the rates have been far below the paying point. This arises from a circumstance which Mr. Brassey, in his paper hereafter referred to, has explained. Those interested in the land question are under great obligations to Mr. Brassey for adding another fact to those we have named, and have still further to name, in proof of the belief that our farmers have not so much to dread from this American competition as they have been and are greatly still fearing. 'The canal and railway companies between Chicago and New York have for some time past been competing against each other for the conveyance of agricultural produce, till the cost of carriage has sunk to a point at which it cannot possibly remain. The rates have now fallen to threepence-halfpenny a bushel by canal, and sixpence a bushel by railway. According to Mr. Brassey, this system cannot last, for the simple and sufficient reason that it does not pay the companies to maintain it. And "it remains to be seen how long the shareholders will give their sanction to a rivalry so prejudicial to their own interests." Hitherto those who know the subject thoroughly maintain that the American shareholders have been greatly indifferent to this loss which they have sustained, inasmuch as they have drawn the means to meet it largely from British capitalists, who have not, to put the matter mildly, always had their interests attended to. But signs are abundant to show that this source of help will not be long open to the American shareholders, so that, driven to rely upon their own resources, they will be compelled to raise their freights. If, then, the cost of carriage be increased, the American exporter at once loses

one of his principal sources of profit. Nor is there any ground for fear that if competition slackens in the west, it may be taken up by the farmer in the east; for the tillers of virgin soil on the farther side of the continent could always undersell every other American producer, if no longer able to compete with European rivals.'

Further, the reader will find in the section we have above referred to, a brief statement of the very characteristics of American farming itself. From these we arrived at the conclusion, at least suggested the probability of this being likely arrived at, that the competition, now so keen, and feared to be keener still, could not be carried on with profit. And to the absolute necessity of having this profit, no one is more thoroughly alive than is the American. We have explained the peculiarities of American farming, peculiarities which absolutely enforce the widening of the space between the locality of production—the 'far west'—and that of consumption, the 'farther east' of Great Britain. Another peculiarity is the exhausting, wasteful character of American farming. It is essentially a draining process,—the very reverse of ours, which aims at, and largely secures, if not a positively increasing value, certainly a maintenance of that high productive power which by good farming is secured. But if farms, as we have shown in the chapter referred to above, so much the nearer to the point of embarkation, are so rapidly exhausted, and when exhausted left, this may be asked, Why are not these exhausted farms—cheap as they always are—taken in hand, revived, and made to yield produce for transportation to this country? The reason is not far to seek. It will not pay. Wages are high at all times, higher still in good times. The very circumstances which bring, as a rule, good times to America bring good times here also, and render our farmers better able to meet the American competition, thus reducing the demand here for, and of course lowering the value of, American farm produce. This tends still further to discourage men from improving exhausted farms. Nothing struck us more in our visit to America than the number of farms worn out by the vicious and, from many points of view, the reprehensible system of farming. These, in point of locality, soil, and indeed in everything

calculated to tempt the *real* farmer to take them in hand, lay wasting as they waited for occupiers. To our question, oft repeated, Why should this be? came the one reply, It will not pay us. If capital cannot find an outlet in this country,—which we do not believe,—we could with great ease show many outlets in America. At the present time, end of 1879, it has been calculated that the balance against the farmer here in the production of wheat is only five shillings a quarter. That is, if by any circumstances the British farmer, as by good seasons, good times, could raise wheat so as to get more by five shillings than he now gets, the American farmer could have no chance of competition. Indeed, he would lose it before this figure was reached. Is it unreasonable to suppose that circumstances will ere long enable the British farmer to restore the balance?

That the British farmer will have reasonable hope that his labour under the changed circumstances of his holding which we have discussed will be remunerative, there are surely encouraging signs in what we have said. Mr. Brassey, in a paper just read (November 1879) before the Statistical Society on the subject of agriculture in England and the United States, drawing, of course, pointed attention to the depression here, and the effects of American competition in it, takes the same view of the matter as here explained. The paper is very valuable; all the more so that its facts are based on the results of personal investigation, and that it is published just at the right time. It is far too long to be dealt with here, even in the briefest way; but, as giving the gist of its bearing specially on the important point we have been discussing, we append the following extract from the article from which we have already quoted: 'American competition can be sustained only under exceptionally favourable conditions, as long as the cost of labour is nearly one-third higher than it is in this country. Wages in America are about 4s. a day all the year round; and though provisions are cheaper, rent, clothing, and all manufactured goods are dearer than they are in England. The American grazier has followed in the footsteps of the American farmer. He is gradually deserting the middle and eastern States for "the pastoral regions west of the Mississippi."

"And," says Mr. Brassey, "it is incredible that animals can be transported by rail from the pastures of the Rocky Mountains across the wide continent of America, and then transhipped to Liverpool, at prices sufficiently low to deprive the British agriculturist of his legitimate profit." In process of time, too, another item of expense will overtake the stock-feeder. He will have to pay for his pasturage, which at present he can get for nothing. On the whole, therefore, it does not appear that the competition which we encounter from America is established on a fixed basis, or that we have sufficient reason, as yet, to regard it as a permanent condition.

Still, notwithstanding the views here stated, and the hopes here expressed, the competition between the British and the American farmers is vastly too serious to be made light of. There is, however, not much fear of this being done, even though both the views we have stated cannot easily be shown to be wrong, nor the hope that we have expressed unreasonable. The hope most likely to be realized is that in connection with the transport question. For, as just stated, it can scarcely be continued, or, to use Mr. Brassey's own words, 'it is *incredible*' that the abnormal and altogether unusual circumstances both of railway and Atlantic steam traffic now existing can be long and thoroughly maintained. The view is stated in regard to the competition between the English farmer and his American brother, that it will gradually become less and less keen, so far as the American is concerned, from the circumstance that American production or yield will get less and less every year. The view is reasonable, indeed it is absolutely correct. But while so, it cannot be said that it breathes much of hope—certainly not of hope immediately to be realized. It will be years before the results of the reckless system of agriculture pursued in America, and which we but briefly described, will show itself in its worst features. And while thus the work of years goes slowly on, the British farmer must needs live on. All this points to what we have throughout insisted upon, and to which our best agricultural authorities have drawn attention during the last few years, especially since our agricultural depression has assumed such a particularly gloomy

position,—namely, the necessity of the British farmer endeavouring in every possible way to add to the sources of his income. How or in what direction this can or is likely to be done, we in various parts of this work have attempted to explain. Meanwhile, rising from this often-stated view of the position of this question of American competition,—a view which may be said to be the selfish one,—the other way of looking at it should assuredly not be forgotten. And it is this, simply stated. In place of looking upon the fact that America can supply us so liberally with wheat, or rather 'breadstuffs' (for Indian corn or maize now assumes gigantic figures in the transatlantic trade), as a thing wholly to be deplored, it ought rather to be an occasion for thankfulness that we have sources of supply for what really is the staff of life. But, further, it should be remembered,—what, however, in this question has been too frequently forgotten,—that what ministers to the prosperity of one branch of the population ministers to that of all the others. And it does so, and that in the most striking and also in the most satisfactory manner. Hence it is that when trade between this country and America is good, the farmers share in the general benefit. And this, be it noted, is not an ideal or visionary thing, but it is tangible, and realized by them more or less directly in the shape of hard cash; so that the American competition is one not wholly of loss to the British farmer. In certain circumstances, indeed, it will be more than made up to him. Nor can it be otherwise than a matter for congratulation, that in consequence of the large supplies of food-stuffs obtainable from America, the prices here are often kept low, staving off those 'famine prices' which brings so many evils in their train. And when food is cheap and trade even but moderately good, just so much the more have people to spend; and in proportion to this, as well as to the 'orders' which in good times the Americans freely send us for our manufactures, do the farmers share in the good things which are thus going. Further, and finally, we have shown here that there are many departments in which our farmers are completely masters of the situation, in which American competition is powerless.

Small Farms.—This is another of the assumed

cures for all the evils which oppress and depress agriculture. And in putting it before the public, and pressing its claims upon the landed estate proprietors, those who advocate it have not always advocated it with that thorough acquaintance with facts and the circumstances of the country which one might reasonably have expected. This is greatly to be regretted, as it raises false issues, creates prejudices, and causes many to form erroneous opinions, all of which have the direct tendency to complicate what would otherwise be comparatively simple. It tends, moreover, to raise false hopes in the minds of the very class intended to be benefited. And that, surely, is not an end to be desired by philanthropists. For of those they may thus incite to embark in small farms, there are considerable chances that some will not have their hopes realized, certainly not realized to their fullest extent. Under many circumstances, indeed, there will be no real hope of success at all, but, if not immediate, certainly ultimate collapse. And of the two, it may well be questioned whether it be not better to know quickly that an enterprise is hopeless, than that many years of labour be given to the attempt to keep off the evil day.

It is this point, indeed, and it could scarcely well be any other, on which the two parties who publicly interest themselves in this question join issue. The one party sees nothing but good in the scheme—one calculated to improve the agriculture of the kingdom, by adding largely to farm produce, while at the same time, if not indeed as an inevitable consequence, to raise the labourers to a far higher moral and social position than they at present occupy; in fact, that this will not be effected till the scheme be universally carried out. The other party holds views in regard to both positions almost the very opposite. Not but what they admit that to a certain extent the position of a labourer may be raised by working for himself rather than for others. But they believe that, as a rule, this influence would operate but to a small extent, while in many cases it would deteriorate rather than improve them. But on the second point there is no doubt as to the direct and thorough antagonism between the two parties. And the second party,

it is of essential importance to note, is almost wholly made up of practical men, and of these the great majority actually engaged or actually connected with farming. To which side does the weight of correctly stated facts and evidence incline? We do not hesitate to say, to that of the practical party. Indeed, it would scarcely be an exaggeration of the statement now made, to say that the opposite party has scarcely got a single practical fact to support their opinions.

The practical party, as for distinction we name it, has been charged with numerous faults and shortcomings. Amongst others, that it has a strong desire to keep down the class who would take, or are supposed to be ready to take, small farms if they could get them on fair terms, or on their own terms,—two very different things, it may be remarked in passing, or modes of looking at the subject, as we shall presently see. Now this is a grave charge to make against any party. But it is not true, neither is it supported by the facts of experience. The charge is supported by apparent pecuniary interests, inasmuch as many of the practical party are themselves farmers, and the small farmers might form a serious element of competition. But apart from what we know to be the characteristics of farmers as a body, facts can be appealed to, if facts be really wished for. As for keeping down their labourers or others, we know of no class so desirous to raise up their workpeople as farmers are. And few instances indeed could be brought forward to show that to prevent their men from farming on their own account was any desire of theirs. Much more easy would it be to show that they help them whenever a good chance offers to push their way in the world. The question has been asked, 'Are masters in the manufacturing districts peculiarly remarkable for the help they give their workpeople to become masters?' 'Two blacks,' to use a familiar phrase, 'can never make a white;' and because Tom does wrong, that does not absolve the wrong done by Jack. Therefore we dislike exceedingly the *tu quoque* style of argument, although very likely points could be made out of its particular application as above suggested. The truth is, that the reason why the practical party is so opposed to the establishment of small farms on

the extended scale proposed by some, and demanded in no measured terms by others, is simply this. From the practical experience gained in cultivation, either of their own land and farm or that of others, they believe that small-farm cultivation would not add to the produce of the country; that is, taking the system of small-farm cultivation as it has been hitherto, and seems likely for the future to be carried on. Experience, gained on large and on moderately large farms, shows but too clearly the difficulties of availing of all the improvements of modern farming to be great. But in the case of many, the difficulties of procuring the necessary capital to carry on farming even on the ordinary or routine system will be greater still. Hence they know that small farmers would as a rule have but a struggle, a perpetual struggle, to make ends meet; a struggle kept up, and never getting beyond the point of simply meeting demand and no more, and this only with good health and more than the average strength and activity; but a struggle consequently which, when sickness came or strength failed, would be hopeless. In fact, the experienced men of the practical party know that their labourers are infinitely better off as labourers than they would be as small farmers on their own account,—that they would have much less work to do, and that of a much easier kind, and that their living would be as good. And over and above, and perhaps even more important, they know that the labourer would be saved the most harassing of all the cares of life—the finding of the ways and means, or the never-ending trouble of trying how to find them. This is perhaps the most important consideration, for it is patent to all who have their living to make, no matter how, that it is not its work but its worry which kills. If, then, to secure a comfortable and, on the whole, easy life, and to keep them from one which is at the very best a struggling and therefore a hard one, be not kindly and philanthropic, one would like to know what these terms really mean.

That this view of the case is in its main features correct, facts are again appealed to. We have noted several of these. Space cannot here be given to the recital of more, but they lie ready to hand for those who desire to have them.

They are, unfortunately for the class of small farmers, but too numerous. They will be met with not only with us, but also on the Continent, that paradise for small farmers wishing to save; and very striking facts they are, though not quite in support of the views held—not by the practical party. But the practical men can, and do also, go to the Continent, and draw from the system of small farming there some of their strongest arguments in support of the view above named, that its general adoption here would not add to the comfort of the labouring population. For, as we shall see presently, there is a wide difference between small farming as practised on the Continent, and small farming as practised here,—a difference not yet observed by the party who advocate the small farming system as a cure for all, or nearly all, the ills which agriculture seems now heir to.

The most striking, perhaps, as it is the most recent evidence in support of the above position, is that just published (winter of 1879) in the Official Report of the Irish Local Government Board. This shows that beyond all doubt the greatest suffering prevails amongst the small farmers. Those who are surprised at this, need not feel any if they will read what we have given in the second chapter of the Fifth Division, in our notice of a paper by Professor Baldwin. Those who know Mr. Baldwin, know well the accuracy of all the facts he brings forward in illustrating any paper on agriculture he undertakes, no less than the 'soberness' and essentially fair-sided conclusions he draws from them. But a child could draw but one conclusion from the facts as stated by Professor Baldwin (which see as above). Continually between 'the hammer and the anvil,'—a French proverb most suggestive of a wofully crushing position in life,—we felt sure from what we knew of the case, that when any period of distress came, suffering would at once come to the class, and suffering most severe. This is certainly matter for deep regret. But it will be well if the lesson it conveys be taken to heart. Assuredly it is not in favour of the general extension of small farms, as advocated by some. But facts of the same kind—though not perhaps in degree—can be met with everywhere throughout the kingdom.

Since writing the section in chap. ii. Division V. on this important subject, everything which has been advanced by both the parties we have described goes to prove the correctness of the conclusion we arrived at. It is not that much new experience has been gained, for the time has been too brief for any amount of practical work to be done. But experience, or rather the facts which it affords, was not needed; it was there, has been there for long. It is only that the facts are being brought more and more to light. And this work has been done by the practical party, who are becoming daily more and more convinced that the time for 'speaking out' has come. And this in view of the new phase which the question has assumed—a phase or position which carries with it matter of the gravest importance to all classes of the community. The interests of landed property as a property are being attacked, and will be materially and permanently injured should the wishes now openly held, and as wildly as openly advocated by many, be realized even in the most modified manner. It is not this fact which alone gives importance to the question, but it is that the principles advocated are utterly subversive of all those which constitute the very tie which binds society together, and bestow upon every man the right to retain property he has become possessed of. It is with good reason that many express the hope that the fact that an attack made upon vital principles in connection with any one class interests all classes alike, will be understood before long by the nation. It will only be then that this question of small farms, and other questions which have been raised in connection with landed property, will be seen to possess a vital interest to the nation vastly more important than if they concerned the landed proprietor only. It may be humbly stated, without fear of the statement being contradicted on sound principles, that the *opinions generally* held on this small-farm question are nearly wholly erroneous. They are based upon one-sided statements, with which many have been but too liberally supplied, the whole facts of the case never or rarely having been placed before them. But all the facts are easily obtainable; those against the wide and general adoption of the

small-farm system as a cure for all agricultural evils being as easily got as those which are in favour of it, or presumed to be so. We regret that space prevents us going fully into a statement of all the facts. To many of them we have in Division V. specially referred. Much of the matter given in the present Division has a close bearing also upon the question, while to one or two others we now devote some paragraphs.

The difficulties connected with farming on the large or comparatively large scale, or what may be called ordinary farming, are well known to practical men. When the farmer is unfortunate enough to have an unkindly soil; or which, if good, demands the expenditure of much labour; or if his farm is in a locality with a variable and generally bad climate; and above all, if he be short of the necessary capital, his position is such that it almost precludes all chances of great success. Even under the most favourable circumstances as regards capital, and even with a fine soil, the difficulties he has not seldom to contend with are such as would not induce many business men to confront them for the chance of such profit as can be obtained even at the best. Lowering markets, foreign competition, bad seasons, all tell with painful force upon the position of the farmer. And, as is the case at the time we write with too many, even of farmers in the first rank of their calling, the losses of a few disastrous years may sweep away the profits of twenty.

But if the difficulties connected with large or ordinary farming are great, they are not less in the case of small farms, and this even when placed under the average of favourable circumstances. But should the small-farm system be widely extended throughout the kingdom, as is advocated by agitators, so that it will form an important feature of the institutions of the country, all the difficulties, as each day's experience shows more and more clearly, will be greatly increased. We have glanced at some of the leading points affecting the question in very brief fashion—all too brief, considering its great importance. The point, however, to which we have drawn special attention in the brief space at our command, is that which is perhaps the most practical of all those connected with the question. A party

distinguished, if by nothing else, at least by the persistency with which it claims to be heard as the only true exponent of the evils which afflict agriculture, and of the methods by which these are best and most quickly remedied, insists that the great evils are, first, the large acreage owned by landed proprietors, and second, the desire of well-to-do farmers to concentrate a number of small farms so as to form large ones. These evils, they maintain, are chiefly those which depress agriculture and keep down the produce of the farm. The consequent remedy, according to this party, is the subdivision of the land, the complete doing away with the system of large farms, and the substitution for them throughout the whole country of small farms under peasant proprietorship.

Apart altogether from other difficulties—and surely they are great enough—in carrying out a scheme which can scarcely be called otherwise than revolutionary, its advocates do not tell us how they are to overcome the difficulty attendant upon the distribution of the farms, or how, when allocated, the parties are to be made satisfied with it. For all the farms cannot be of equal value, cannot be all favourably situated. Neither are we told what is to be the limit or maximum of acreage of small farms; or how some of the new race of proprietors are to be satisfied, if some of them believe, as many will, that they should be made smaller still. Nor is it very clear whether the enormous number of small farms thus created are to be peopled wholly by 'peasants,' or whether the town workers who may have a desire also to get a slice of the land are to be gratified or not by it. And if so, it is not made clear how men who have not the slightest idea of anything connected with land and its culture are likely to aid largely in the production of food for the people, which we are told is to be one of the happy results of the establishment generally throughout the kingdom of the small-farm system. We have said there are other difficulties; some of these we have named, others can easily be guessed at before this system will be established. But the difficulty of locality is one which we take to be insuperable. For, as we have said, it can be easily proved that the small farmer who has the best chance of being a successful one is he who is

placed in exceptional circumstances altogether favourable. The most successful small farmer—we might almost safely say that the only successful farmer, successful in the true practical sense of the term—is he who is located near a large town or village, or in the centre of a thickly or even fairly populated district of detached hamlets or collection of houses. These create a never-failing demand for farm produce; and the more varied in character that produce is, the better the chances of success. Such districts, moreover, give to the small farmer much in the way of manure, as well as not a little of what serves as food for his pigs, rabbits, pigeons, and poultry. True, these have to be collected, but the cost of this is generally amply repaid by the cheap rate at which he can purchase these materials. Nay, it may be stated as a rule that they are found for nothing, being considered by the occupiers of the houses rather as nuisances gladly to be got rid of, than as sources of income. And should the collecting of these materials cause the small farmer to keep a pony or a donkey and small cart, this again may, by a clever fellow always looking to his business, be made a source of income; for it is surprising how many little odd jobs he can pick up, and good paying ones, if he has a conveyance, however humble. Carefully studying the wants, and the ever-varying wants, of the people amongst whom he is placed, he will direct his attention to those which are not only in the greatest demand, but for which many, in their desire to have them, will pay high, fancy prices. With never-flagging industry, watchful attention to all around him, a small farmer thus situated will find that there is more than a mere living to be picked up. He is in fact a 'Jack-of-all-trades,' ready to turn his hand to everything by which he can gain an honest penny. Much of all this is not farming, it may be said. True, but it is precisely that which makes small farming pay. For small farming proper, even in favourably situated circumstances, does not as a rule do so—that is, farming in which the usual system of cropping is followed. To this ready adaptability to take advantage of every chance, the small farmer must, it is scarcely necessary to say, be a sober and, more than a sober, a prudent man. Money can make

money, but cannot save it. And if to a fairly good knowledge of farming, gardening, poultry and 'small fry' keeping, he can add a knowledge of some mechanical trade, or be able fairly well to do some of the work of more than one, his chances of success are greatly increased. It is unnecessary to depict the results of cases the circumstances of which are the opposite of all this.

We are again and again referred to the Continent for proof of the value and the success of small farming. But we have in Division V. chap. ii. shown how different in many respects the small farmers abroad are from those amongst us. We say nothing here of the very different soil, climate, and market systems, and the personal circumstances of the small farmers themselves. This point has been already alluded to in Division V. But we may say in passing, that it will be long before our labouring population will exercise the self-denial of the Continental farmers in the method of personal living, equal them in their careful and prudent management of money matters, their economy in every department, and vie with them in the exercise of a laborious and painstaking industry, which is the wonder if it be not the admiration of those who know what constitutes Continental small farms. In nothing do the small farmers abroad differ so widely from the small farmers with us as in the variety of produce they contrive to raise. They are farmers in the one ordinary sense of the term. But they are something more; they are fruit-growers, market gardeners, and almost invariably poultry-keepers. These are the successful ones, we might with almost perfect accuracy say the only successful ones. For it is not to the small farmers of the Continent who farm in the ordinary way—corn-cropping, again to use the term—that we have to look for success. The chances of success, then, amongst our small farmers, we repeat, will be greatly increased by the adoption of a plan based upon the principle of change or a variety of produce. An eminent statesman has recently pointed out what can be done in the way of flower culture, and this might be added with reasonable prospects of success to the work of our small farms. Reasonable prospects! for, no matter what the system of farming may be, it must be influenced by circumstances such as

those we referred to, and these every practical farmer knows must be existent before the highest possible success can be secured. It is a rare thing to find a farm in which all the circumstances are met with favourable to such success. And as the natural peculiarities of districts vary much throughout the kingdom, from those which are most favourable down to those the least so, all the small farmers cannot, therefore, possibly be alike favourably situated throughout the kingdom. And if the small-farm system is to be made universal in the country, those truly interested in the social progress and national welfare of those who are to cultivate them may safely be left to infer what are the chances of fair and reasonable success. Natural circumstances cannot be treated in the same precise, definite way in which circumstances connected with any artificial arrangement of our own formation can be treated. We may, so to say, compel nature to change her circumstances, but this can only be done up to a certain point and within certain limits. Beyond this we are powerless. And we have shown that these limits are extremely narrow. And our modifications are liable to be rendered greatly inoperative by changes which come in a way we know not how, and at a time we know not when. This is very unfortunate so far as the realization of the wishes are concerned of those who so earnestly desire to see the small-farm system universally extended. But it is a circumstance which they cannot control. It must therefore be accepted, with all its consequences. What these are we have endeavoured to show, and we believe them to be correct; if not, we shall only be too grateful to be shown how they are not. For we have a desire, as ardent as any of the most ardent advocates of the system, to see any one system adopted which, while it secures the material improvement of the working classes, is not secured by the sacrifice of the just rights of others. And no system can be right or can succeed which is based upon principles essentially wrong. We say this in view of the fact that the new phase into which the advocacy by many of the small-farm system has entered, carries in its first principles a subversion of all social rights and order. A few sentences will show the main features of this new phase.

We have referred to the notion so persistently maintained by many of a large and influential class, that the farmers are opposed to the further and complete establishment of the small-farm system, and this for reasons wholly selfish. If this were true, they would well deserve all the weight of opprobrium, at least of fault-finding, which has been laid upon them. We have shown that it is not true. But if farmers have been blamed for raising obstacles in the way of the system being carried out, what shall be said to characterise the way in which landlords have been denounced for acting in the same way, but, it is said, to an unfortunately greater degree? To them and to their motives for so acting, as it is said they have acted and are now acting, the harshest terms have been applied.

But in truth the landlords do not in any way deserve this blame, this vituperation, this attributing to them of such degrading motives. They may reasonably be supposed to be alive to their own interests. If even only moderately so,—and this surely may be conceded to them,—it is clear that they can have no interest in preventing their land being parcelled out for small farms. Their interest is all the other way; but all the more so if it be true, as stated by many of the advocates of small farming, that far higher rents will be obtained for them than those obtained for large farms. A high authority in matters connected with the business of the kingdom, and high in social position and influence, Mr. Brassey, M.P., president of the Statistical Society, stated the other day (November 18, 1879) that landlords have no interest in keeping down small farms. And, following Mr. Brassey, another authority still higher in social position, Lord Derby, has recorded his opinion that landlords are the best judges of how their land should be let. One would think so. This principle would be as a mere matter of course conceded to other classes, why should it be withheld from the landlords? And knowing, as no one can possibly know better than they, the struggle which small farmers have to secure merely a good living and make ends meet, is it to be wondered at if they are chary in cutting up their land and parceling it out into small farms? They know that the result would be, not the difficulty to get the rent,—more is done in the

way of kindly consideration on this point than is popularly conceived,—but the deterioration which the land would undergo in their hands, a deterioration at least much more likely to happen with small farms than with large ones. We have already shown how this is likely to come about.

Surely landlords are fairly entitled to manage their property on the same business rules which regulate the management of all other property. We have never seen it proved yet, that there is really anything exceptional in property in land which caused it to be exceptionally treated. No doubt, if its management involves anything prejudicial to the interests of the community, that can and ought to be altered. But then it is only just that the proof that the management is prejudicial be complete. It must not rest only on the mere expression of a wish or a determined will of a certain party that it should be so altered *in their favour only*, splitting up estates into numberless small farms. On this ground it would be easy to get up the very widespread expression of a wish that cotton mills should be split up, or machine shops, etc., to give little businesses to a number of little men. This wish amongst workers in the manufacturing districts has, in fact, been expressed, and is now being so daily, and will, we suspect, be still more so should the floodgates of communistic ideas be opened wider than they are opened now by some of the agitators on the small-farm question, who plainly go in for confiscation of landed property, for it is impossible to see it in any other light but this.

Mode of Action.—We have said that there is a great difference between the action of the labourer who gets land for his small farm on fair terms from the landlord, and the labourer who demands the land on his own terms, fair or the reverse; or, what many now do, and are being sedulously taught to do, demand it simply,—demand it or claim it as a right to be obtained or taken without any terms at all. This difference carries with it matter of much graver importance than is suspected even by many of those who have had their attention directed to it. Nor is this at all a fanciful view, which is held by so many. It is anything but that, as is easily enough proved by facts in daily life not difficult

to be met with, if one looks abroad for them. One, indeed, has not far to look.

It is the open and unabashed advocacy of the last named of the points of difference which constitutes the new phase into which the question has entered. The opinions now advocated, and with all the energy which characterises agitators who know their business well, are simply communistic, and 'go to the root' of all those principles which bind society together. The principle of operation now proposed by the agitators for the consideration, or, as they put it, the immediate action of the labourers, is characterised by great simplicity. It reminds one of the pithy rhyme of Coleridge; for it is, in fact, the

' Good old rule, the simple plan,
That they should take who have the power,
That they should keep who can.'

No doubt it may be said, and with perfect justice, that the very absurdity of this phase into which the question has entered, so far as the labourers themselves are concerned, renders all chance of its ever being realized in future simply impossible. But it is not the fact that, however willing to 'take' the labourers may be, they are not at all likely to 'get,' which has alone to be considered. It is for the nation generally to conceive the influence which the mere advocacy on the part of the agitators of such wild notions, and the too ready belief in them as shown by the labourers, has upon them. That this influence is of the worst character, no one holding the 'eternal principles of right and justice' will for a moment deny. And those who do believe that this influence has not been widely disseminated, and much more widely and deeply exerted upon the labourers, and that it has not had any practical effect for the worse upon them, give, we fear, the best proof that they know but little of the class, their modes of living, of thinking, their aspirations, and their hopes. This influence it is in our highest interests as a community to counteract and get rid of. How this is to be done it is not for us here to say.

We put this point briefly here, to show how much more extended is the influence of the principle we are discussing than is believed by many, and to show also how deeply interested are

all classes of the community in possession of property of any kind, however small in value it may be, in putting an end—if this can be effectually done—to the advocacy of such dangerous principles. At all events, it behoves all those of influence to speak out plainly on behalf of the law-abiding portion of the community, to let their opinions be made as publicly and as vigorously known as have been those of the agitators we have referred to. These, up till now, have had the monopoly, so to say, of the attention of the labouring classes. We talk of education, but education falls far short of its duty if it fails to teach the immense importance of the principles of right and justice. In view of this, some of our leading men may find another inducement in addition to that we have just named to do their utmost to stem the flow of a current of opinion which sooner or later, in one direction or another, will be sure to lead us to a position in our national progress anything but to be wished for.

Before concluding this subject of small farms, there is yet another point which ought to be noticed. We are accustomed to contemplate complacently, and that, we confess, quite justly too, the vast progress we have made exclusively in all that relates to the arts and sciences; but it is, according to good authorities, as much in connection with agriculture as in any other branch of industrial work that this amazing progress is best illustrated. But while thoroughly satisfied and gratified with this material progress, the question is rarely asked, To what or to whom are we, the nation, indebted for this? The causes no doubt are numerous, and by far the greater number and the most important of them have been referred to in these pages at greater or less length. One, however, must be noticed here, as it has a close bearing upon the small-farm discussion. We are told that when, if ever, the small-farm system shall be carried completely out, as advocated by many, the farm produce will be greatly increased. We are not told how this certainly most desirable result is to be attained. All that is generally vouchsafed to us on this head is some vague reference to the fact, assumed to be really so, that small farmers are so industrious, and have such methods of work-

ing, that the yield is invariably larger in the case of their fields and their crops than in the case of those of farmers who farm on the large scale. And further, by way of corroborative evidence, we are referred to the results of small farms in some isolated part of the Continent. The circumstances of the cases referred to—if, indeed, any special and well-authenticated cases of successful practice on small farms are at such times really in view—are not, however, given. If they were, a flood of light would be thrown upon the statements,—not, however, of the character claimed by the out-and-out advocates of the general or universal small-farm system. We gladly concede that small farms offer unusual advantages to any one capable of making the most of them, and when the circumstances of soil and climate are favourable, in the way of gaining yields larger than the average ones of large farms; and this just or chiefly because it is better always to farm a small acreage well and thoroughly, than a larger acreage carelessly or in a loose or perfunctory way. The small farm admits of this being done in the most direct way. We concede also, and that gladly, that many of our small farmers have had great success; but then it is chiefly under exceptionally favourable circumstances. Further, it is admitted, and most readily, that one class of true small farmers, that is, the yeoman and crofter, etc., that is, those who have been brought up to and been connected all their days with the land, are the most industrious, painstaking, and economical to a degree; all of which do not by any means, as a rule, secure to them the reward they deserve. And the practical party are not a whit less, but we should say are equally anxious with what we have called the philanthropic party, to see a moderate increase in the number of small farmers of this the yeoman class throughout the kingdom. They wish this all the more heartily, and none the less honestly, seeing as they do the advantage to the nation of a class of this kind. But it is just because they know—and here as on other points they appeal to facts—that a very large increase of the body of small farmers throughout the kingdom would do, as we have shown, harm to them socially, that they wish the class to be limited. And further, while conceding all the points we have

stated above, they maintain, without the slightest fear that the statement can be controverted by facts and sound reasoning, that if agricultural improvement generally had depended upon this class, we assuredly should not have witnessed the splendid developments of the last thirty years or so, to go no farther back. Indeed, it may be safely said that had improvement rested only with the class of small farmers, we should not have had improvement at all. Nor need this be matter of surprise, when we consider the circumstances under which they as a class exist, and under which, as we elsewhere have showed, they may be said continually to struggle, rather than to exist in ease and comfort.

It is to the proprietors of lauded property, as also to the race of farmers occupying farms of greater or less extent, but none of them 'small' in the sense we now are considering the term, that we owe all our modern improvements in farming, the value of which it is impossible to overestimate. Those farmers have become prosperous simply because the extent of their holdings was inducement enough to them to devote their whole energies, and all the help afforded by a thorough knowledge of farming, together with a sound, good, and very frequently highly scientific education, to the cultivation of their land in the best style. And not only so, but to draw to their aid all the external resources of scientific knowledge, technical skill, and mechanical ability which have made the present a remarkable epoch in the history of our country.

But if the triumphs obtained in this way and by those two great and influential classes have been striking, what shall be said of the still more striking ones which have been obtained by not a few of our leading landed proprietors, no doubt in fewer numbers, but yet in magnitude infinitely greater, over what may be called the obstacles which nature presented, and which *apparently* could not be overcome? For when we look at vast areas reclaimed from the sea now bearing the richest of crops, extensive marshes drained, great bogs reclaimed, and changed from almost worse than bare sterility into wide expanses of smiling meadows and richest pastures; almost endless tracts of common and wild weary wastes of heath and woodland brought into cultivation; hill-sides and tracts exposed to bitter winds which stop all vegetation,

clothed with wide varieties of trees, all fitted to yield the shelter which is necessary to vegetation and pave the way for better and higher culture,—when we look at all this, and more than this, as having been actually done, and at the still greater works now being done and proposed to be done, we see that a great victory has been won over the difficulties presented by natural obstacles,—obstacles, as stated above, apparently impossible to be overcome. Nor could they have been overcome otherwise than by the expenditure not merely of enormous sums of money, by the use of the most elaborate machinery, the employment of the soundest scientific knowledge and the highest technical skill, but by the display of the most advanced business ability, the most daring in one sense yet in another the safest of speculations, and, above all, by an energy and patience under difficulties often of no common kind, and a high patriotic spirit impossible to be too highly praised. Few people there are who have even the slightest conception of the vast amount of work done in this way and its exceeding costliness, still less of the enormous benefits the nation has derived directly and indirectly from works so vast based upon schemes so comprehensive. Nor should it be forgotten that all this work presented, at the first at least, but a comparatively poor prospect of paying. At the best, a very long period had to be passed over before a profit could be realized, while for long nothing but expenditure had to be faced. Such work, little thought of as it is, is in reality work of a highly patriotic kind. And if it be true, as is said in the well-known phrase, that he is a benefactor to the human race who has made two ears of corn to grow where but one grew before, what can be said of the beneficence of those who have done work greater far than this in amount? And yet it has been done, is being done now, almost wholly by the very class of landed proprietors who are so much abused as those who do nothing, and never have done anything, for the nation. Of course this view, as thoroughly erroneous as it is uncharitable, is held by but a few, even these constituting a party by no means famous either for their number or their standing in society. Still, for what they are deficient in those respects, they make up by the

persistency with which they keep pushing before the public their own view. A persistency which has had the unfortunate result of making many believe it to be true who really do not wish it to be so, and who would be but too glad to be made aware of how the matter stands. Where so much has been done, and by so many, it is invidious to give names; and yet, as in the text we have had occasion to give one name in noticing the splendid work of reclamation of wide tracts of almost useless land which has been and is still being done by His Grace the Duke of Sutherland, it will not be considered invidious if we couple with this the representative of an illustrious southern house, His Grace the Duke of Bedford. The history of what the house of Bedford has done through decades upon decades of untiring labour, and of vast pecuniary expenditure, in reclaiming land which was worthless, has been partially written. When fully so, the nation will then have an opportunity to learn how much even one house has done to add to *the true wealth* of the kingdom, and to conjecture from this what must be the aggregate work done by so many other houses in other parts of the kingdom. They may also then conjecture what likelihood there is of such important national works being carried out in the future, if, for the race of landed proprietors who have done such good work for their country, there be substituted a race of small farmers, who, at the best, will almost certainly have a sore struggle to make both ends meet. This point, amongst others, the nation should see to before it is quite too late.

But in addition to the enormous services done to British agriculture, and of course to the nation, in thus adding so much to the productive area of the land, of which we have only named two examples,—one part of the reclamation on the Bedford property actually gave to the country no fewer than six hundred and eighty thousand acres of the richest land in England, and this wrested from what was truly a 'noxious swamp,' not merely useless, but positively dangerous,—it should never be forgotten that to the landed proprietary is almost solely due all the improvements in breeding, rearing, and feeding of stock. To them, directly and indirectly, we owe the best and finest of our modern breeds of cattle, of sheep,

and of pigs. No doubt we but too gladly record the fact, or rather refer to what is so well known, that no little is due to the tenant farmers of the kingdom. Of this we have abundant evidence around us. But in nearly every case the first impulse—to say nothing of later and still continued efforts involving large expenditure—was given by the landed proprietors. So also largely in the case of the machinery and the implements of the farm. To a class, therefore, from which so much material benefit has been obtained, a fair debt of gratitude is due by the nation. This would have been paid long ago, or more fully than it has, had it really known not merely the extent, but particularly the nature, of the service it has done. But this profound ignorance of the country generally is being now dispelled; and the more it becomes so, the more clearly will it be seen how largely indebted the nation is to the class of landed proprietors, aided as they have been, and that most energetically, by the large tenant farmers of the kingdom.

Proposed Changes in the Laws affecting the Interests of Landed Property.—For its direct and mediate, as well as for its indirect and future influence, not merely upon the interests of property in land, but those of other property of whatever kind it be, we have shown, we trust, the grave importance of the small-farm question. We now pass on to the consideration of other questions, which many will hold to be of even greater importance. Of these some have been already noticed in Division V. Of those remaining we shall first draw attention to the law of distraint.

The Law of Distraint is one of those connected with the landed interest which it is proposed to repeal. That grievances exist which owe their existence directly to it, no one disputes. But grievances to some one arise out of every law we have. There is not one exception to this. That some of the grievances of the law of land distraint are capable of being got rid of is true, and if they can, we believe they will be done away with; and the landlords will have no interest in preventing changes being made, only they must show them to be beneficial and capable of being got rid of. And assuredly in those cases where hardship does arise, especially to those third parties who may be said to have come innocently,

as it were, under the action of the law, it will be to the advantage of the landlord should he not strain his rights under it to the utmost. No doubt it may be said that when a law is productive of hardships, the law ought to be repealed. True to a large extent, so far as its action in the line of those particular hardships is concerned. But it does not follow that the law ought to be repealed wholly. If there are numbers who maintain that the action of the law is wholly prejudicial in the interests of agriculture, it must not be forgotten that there are as many, one might safely say more, who on the other side maintain that such is not the action of the law *per se*. And amongst those, it must be noted, are some of the most practical men of the day. Certainly it only seems reasonable to say, that with those who are so anxious to see the law of distraint repealed so far as agriculture is concerned, rests, and alone rests, the burden of the proof that its influence is prejudicial to the interests of those engaged in the pursuit of the art. More than this. It is not unfair that they should be asked to show how it can be repealed, and if repealed, what further they propose to substitute for it in the way of giving the landlords of landed property as much, to say the least, security as the landlords of house, factory, or other property enjoy. But when they come to one of these reasonable requirements, they may find that repeal of the law of distraint is one of those changes which are not so easily made. Not a few, and men eminently practical, maintain that, under the present complicated system of commercial law, this law is not capable of being repealed, questionable if it can be very much altered. This view of the case may be somewhat novel to some of our readers who may not have considered the matter in all its bearings. But it would appear, on a careful consideration of all the circumstances, that so bound up is the *principle* of the law of distraint with every other law regulating the business relations between man and man, that no lawyer, or any number of lawyers, could, it is said, and by competent authorities, devise a scheme for its repeal without bringing about a complete revolution in the whole of what is called the Commercial Law of England. It is from this that we have said that probably the

repeal of the law of distraint is almost impossible at present.

And it is not easy to refute the arguments of those who maintain this view to be correct, namely, that if the law of distraint be bad not only in its operation, but, as they contend, in its inherent principle, as applied to land,—if this principle be found to form the basis of a law or laws affecting property other than landed, this law or those laws ought in strict justice to be repealed also. Are those who so warmly advocate the total repeal of the law of distraint as applied to land, prepared, therefore, to repeal the law of distraint as applied to property in houses, factories, workshops, in fact all the wide range of buildings from which so large a class of the community derive the chief portion of their income, some the whole of that? If in strict justice the law of *land* distraint ought to be repealed, in strict justice the law of distraint for *building property* should also be repealed. We do not say that it ought. But this we do say, that should any agitation, from any cause whatever, be got up by tenants of house and other property for the repeal of the law of distraint, or, as it is popularly called, the landlord's law, then a list of grievances will be brought forward, as great and as numerous as those which have been and are now being brought forward in favour of the repeal of the law of land distraint. It can with strict truth be said further, that if the law of building property distraint was repealed to-morrow, from to-morrow would date a complete revolution in our social arrangements. For very few men would then create building property without the safeguards with which it had formerly been protected. Landlords of houses and the like may be utterly wrong in supposing that these were real safeguards. We suspect, however, that they do suppose this.

Is there, then, no way of getting rid of the grievances which the law brings into existence? Or if they cannot be got rid of wholly, can they be so modified as to be comparatively harmless? Some eminent authorities put the case thus:

A man may covenant or contract himself out of what really are his own just rights; but this applies as well to landlords as to tenants. Nay, a tenant may to-day be stopping all attempts of the landlord to get him out of his house pro-

perty, and this although he never has paid, never means to pay, a penny of rent, and this, moreover, when he, the tenant, is allowing the property to go to 'wreck and ruin.' Nay, making it go so, by tearing down and burning the wood fittings, and in every way doing his very best to do the very worst he possibly can to the property. We know of a farmer who kept possession of house and land for years, till at last the landlord was glad to pay him a round sum to get rid of him, as well as having to pay a still larger one to make good the injury done to his property. When talking, therefore, of the powers of landlords, it is well to think of those of tenants. Each of the parties, landlord and tenant alike, has the power to exercise those powers, the other party consenting—or, in other words, agreeing—to covenant or contract himself out of his rights and privileges. Agreeing, we say; but this may be done in ignorance as well as by willing intention. Hence the necessity for both to make sure of what their covenant, contract, or agreement is; in homely words, to be sure as to the bargain they make. To do this effectually, let no one grudge the cost of securing the best legal advice and assistance he can command. Many a tenant, just as well as many a landlord, is now complaining of grievances—and justly complaining, for they exist sorely to his loss—which have arisen, to put the matter plainly, solely through their ignorance of what they had each a right to demand, or of indifference at the time of making the contract as to what its terms were. If the law of distraint has to be reformed as applying to one form of property, it has to be repealed as applying to another or to all forms. But seeing, according to practical authorities, the almost insuperable difficulties in the way of repeal, it would be well if tenants would give thought to devising some means of getting rid of the grievances caused by it, and of which they so complain. Nor would a like consideration on the part of the landlords be aught but beneficial in its results. The principle of 'give and take,' or of 'compromise,' is, after all, the best way of transacting business of any kind. And this principle, we venture to maintain, will be found not merely alone applicable to the solution of the difficulty thus briefly discussed; it may be found so to others of what

are called the 'burning questions' of our day, as, for example, to—

The Revision of the Land Laws, which, with all the changes this term includes, constitutes one of the not least important of those being now discussed. All classes of the community are interested in this question; no one is free from its influence. It is therefore greatly to be regretted that in its discussion so much has been brought forward in direct opposition to the principles of those laws which affect and protect the interests of property, of whatever kind it be. Much of what we have said in connection with small farms bears with equal force on the details of this question. That there are features in the land laws which claim attention, and details which require modification, and some which demand repeal altogether, is admitted on all sides. And that very considerable revision will be made, and sooner than many at present anticipate, seems to be beyond a doubt. But this revision will be on the present 'lines,' so to say, and the rights of landed property will be protected, even although we find it by not a few talked of as if it could be dealt with, and legislated for, on principles and in a way wholly distinct from those which affect all other classes of property. Before property in land can be dealt with in this exceptional way, it is only in honest fairness right to show *why* it is exceptional. No doubt there is a legal distinction between 'real' and 'personal' property. In the case of landed property, the estate is held on the assumption that nothing can be done with it inimical to the interests of the nation at large; in other words, that the 'estate' can only be held, not the land absolutely which that estate represents. But this does not apply to land which is only used for agricultural purposes, as some think, and indeed maintain. It applies to land for whatever purpose used, be it for farming, or mining, or quarrying, or building. But this legal distinction here noticed may in truth be defined as a legal fiction, for we know that practically an 'estate' is property; this 'fiction' being but the expression of the legal dictum, that the land absolutely is the property of the commonwealth. But there is therefore nothing exceptional in landed property consi-

dered as farming land. Or, if it can be interfered with, it can only be so on the same grounds which render land used for other purposes—as building or mining—liable to be interfered with. This is a very different position from that held by some who agitate for a revision of the land laws, as if it could and did apply to farming land only.

The attempt to show that property in land is *exceptional* to those laws which protect the rights of all who acquire property, has, however, often been made, but made, we regret to say, not seldom with that ready ignoring of all facts which characterizes the utterances of those who, coming to a question with foregone conclusions, based generally on prejudices, treat facts as of no importance. All the facts go to prove the opposite of much that is advanced by those who demand the revision of the land laws. And if they advocate this without a knowledge of them, they are placed in a false position, totally different from that occupied by those who, knowing facts, have the right to discuss probabilities and propose plans.

We are generally told by various platform and press authorities, that all the depression which has so long weighed heavily, and still weighs heavily on agriculture, owes its origin to the 'monstrous system' of the land laws; and that this depression will not be removed till those laws are altered. It would be but reasonable to suppose that the causes which have brought about that depression which has weighed so heavily also upon other branches of industry, have operated more or less in bringing about that under which agriculture suffers. But refraining from further pursuing this common-sense view of the matter, we may fairly ask those who advocate the revision of the land laws on this ground to explain the following facts. If the evils pressing upon agriculture were wholly, as it is said they are, in consequence of the malign influence of the land laws, how is it that those who are not in the slightest degree influenced by those laws, so as to be under what is called 'landlord's influence,' feel the 'depression' as heavily as those of their neighbours who are under this influence? This class, the members of which are in no way influenced by the landlords or by the land laws, is a large one, very much larger than is generally

supposed, but which the agitators will not care, at least generally, to concede. One district might be named, famous for the high quality of its soil, in which nearly all the farmers are their own landlords, and cannot therefore be said to be under the 'landlord's influence,' as it is termed; and yet in this district the depression is felt as badly as in other districts where the so-called landlord's influence exists. This class, as we have said, is a large one, and is not made up alone of private gentlemen, who for one reason or another farm their own property; but both the numbers and the influence of the class are largely added to by practical farmers of the highest standing, who, frankly avowing that they are perfectly and absolutely free to farm as they like, and are under no depressing covenants, as frankly avow that they feel the full effects of the depression not a whit less than other farmers, many of whom attribute their want of success to the operation of the land laws, or to some stringent covenant under which they farm. The inference to be drawn from this important fact is obvious enough.

We have said, when considering the question of the law of restraint, that the character of covenants or contracts depends greatly, if not wholly, upon the parties contracting; so that a landlord just as well as a tenant may covenant himself out of his rights. This is equally true in the case of large farms. The very highest of practical authorities on agriculture, of all shades of party, of all varieties of opinion in politics, agree in this, that all the relations can be regulated by the contracting parties themselves. This, in point of fact, has been that under which our whole system of business, including, of course, that connected with land, has gradually been formed, and upon which it rests. Our laws as a rule only 'confirm customs,' and render obligatory upon all parties alike the observance of these principles of right and justice. What these authorities maintain to be an incontrovertible fact, is stated in the familiar phrase that both the parties, tenants and landlords alike, 'have their business in their own hands,' and this conferred on them by virtue of the principle embodied in what we know as the 'freedom of contract.' And this opinion, coming as it does from men eminent for their sound

business knowledge, their practical acquaintance with agriculture, and their social position and influence, is surely entitled to at least an equal degree of attention and consideration with that maintained by those who advocate the revision and, as some do, the abrogation of the land laws as the only cure for all the evils affecting farming. This, it appears to us, is not asking anything one-sided or unfair; nor is it unreasonable to ask that it should be considered as a factor—if not an important one, still a factor—in the solution of the question.

In the paper read by Mr. Brassey, M.P., to which we have alluded in a preceding paragraph, we find the following. It includes a number of very striking facts connected with American farms as compared with our own, and of their production as bearing upon the question of competition. The remarks of Mr. Brassey have special reference to the influences which have brought about what may be called the law regulating the size of farms, and also to the question of small farms we have discussed. But the remarks are obviously directly applicable to the principle we referred to in last paragraph, that the relations of landlord and tenant have been in the past, and can be regulated in the future by themselves:—

'It is a most remarkable circumstance, that the distribution of land (in England) for the purposes of cultivation is approximately the same under the system of absolute liberty to buy and sell which prevails in America, and under the more restrictive system which has been handed down from a remote antiquity in our own country. The average size of the farms in seventeen representative counties of England has been ascertained to be 152 acres; the average size of the farms of the United States, according to the census of 1870, is 153 acres. If smaller holdings had been found to offer greater advantages to the occupiers, no obstacle would have been raised on the part of the English landowners as a body to a more minute subdivision. The area of our farms has been determined by long experience, and has been settled, as between landlord and tenant, by countless independent negotiations, each party to the bargain having looked mainly to the protection of his own interests in the transaction. Here, therefore, we find yet

another illustration of the practical ability of the English people to correct imperfections of method and of form without the aid of legislation.'

And yet, notwithstanding such facts and opinions, and others patent to all who know the whole subject, we find schemes of change in the land laws of a most remarkable character warmly advocated. Those schemes are remarkable for their utter absence of those features which convey to the mind almost intuitively the impression that they are business-like in character, distinguished by common sense, and therefore eminently safe. It is perhaps not a matter for surprise that exceedingly wild and dangerous views should be advanced by agitators who have the ears of the labourers, and abuse it so often to their great loss. But it does, to say the least, appear to be a very depressing feature of the times we live in, that such ill-considered schemes as those we have alluded to—to write of them in the mildest terms—are maintained by men of the highest standing, and received with vigorous applauding by cultivated audiences, and enforced by ill-considered opinions, which both speakers and hearers must surely know are wrong, and utterly subversive of all that constitutes the right to hold property. No revision of the land laws, or of any other law, will or can possibly be right which is obtained by the sacrifice of a right principle. That a just revision of the land laws is competent, and that there are many features of them which it would be to the advantage of both landlord and tenant to have altered, and in some cases done wholly away with, no one denies; and this will better and more quickly be secured by considering fairly both sides of the question, as affecting those who can concede and those who claim concession. But that much can be done in getting rid of the evils which press upon many by meanwhile taking advantage of the customs of commercial law usage, and the regarding of the rights and privileges of the laws as they at present exist, not a few practical men believe. By thus simply taking advantage of a remedy which is already within the reach of all, the difficulties, to some extent at least, may be overcome. And this desirable end may be still more quickly attained by attributing such generous and chari-

table motives to others as we claim and expect to be given to ourselves.

The latter consideration may by some be looked upon as simply sentimental. It may be this, but it is something more. For it is but another way of stating the value of the system of 'compromise,' of 'give and take,' which practical men who are distinguished by common sense know so well the value of. And certainly in this great question of revision of the land laws, the discussion should be conducted on fair principles. This has not always been, nor is it now always done. For while all liberty is given, or proposed to be given, to those who wish concessions made to them, equal liberty is refused to those who are asked to concede. And this certainly seems to be anything but a fair way to deal with the matter, to say that the tenant, if he has ever the opportunity or chance to make a good bargain with his landlord, has full right to do so, and is to be praised for doing it; while, on the other hand, the landlord is to be debarred from making the best bargain he can with any proposing tenant. If this mode of dealing with the case is to be conceded and admitted as the correct one of the future, it will be a most effective way of getting rid of that other and better method, which hitherto has been and now is found to be so effective, and which is alluded to in the last paragraph but one, in the words of Mr. Brassey, M.P., as a method to 'correct imperfections of method and form without the aid of legislation;' in other words, that system of mutual concessions and admissions which are, by the universal consent of society, held to be indisputably necessary to the just and therefore in every way satisfactory settlement of any question. But the misfortune of the thing is, that, while admitted to be so in one's calmer moods, when judgment is allowed to preside, not prejudice, so soon as the warmth engendered by opposing interests, or those which are supposed to be opposing—the result in both cases is practically the same—is aroused, those principles often wholly vanish, and all the consequent evils follow with their disappearance.

There can be, and we make, no exception to the application of those principles now stated. Where it is forgotten by one party, no matter how deeply we may sympathize with its position, its

aims, and work, we are as ready to condemn its action as when it is forgotten by the party occupying a different position in our estimation.

Shrewd business men will not look forward to the time with anything like satisfactory complacency, when this old but thoroughly good method of settling business difficulties is done away with. Certainly none the more satisfied when they find that it gives place to a method as regardless of the feelings of one of the parties concerned, as it is of his just rights and privileges. For how is it,—and the question may well be asked, in view of the strange schemes we find advocated by many who certainly ought to know better,—how is it that landlords are excluded, or proposed or expected to be excluded, from the privilege accorded to all other classes of managing their property in the way they conceive best calculated to promote its interests? What is there connected with land which brings this about? Is there anything connected with it which sets it aside from all the rules of political economy, of which we certainly have heard much of late years? There is much that is pregnant with the weightiest interests in the reply to questions such as these, bearing upon all classes of society in possession of property in land alone. Land is surely as much a property, just such an investment, as cotton mills, ironworks, shops, or the like. Do we ever hear of unjust demands being made in the case of cotton mill, coal pit, mineral property, or the like, to split up their gigantic structures or their far-reaching seams into a large number of small departments, each of which is to be worked by one of their workmen, or let off on demand to some working man who may be utterly ignorant of cotton and all connected with it, or who only knows the difference between coal and iron? Are the owners of these classes of property ever denounced in the same terms, and have the base motives been attributed to them, with which the proprietors of landed estates are so familiar? And yet there are those who fail to see, that if the principles of interference with private rights justly founded are to be carried out in the case of owners of property in land, they should also be carried out in the case of owners of mill or of any other property. Surely the well-known astute-

ness of business men must have failed them, if those of them who advocate the compulsion of owners of property in land to deal with it as certain parties wish it to be dealt with,—failed them, assuredly, if they do not see that if landlords are compelled—for it appears to be fast coming to compulsion—to parcel out their land for the benefit, or assumed benefit, of their labourers, other consequences will follow. Many business men appear to have overlooked this, and what those consequences are. They know but little of their workpeople,—‘their hands,’ as they are called invariably, as if heads and hearts were of no moment in the reckoning,—if they suppose that they will not quickly learn what is taught them, and begin to ask—and some are inclined to do more than this—why they should not have a slice of their master’s property as well. They are apt scholars enough in this school of ready reprisals. And in view of the fact that they have learned the lesson to a much greater length than many are aware of, it would be well for the country generally to take special note of, if so be that some means could be devised for getting rid of such communistic movements, so heedlessly begun by certain agitators. The main feature of all such schemes is, that the land is proposed to be taken from the landlords and from the farmers also, and given to the labourers and others,—a curious way, certainly, to get rid of agricultural distress by so largely adding to it.

It is impossible to write too earnestly on this subject, more especially when schemes are brought forward each of which is said by its proposers to be a perfect panacea for the evils or assumed evils which oppress or depress agriculture. But those schemes, when looked into and stripped of the sophistical expressions by which their true character is glossed over and disguised, are at once seen to be nothing else but schemes of confiscation. The very terms in which they are stated proves this, and in such a way as the veriest schoolboy would understand. No doubt the proposers of such methods of dealing with the land difficulty very indignantly repudiate, as is certain to be the case, any such intention on their part. But if landlords are by Act of Parliament compelled to sell their land whether they wish to sell or not, and are further com-

pelled to accept of such sums as Parliament in its wisdom sees fit to decide upon as the right price to be asked, what does such a proposal mean? what can it mean but what the words convey? No doubt the proposers will indignantly repudiate all such intentions on their part as to propose for the consideration of business men what all business men will at once see, on calm consideration of the important point at issue, is a complete subversion of or doing away with all those ties or bonds which make property honestly obtained sacred from all attacks.

We say in calm moments, for our profoundest thinkers on ethical subjects have not failed to note how prepossessions, preconceived notions, or prejudices go very far to warp, often so far as completely to becloud a man's mind, so that he at first consents to a proposition at which afterwards his reason revolts. We feel, therefore, quite at ease as to the ultimate reception or treatment of the proposals we have referred to, or such modifications of them—but still going in the same lines—as may yet, in these days so fruitful of schemes of change, be brought forward. When once it is known that such schemes do away with 'freedom of contract,' business men of all classes will perceive that it is then high time to put a stop to them, as utterly subversive of the best interests of the country. For no one knows better than they do how this 'freedom of contract' is the very essence of sound business. On this point men of all shades of opinion are agreed, and but a very small minority indeed would be found who, as having opinions differing from this, would be disposed to support schemes of land treatment and disposal such as those we have just described. Beyond all dispute, their supporters are bound to prove four things: First, that landed property *qua* property is placed under such exceptional circumstances that it may be dealt with exceptionally; in other words, that if you have invested in property of any kind save and except land, the law will secure you in the possession of it in perpetuity, and under all circumstances will protect your rights thereto; but that if you invest in land, the same law, in place of protecting your interests therein, will

deem itself quite right to take it from you for a definite purpose. In the one case, any one taking your property will be looked upon as committing a felony; but in the other he will simply be exercising a right. The second thing the supporters of those schemes are bound to prove, is (granting the first to be admitted as proved) that the class for whose benefit this change of land proprietorship is to be made will really be benefited and raised in the social scale, and be in every respect better off as proprietors of small farms than as labourers on large ones owned or occupied by their employers, or than when engaged in other callings to which they have been brought up. The third thing to be proved is, whether under the new system of small-farm cultivation the average annual increase or yield will be much higher than it is under the system of large-farm cultivation. The fourth and last is, whether under the new *régime* of small farming, agriculture as a science and an art will make greater progress than it does or has done under the old *régime*, and whether the improvements which are beyond dispute the present characteristics of every department, crops, stock, and land, and all connected with them, shall be equally the characteristics of the same departments under the new *régime* yet to come. When these four points are satisfactorily answered, then, but not till then, will be the time to consider how the new scheme or system could be carried into effect without greatly endangering the interests of the parties concerned in the retention of the present system. Should ever such a train of inquiry as we have indicated above be instituted, we confess we cannot congratulate those connected with and interested in its successful termination on the nature of the task which will be before them, or the chances that that termination will be quickly reached. It is they who have themselves raised the difficulty, and with them rests its solution.

Modifications in Systems of Farming.—Setting aside proposals advocated by many, much of which is visionary, and some of which it is impossible ever to be attained, others there are who take a more practical view of the position. In no way ignoring the depression under which farming labours, they try to discover some methods by which that can be more profitably carried on, and

the effects of depression lessened, if not to a great, yet still to such a moderate extent as to be a decided relief.

As may well be conceived, such methods, constituting as they do modifications on the usual or ordinary methods of farming, are numerous enough. They are, of course, received in different ways by different men. Some of them are sneered at as wildly absurd, and therefore eminently impracticable, and are set aside as those which are not worthy of any consideration whatever. This must not be matter of surprise,—‘many men, many minds.’ But when so many suggestions are made, and the results of so many actual trials of methods placed before the farmers, it is but reasonable to conclude that out of the whole as thus presented to his notice he should be able to pick up something useful to him in his own practice. He is said to be but an utterly ‘poor thing of a man’ from whom nothing can be learned, no information of some value obtained. In like manner, if out of one of the modifications in ordinary farming proposed nothing can be got, surely out of the aggregate of several proposed modifications some little can be secured.

Thus those most likely to meet with the most notice, and some of the points of which are most likely to be adopted in practice, are obviously those modifications which do not propose any violent change, any very great wrench to the opinions, and, as some would call them, the prejudices of a lifetime of practice. And this is a reasonable view. For farming, unlike other branches of industry, is not capable of being so completely, and certainly not so quickly changed in the details of its system. We have in various parts of preceding sections and paragraphs drawn attention to modifications in practice which are of the character above noted. These are easily adopted, and most of them do not constitute changes so much as they form simply legitimate developments or outcomes of the ordinary methods of farming. In brief, they are rather new details of the old, than parts of an entirely new system.

The circumstances in which the farmer is now placed, and the conditions under which he works, are so changed and changing, that it is incumbent on him to look about in every direction

to see that in which help can come to him. The wise and prudent will do this, and do it judiciously, and success will to a greater or less extent enrich him. But he has but a poor chance of securing even the smallest portion of this, who prefers his prejudices to his pocket or his purse.

In connection with what we have already given, bearing and as concluding our remarks on this subject, we give the following interesting extract. It may be to some suggestive of perhaps more than one practically useful point. The extract is from an article in a leading journal of the day upon Mr. Brassey’s paper, to which we have in preceding paragraphs made allusion. Its opening sentence will remind the reader of a point on which much has been written of late, namely, the necessity there is for having a Minister of Agriculture as one of the Privy Council:—

‘In the United States there is a Department of Agriculture, part of whose business it is to keep the farmers well informed of the condition and prospects of the crops both in Europe and America, and to give them timely notice when it seems likely that some new cultivation may be attempted with success. When corn, rice, and cotton became less remunerative in the South, the Department pointed out that sugar might be cultivated to advantage. It has lately published a manual on the cultivation of the fig; and it has urged Congress to institute a training establishment for those who might embark in silk. It is left to private individuals in England to do what this Department does in America, and we have plenty of counsellors on the subject. All seem to agree that in producing more fruit and vegetables, more milk and meat, and in diminishing his growth of grain, lies the safety of the British farmer in the future.

‘Mr. Brassey gives some interesting statistics to show the profit which may be made on orchards and on various kinds of vegetables. The average price of potatoes during the last ten years has been, in London, £5, 10s. a ton; the cost of cultivating an acre of potatoes is from £17 to £25, and the yield is from 5 to 10 tons an acre. Cabbages make from £60 to £70 an acre; onions, on an average, £35; cucumbers, £45. The rent of market-garden land within twenty

miles of London varies from £4 to £9 an acre; the labour is a little more. Our readers, therefore, can judge for themselves of the profits to be made by this business. . . . Fruit pays equally well when the original cost of planting has once been recovered. The cost of planting ground with apples and pears seems to average about £12 an acre; but the annual expense of keeping up an orchard is not more than £2 or £3, and as the return varies from £10 an acre in an average season to £50 in a very favourable one, the profit on the annual outlay is always very fair, and sometimes very considerable.'

We are at present in what some call a 'transition period' in the history of British agriculture,—that period which comes always at one time or another to every branch of industry, and sometimes more than once in certain limits to some. In such transition periods the workers often seem to rest contented with what has been done in the way of improvement, careless or indifferent about, or at least not very eager to introduce, methods by which that improvement would be greatly promoted. As transition periods come to all, they may and often do serve a useful purpose, as affording breathing times, so to say, in which thinking and energetic men take a quiet survey of the past, a calm outlook on the future, to see how far the experience gained by the one would serve as a guide to the work of the other. But with the majority there is perhaps too great a tendency to prolong the period; an attempt resulting generally in falling back—losing, in point of fact, much of what has been previously gained. If it be so that British agriculture is now passing through one of these transition periods, assuredly the influences at work around those interested in its progress are not such as ought to induce the *dolce far niente*, the 'rest-and-be-thankful' feelings we have alluded to. Never at any time in the history not only of agriculture, but of other branches of industrial callings, were there such a number of influences at work as now, these in some instances distressing, but all more or less distracting and disturbing. What the result to the 'industry' of Great Britain, using this term in its widest acceptation, will be it is not easy to say; but one thing is very certain, that if the difficulties brought about

by the influences we have alluded to be not fairly looked in the face, grappled with and fought fairly out, the result must of necessity be disastrous to the welfare of the nation. It is worse than idle to ignore these influences, or, if admitting their existence, to look upon them to a large extent as but the 'creatures of a day,' which will shortly fade away and be no more heard of. What these are we have in this our concluding section but too briefly glanced at. In our remarks we have endeavoured to show what those points are, how they are acting now, and are likely to act in the future if not met and dealt with.

But for the future of agriculture we have no fear, if only it be left free to develop its inherent energies. To maintain, as many do, that the life has gone or is rapidly going out of it, and beyond all hope of recovery, is simply absurd. But no better evidence could they give that they are ignorant of the whole circumstances of agriculture as existing in this country, than the fact that they can and do insist upon this absurd view as being the correct one.

So far from the life having gone out of agriculture, we hold precisely the opposite view, and maintain that, in view of the great work which yet lies before it, it has but entered, so to say, one of the earliest stages of its existence. So true is it, as has been said of the science, that it is at once the oldest and the most youthful,—old, from the standpoint of extreme antiquity, for, going back to the times when 'hoary grey with eld,' we find agriculture then, as now, the most honoured and most honourable of all; youthful, for on looking at its latest work we see every evidence of energetic action. Great as has been the advance made by agriculture during the last half-century, and truly wonderful as have been some of its developments, this may be safely said of her,—to paraphrase but slightly the ever-memorable words of Newton, at once the greatest and the most simple-minded of men,—'She has thus, like a child wandering on the sea-shore, picked up a pebble or two of greater value than before, but the great ocean of truth still remains unexplored before her.' It is not possible to name a single department in which there is not still a great work yet to do. Of some we have as yet but touched the fringe or outer edge, while their wide

expanse is all but wholly unknown to us; and of others, what we do know about them suffices but to show us how little we do know. Seeing this, it may, however, be said that better evidence could not be given that agriculture is dying out, if of all this great work yet to do, all those difficult problems yet to solve, she has not yet been able, nor is now likely to be able, to master them. But does this really hold true of agriculture? does it hold true of the other sciences, as, for example, telegraphy? Assuredly not. This, the latest development of the sciences, has simply performed wonders, and is daily doing what in times not so long passed away would have been designated as miraculous, or as the work of another agency. There is connected with it not one, but many points, on all of which every one, even the most learned and most expert in the science, agree to confess that they are profoundly ignorant. But this, so far from being accepted as evidence of, or brought forward as triumphant testimony to the fact that the science of telegraphy is dying out, is taken in precisely the opposite sense. And it forms, in fact, the strongest inducement that can possibly be laid before the most learned in the science, the most expert in the manipulation of the most delicate apparatus, to solve those problems, to overcome those difficulties. And although it may be somewhat unsafe to predicate what will be the result of the efforts now being made to bring forward those now unsolved problems into the region of demonstrated facts, yet it may be safely conjectured that the actual result of the efforts now being made by the experts will be to solve them. A like result has been attained before; it may be attained now—is, in fact, being daily attained, for the great difficulty of yesterday is the striking accomplished fact of to-day.

This, in reality, is the position of agriculture; it is one essentially of movement, and that movement is ever onward. Slow it may, nay, must be, for it has to deal with difficulties which do not admit of those rapid movements which distinguish the progress of other of the sciences. But if its progress be slow, it is none the less certain; and although it is not distinguished by those brilliant discoveries which are so apt to

dazzle the popular mind, its progress is marked by the quiet, unobtrusive victories over natural obstacles which give to thinking minds the most solid satisfaction. A science thus distinguished, alike by the successes of the past and by the reasonable prospects of the still greater successes of the future, is not likely to die out and become the effete thing which some seem to contemplate with pleasure. Not likely, even if it were not a science so intimately bound up with the well-being, nay, the very existence of the community, that the prosperity of the one is that of the other. But seeing that it is in reality this, and nothing less nor more than this, to talk of the decadence and the ultimate decay of British agriculture, as some do, is, as we have said, simply an absurdity. We have therefore no fear for the future of agriculture in Great Britain. We have still a science full of vigorous vitality, which is feeling and putting forth its strength from day to day in the making of fresh discoveries and in the getting rid of old difficulties. And more than this, we have still with us the good old race of British farmers, whose profound knowledge, daring skill, untiring energy, and indomitable determination have enabled them to weather storms as severe, to overcome times of depression as bad, and to recover from losses as crushing as those which have so oppressed them of late years. Those who doubt this know but little of what the British farmer is, and how he is now comporting himself in the midst of his great trials. With him, at least, there is no talk, simply because there is no thought, of giving up, or of giving in to these difficulties. The only determination he has is to do his best to overcome them. Those great scientific and natural advantages, and those high moral qualities and business attainments we have just alluded to, will stand our farmers in good stead in their present difficulties, and will do so in those which may yet be to come. Not less will they be aided in their endeavours to do the good work of their duty by maintaining, alike in 'all time of their wealth' as in 'all time of their tribulation,' that firm and abiding trust in the goodness and care of an all-wise Creator, to acknowledge whom the British farmer has never yet been ashamed.

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Weeds, Utilizing the ashes of burned,	444	Young farmer, The, and 'bank advances,'	554
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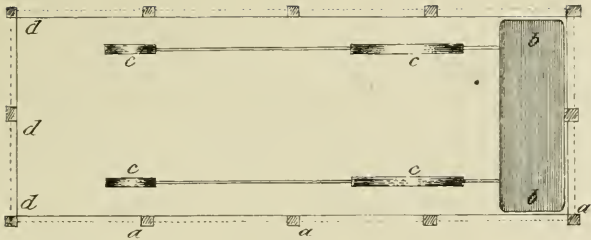


FIG. 1

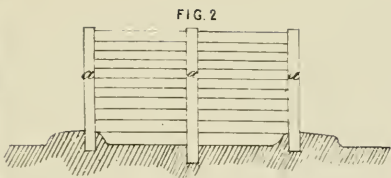


FIG. 2

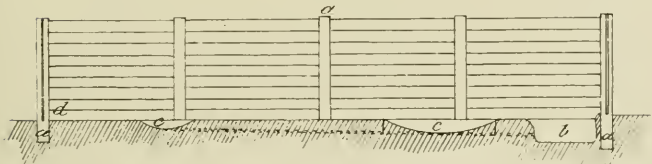


FIG. 3

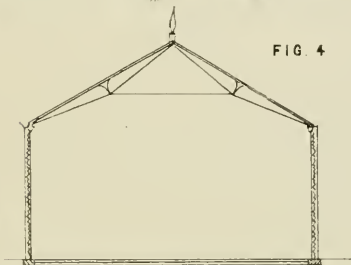


FIG. 4

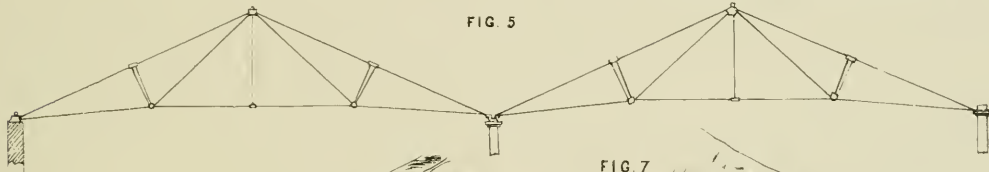


FIG. 5

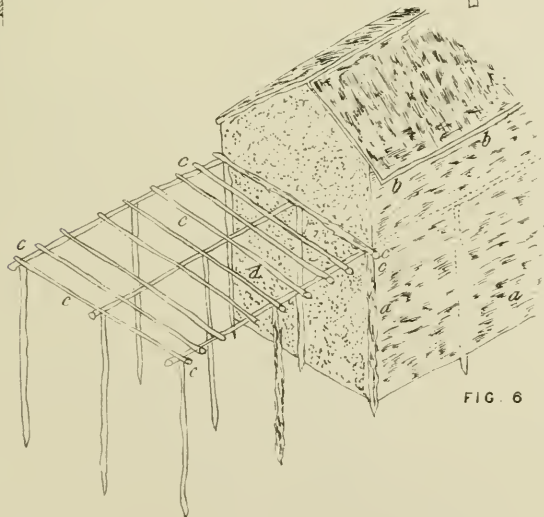


FIG. 6

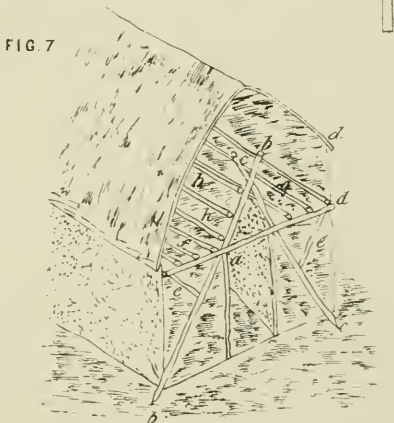


FIG. 7

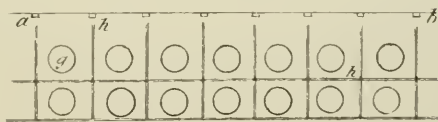


FIG. 8

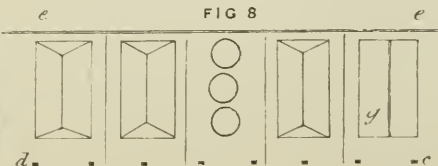


FIG. 9



FIG. 10



FIG. 11



FIG. 1



FIG. 2

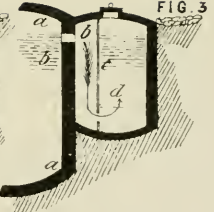


FIG. 3

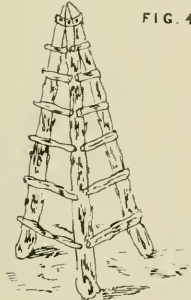


FIG. 4

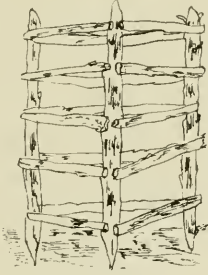


FIG. 5



FIG. 6

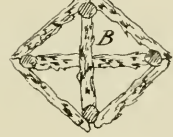


FIG. 7

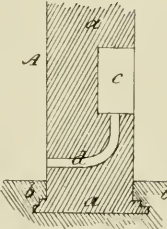


FIG. 8

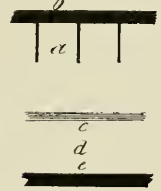


FIG. 9

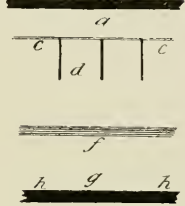


FIG. 10



FIG. 11

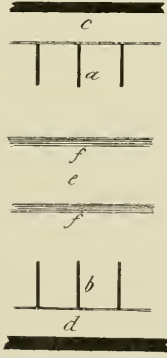


FIG. 12

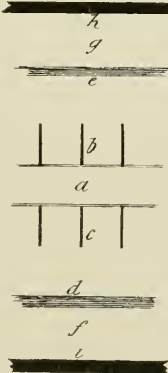


FIG. 13

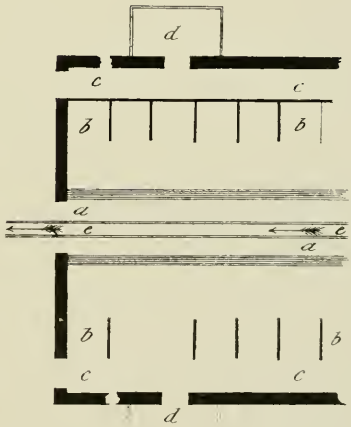


FIG. 14

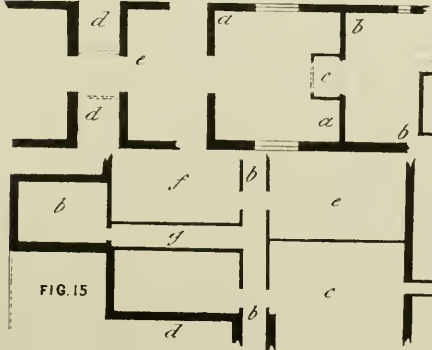


FIG. 15

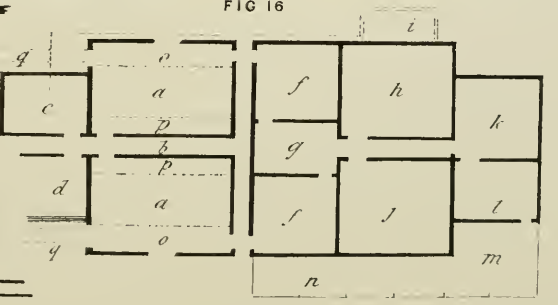


FIG. 16

FIG 1

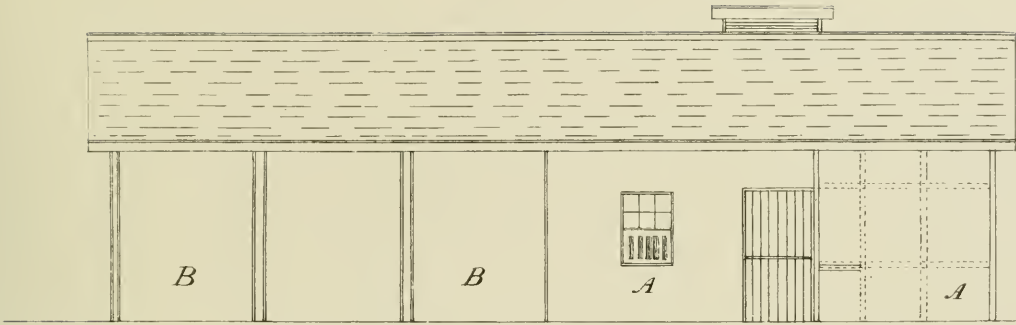


FIG. 4

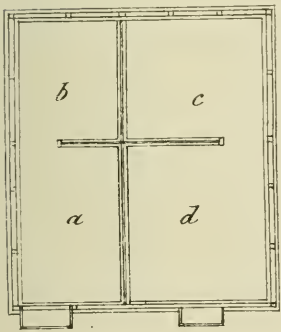


FIG. 2

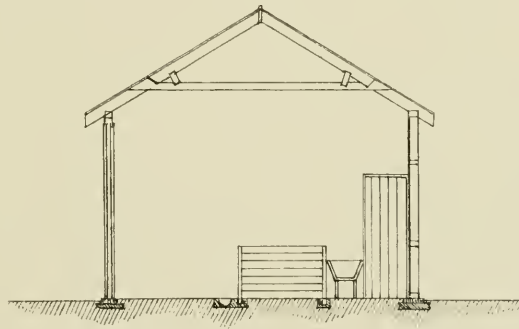


FIG. 5

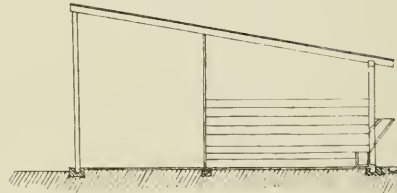
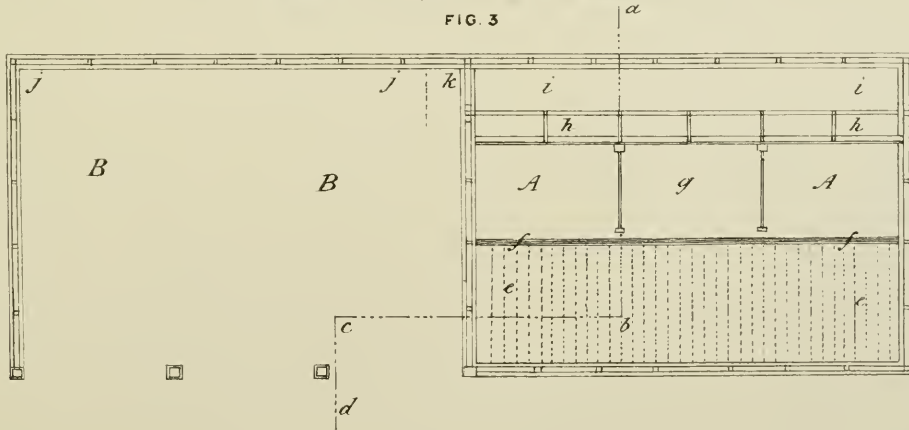


FIG 3



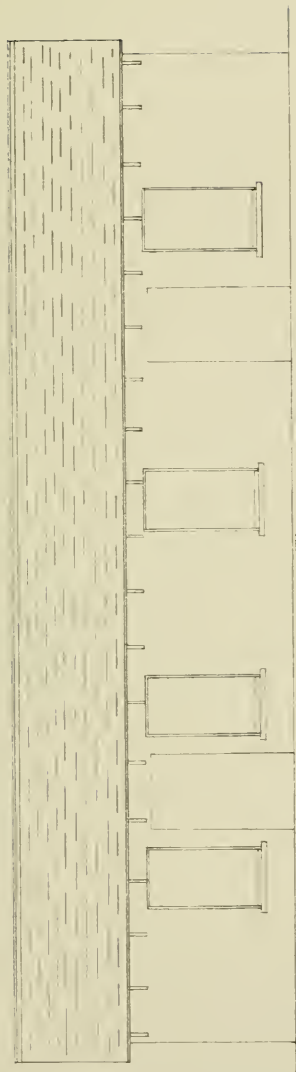


FIG 1

Scale 1/8" = 1 Ft

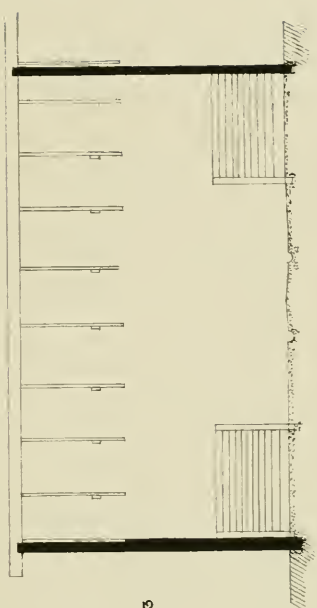


FIG 3

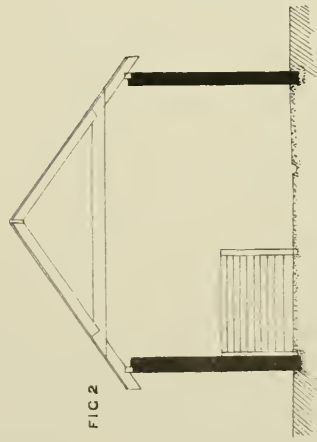


FIG 2

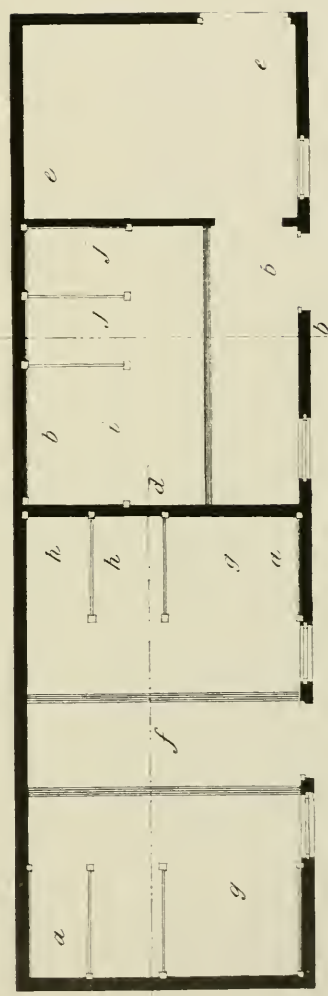


FIG 4

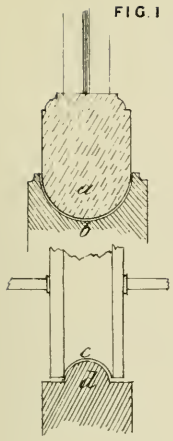


FIG. 1

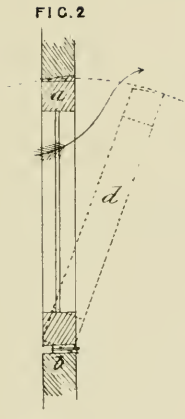


FIG. 2

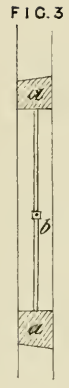


FIG. 3

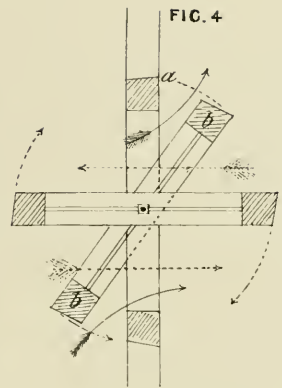


FIG. 4

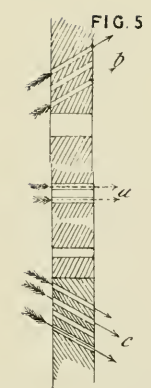


FIG. 5

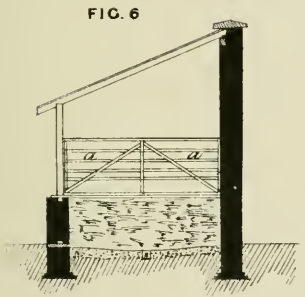


FIG. 6

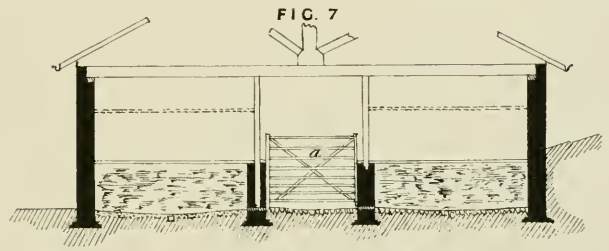


FIG. 7

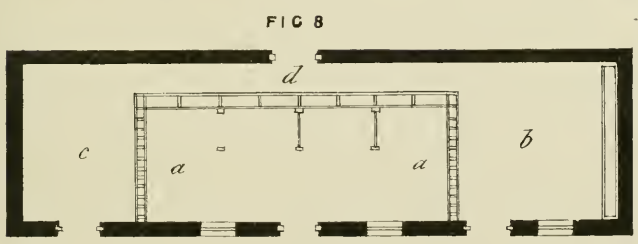


FIG. 8

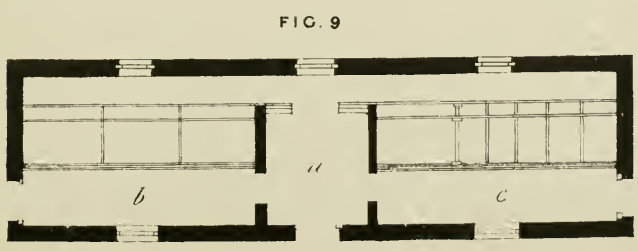


FIG. 9

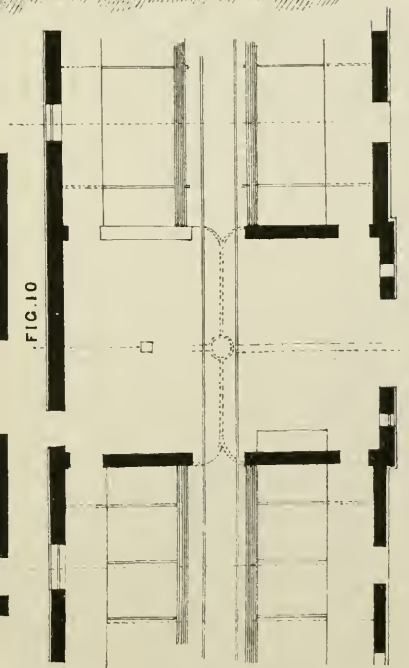


FIG. 10

FIG 1

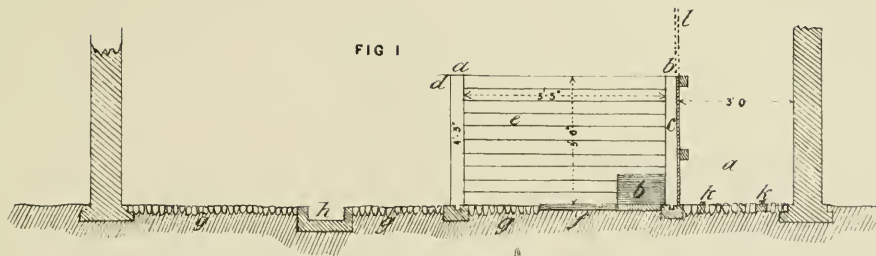


FIG 2

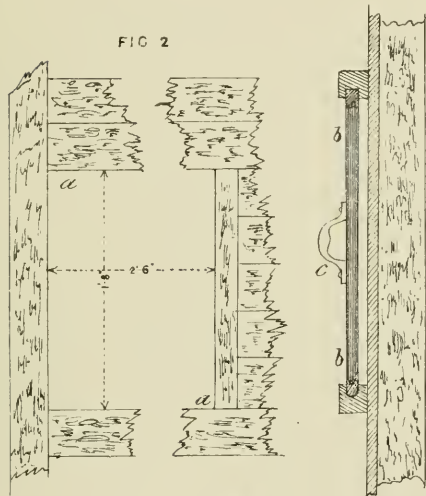


FIG 3

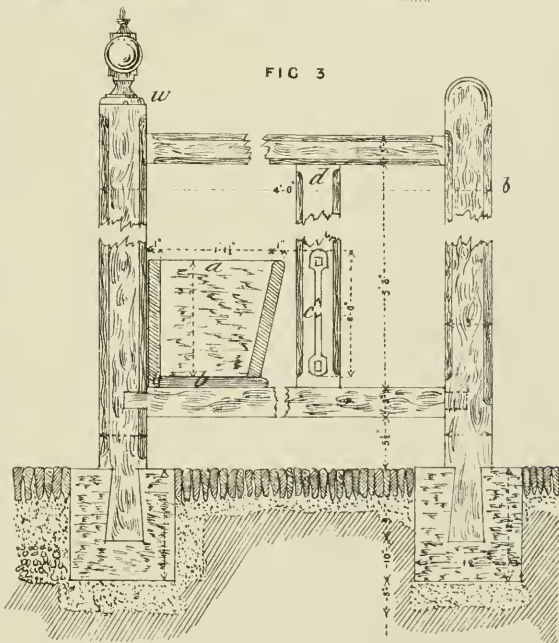


FIG 4

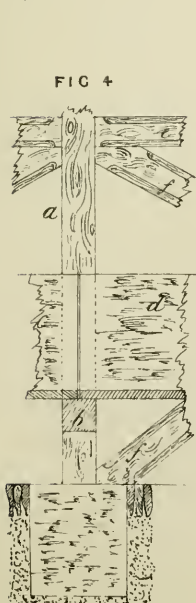


FIG 6



FIG 7

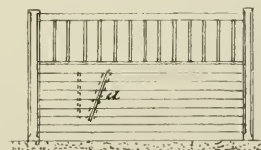


FIG 8

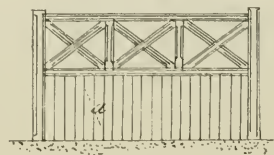
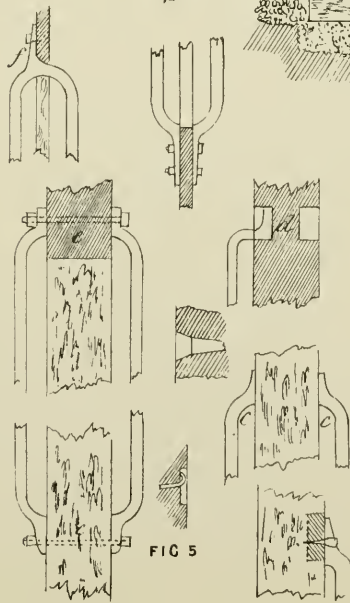
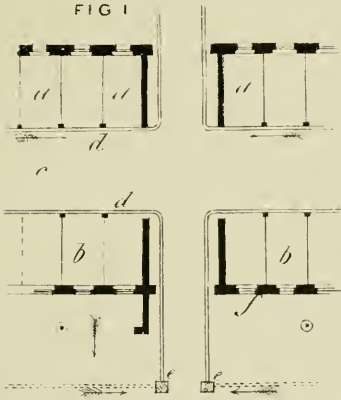


FIG 5



MODEL PLAN OF DOUBLE STALLED STABLE

FIG 1



MODEL PLAN OF SINGLE STALLED STABLE

FIG 1^A

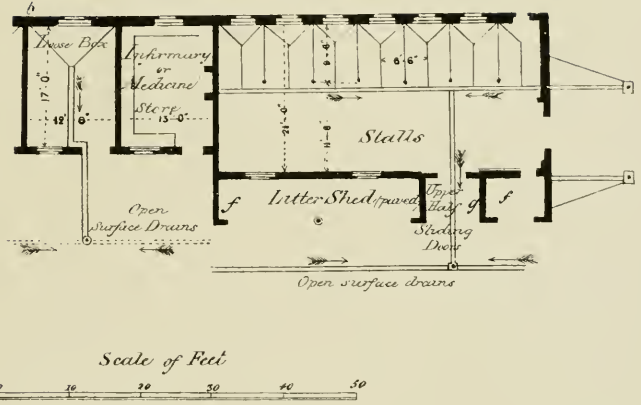


FIG 2

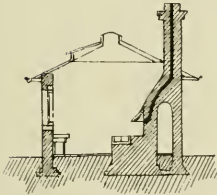


FIG 3

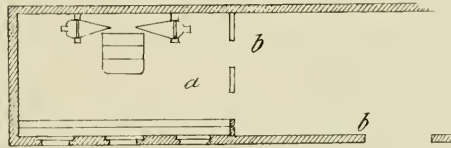


FIG 4

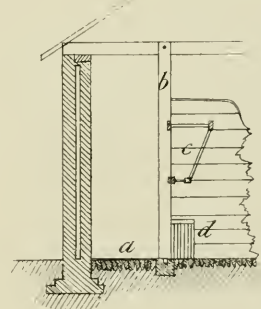


FIG 5

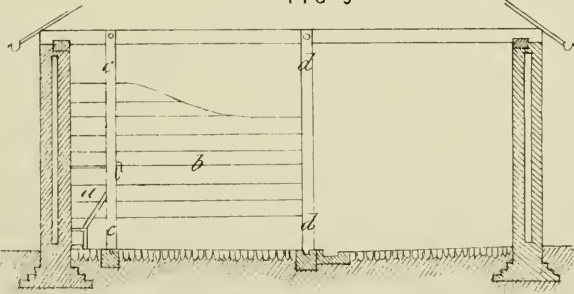


FIG 6

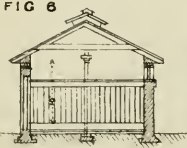


FIG 7

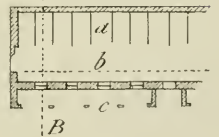


FIG 8

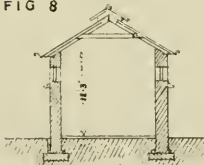


FIG 10

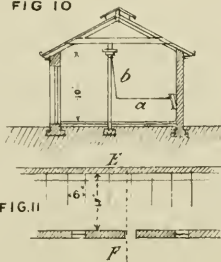


FIG 12

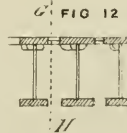


FIG 13

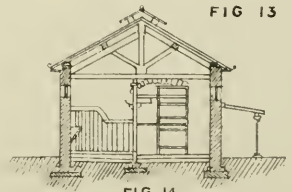


FIG 9

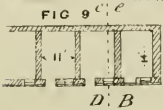


FIG 14

Scale to Sections

FIG 15

Scale to Plans

FIG 1

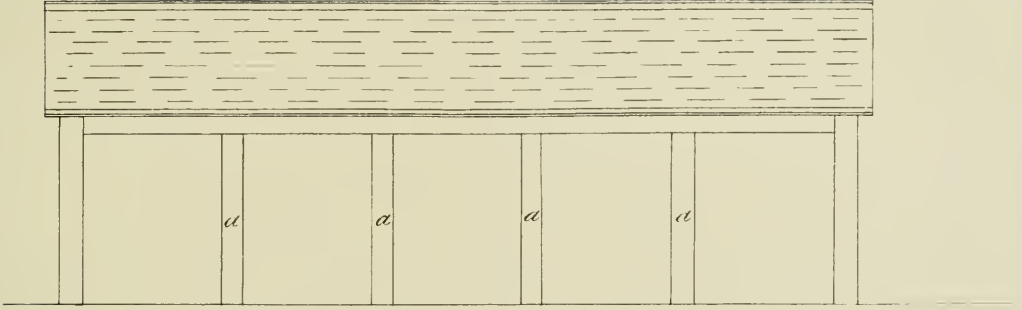


FIG 5

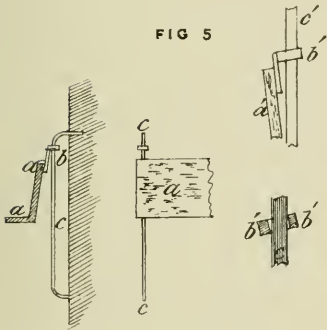


FIG 4

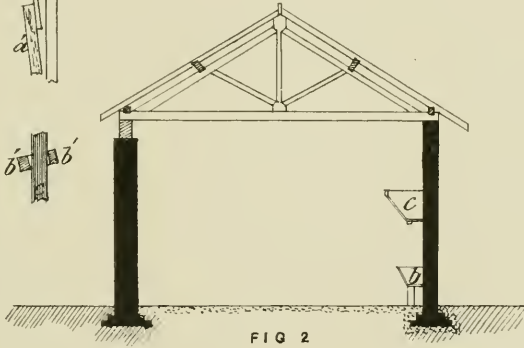
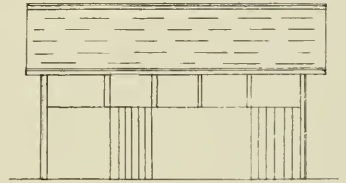


FIG 2



FIG 3

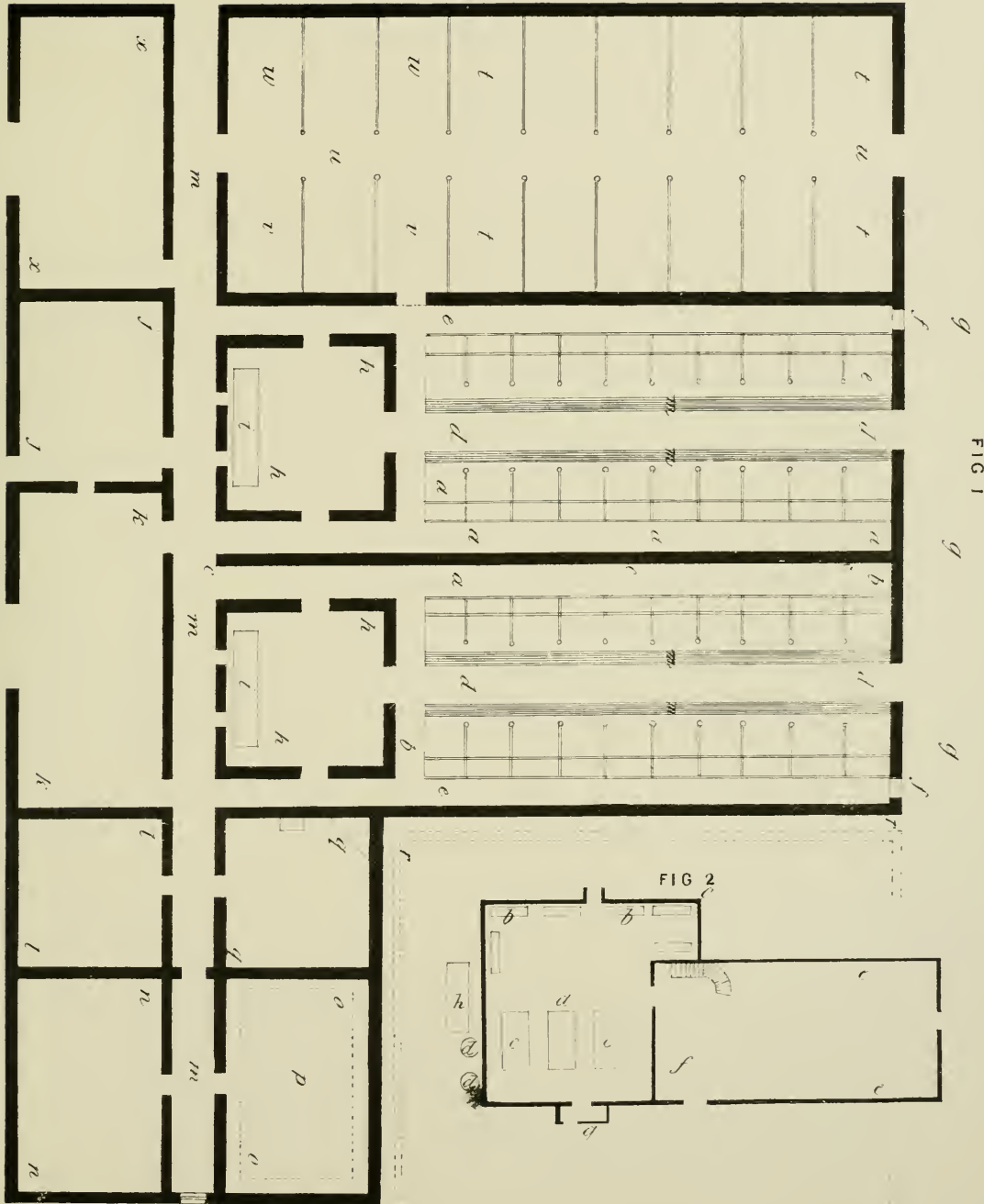


FIG 1

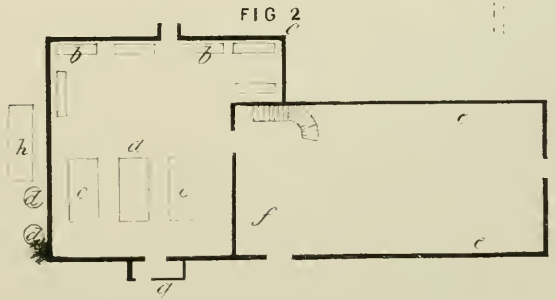


FIG 2

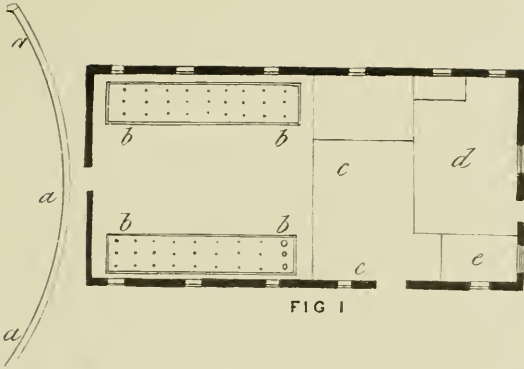


FIG 1

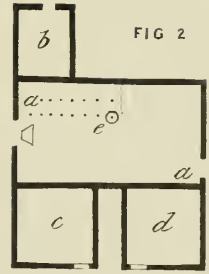


FIG 2

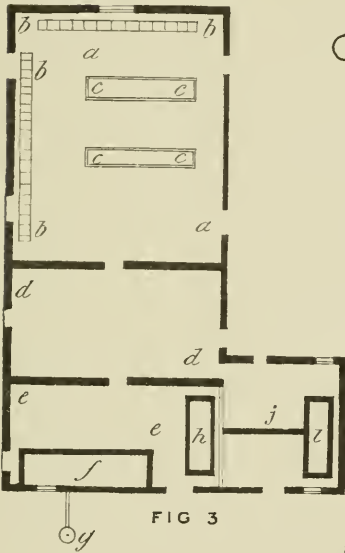


FIG 3

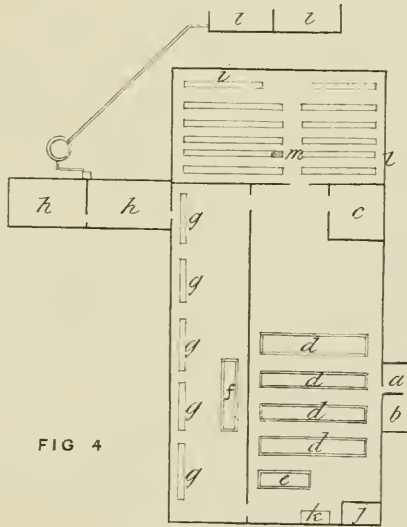


FIG 4

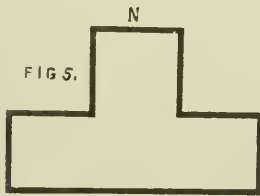


FIG 5.

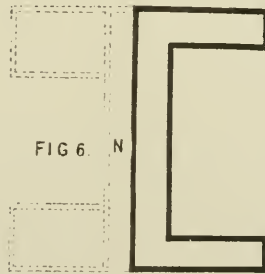


FIG 6. N

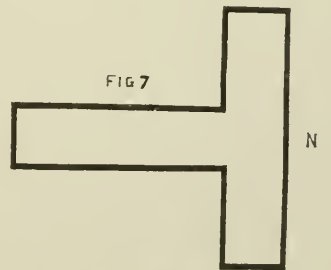


FIG 7

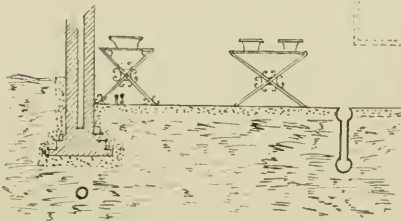


FIG 8.

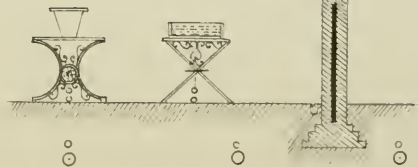


FIG 9

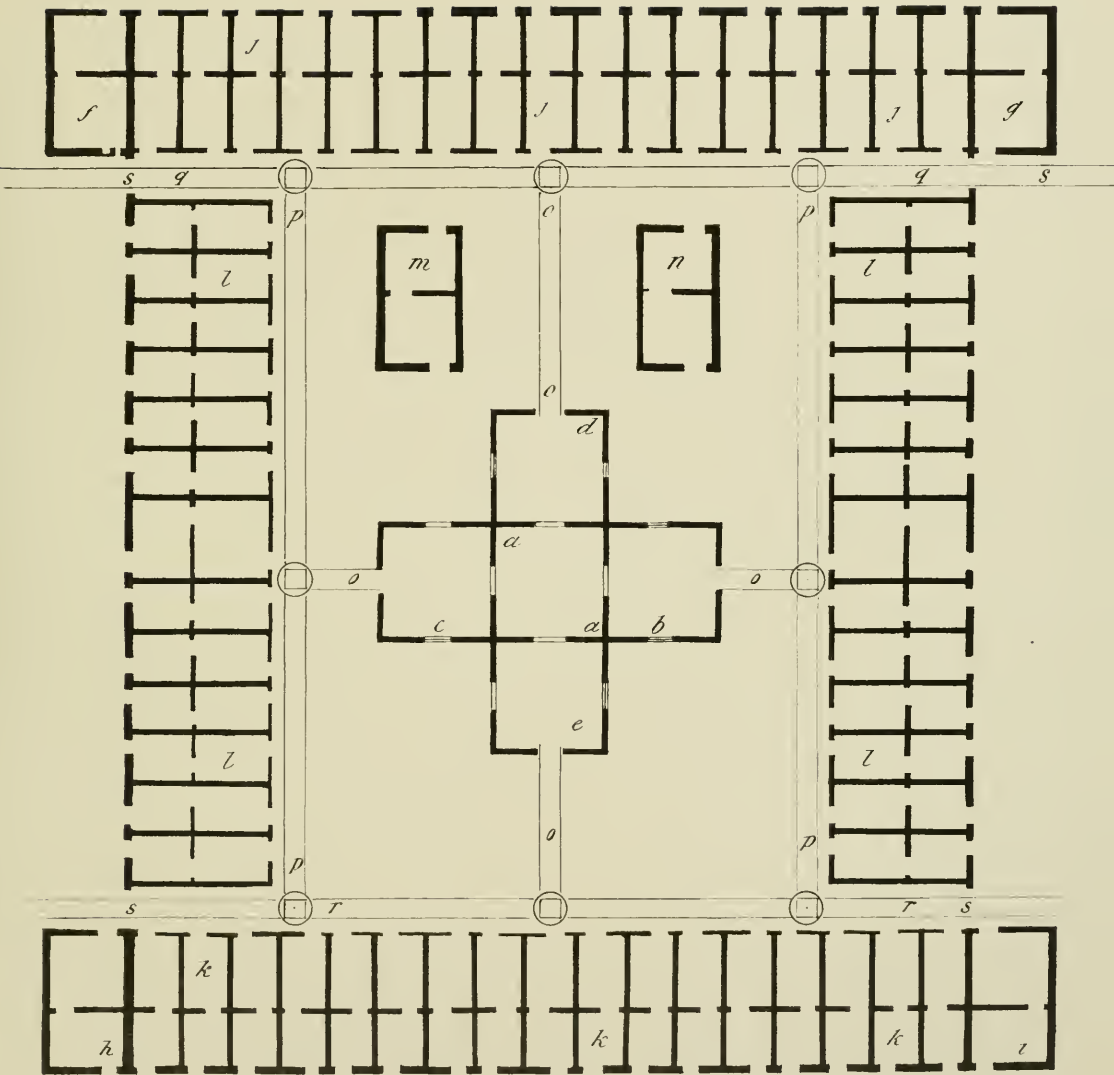
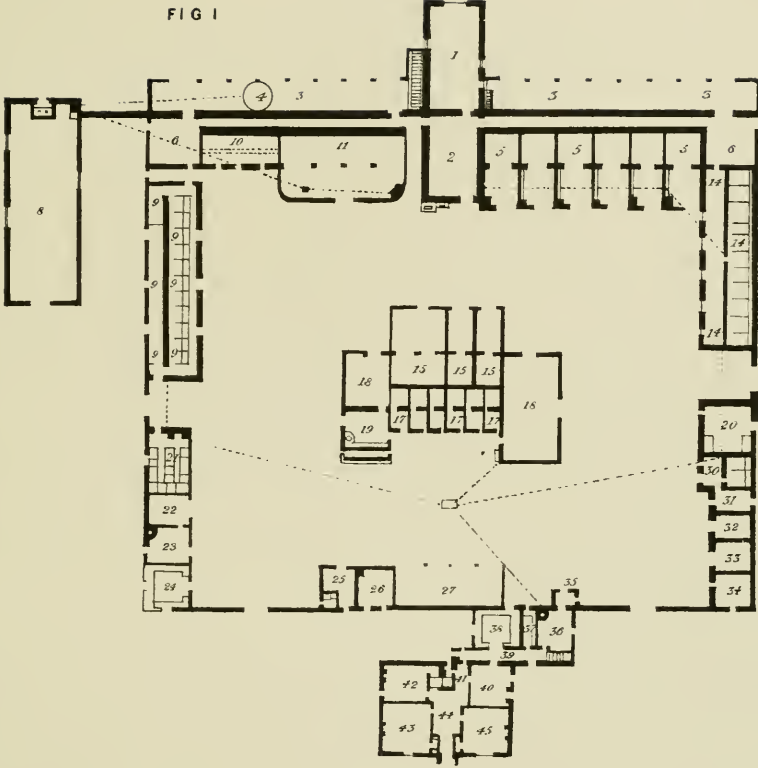


FIG 1



Scale 20' = 1"

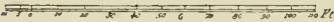


FIG 2

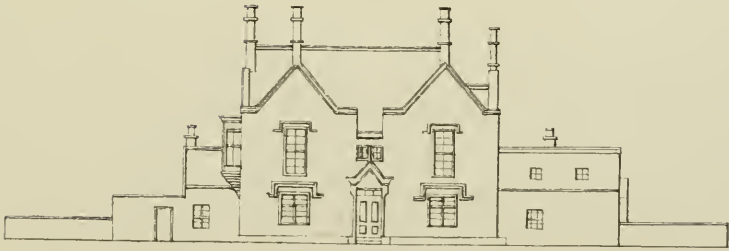


FIG 3.

FIG 1

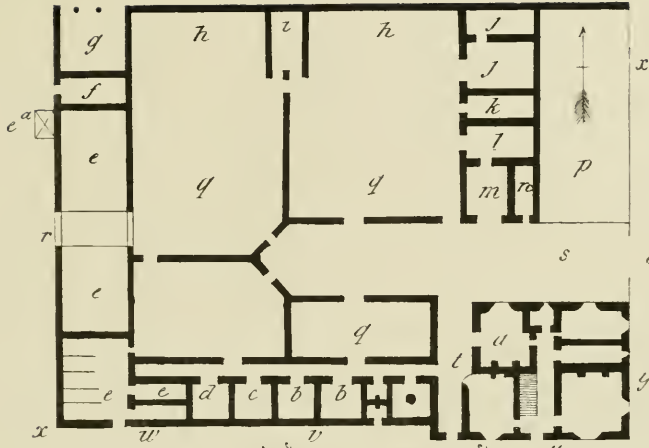


FIG 2

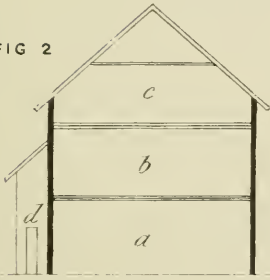


FIG 3

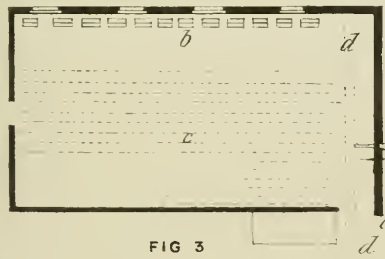


FIG 4

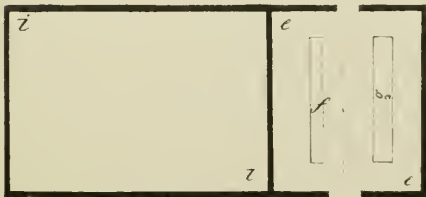


FIG 5

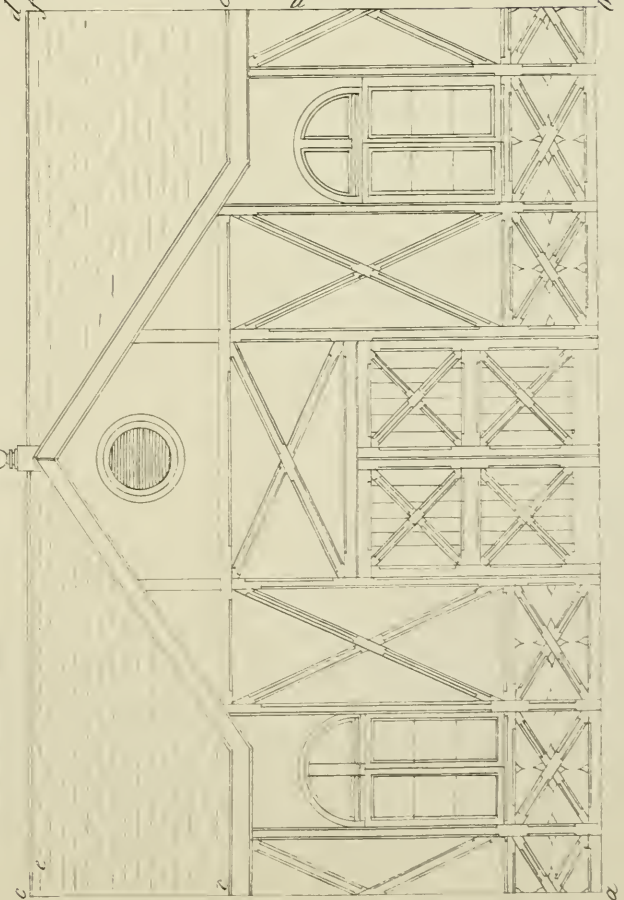


FIG 1

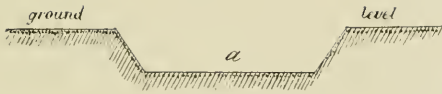


FIG 2



FIG 3

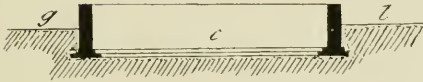


FIG 4

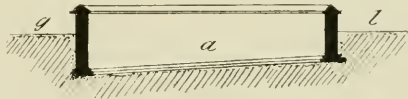


FIG 5

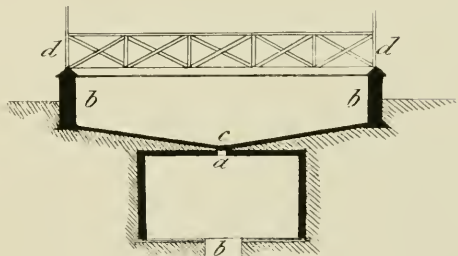
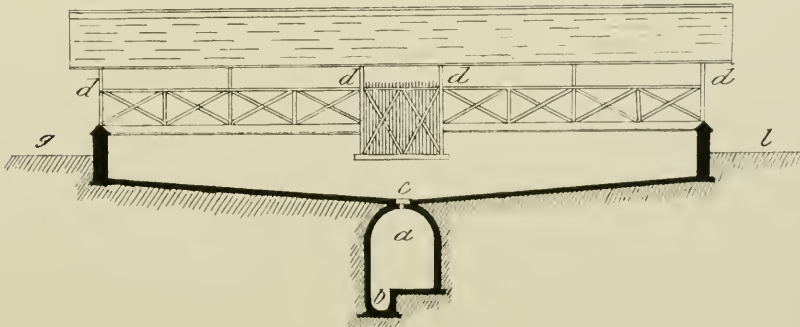
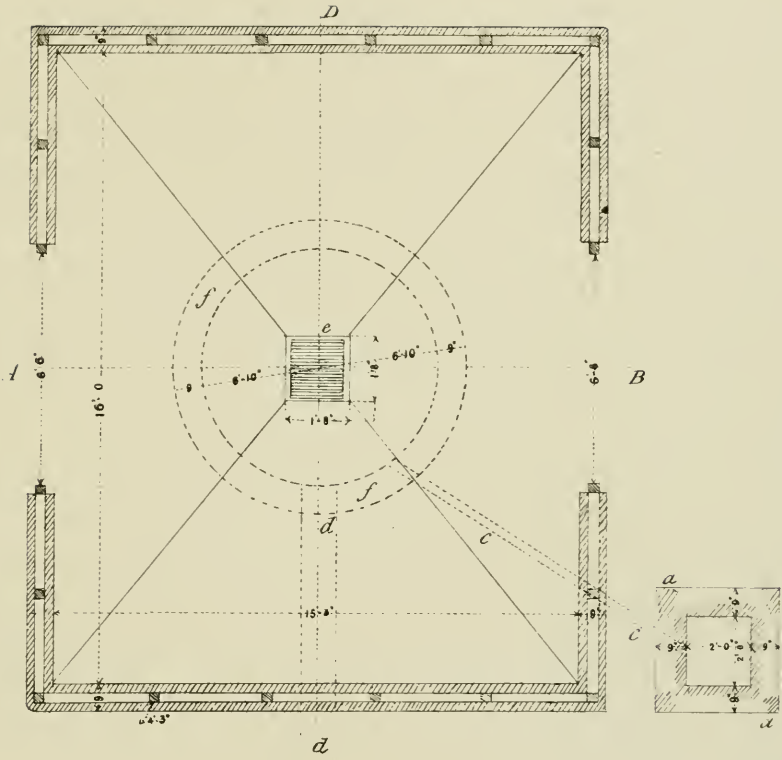


FIG 6

FIG 7





Scale for
Plans & Sections
In Feet 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

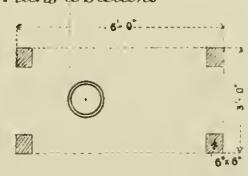


FIG 1

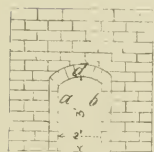
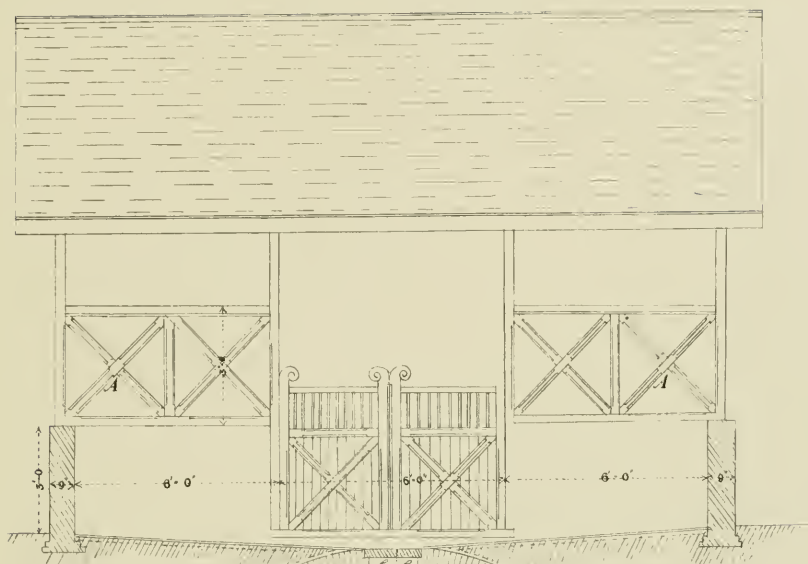


FIG 2

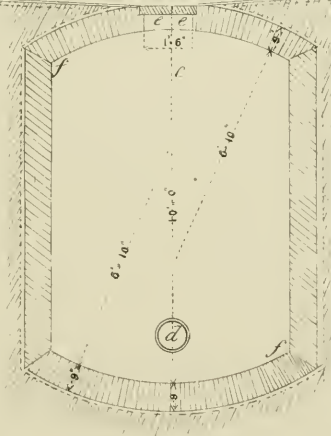


FIG 3

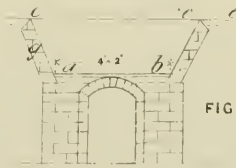
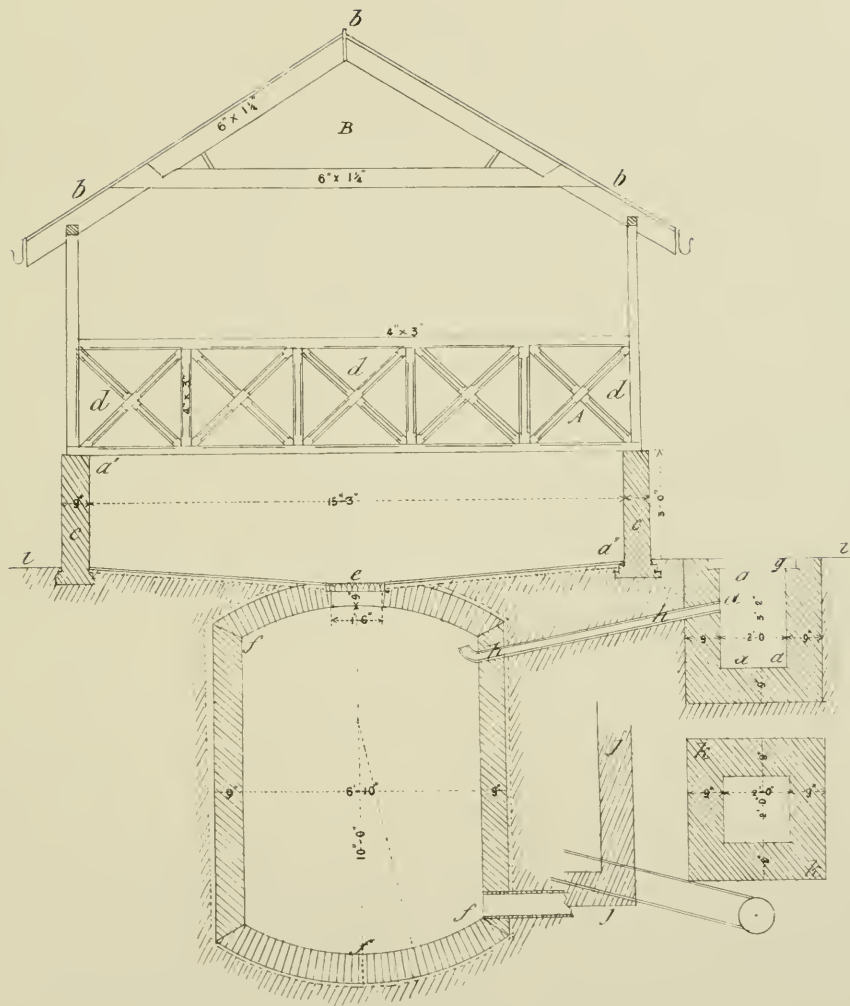
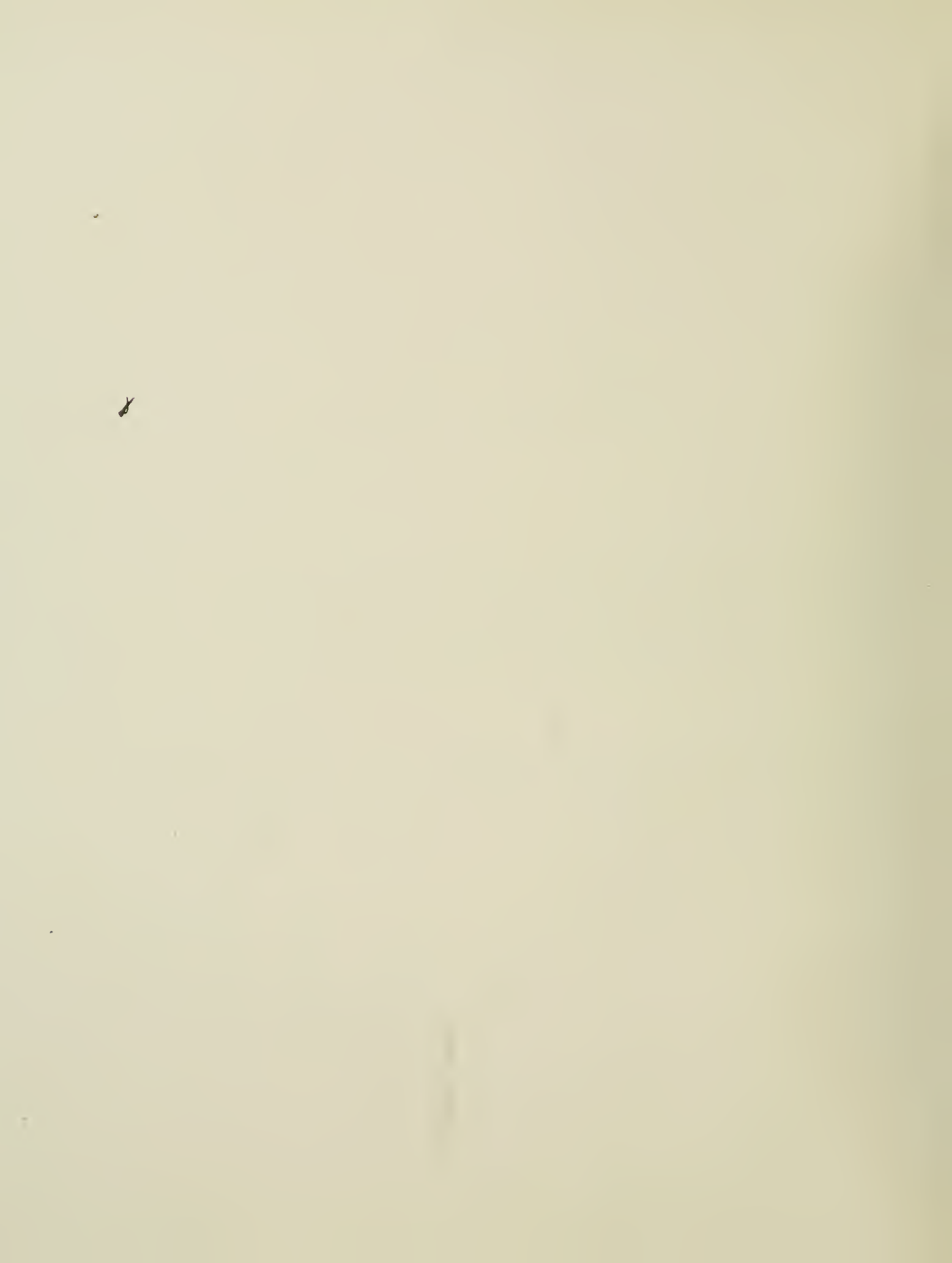


FIG 4





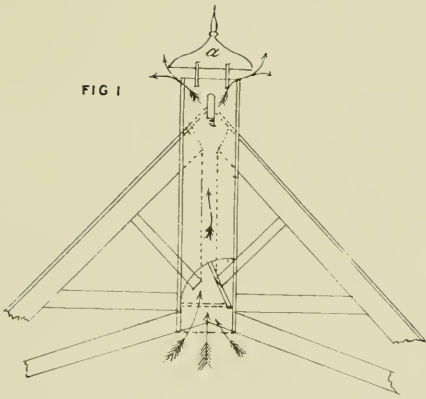


FIG 1

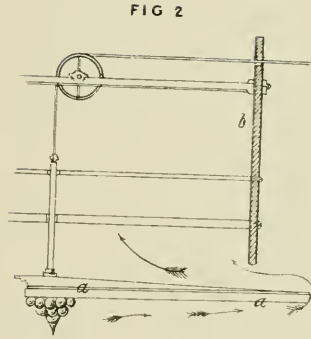


FIG 2

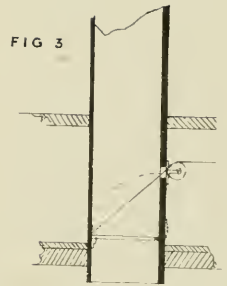


FIG 3

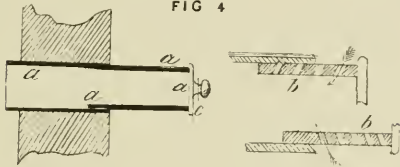


FIG 4

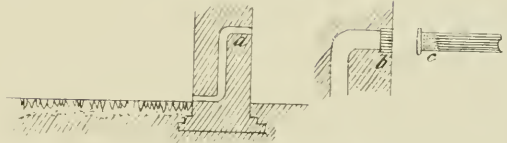


FIG 5

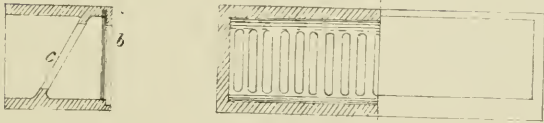


FIG 6

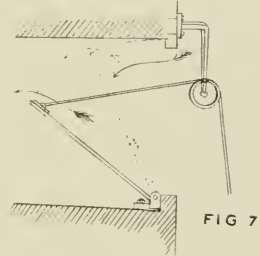


FIG 7

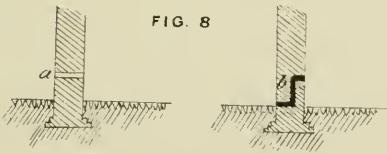


FIG 8

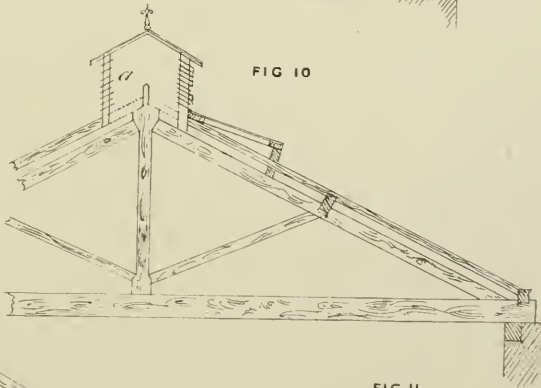


FIG 10

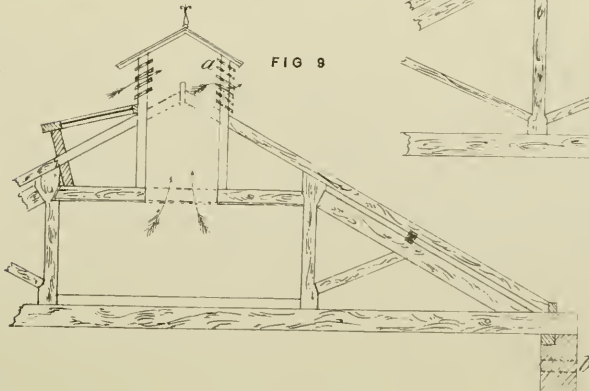


FIG 9

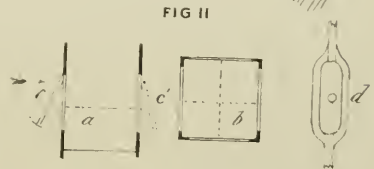


FIG 11

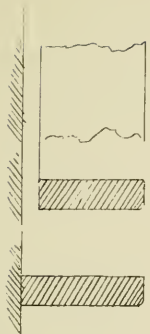


FIG 1



FIG 2



FIG 3



FIG 4



FIG 5

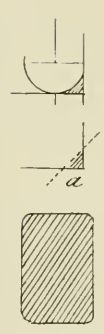


FIG 6



FIG 7

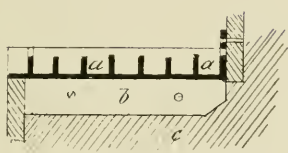


FIG 8

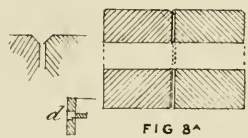


FIG 8^

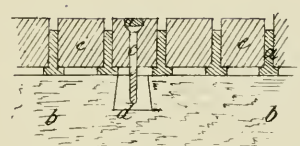


FIG 9

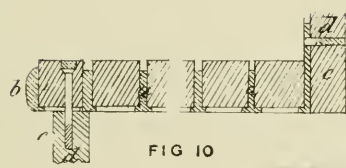


FIG 10



FIG 10^

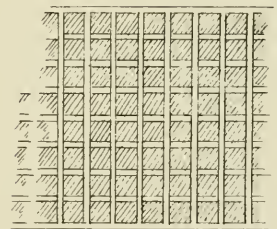


FIG 11

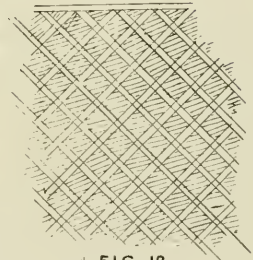


FIG 12

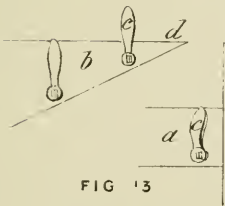


FIG 13

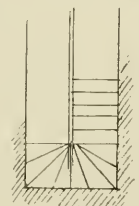


FIG 14

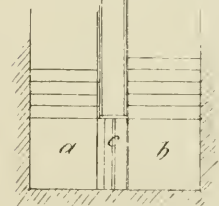


FIG 15

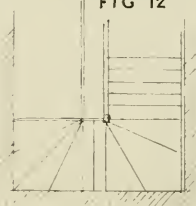


FIG 16

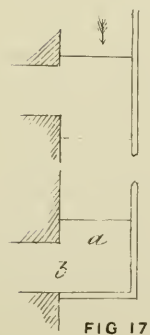


FIG 17



FIG 18



FIG 19

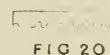


FIG 20



FIG 21

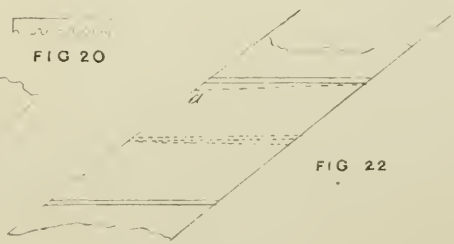


FIG 22

FIG 1

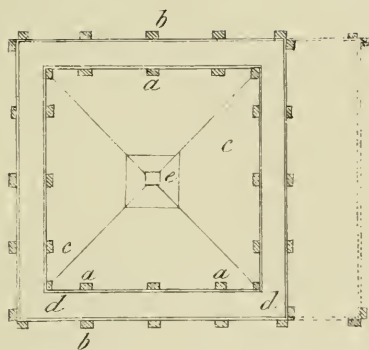


FIG 2

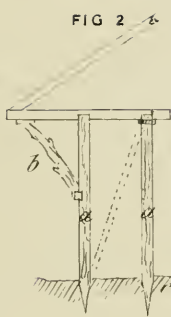


FIG 3

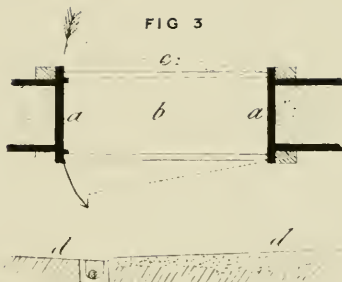


FIG 4

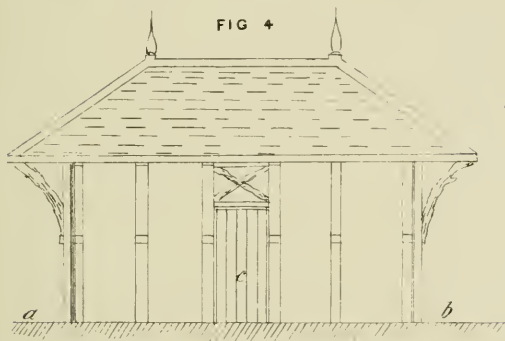


FIG 5

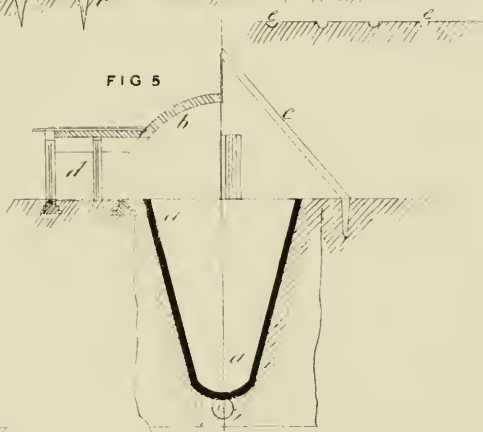


FIG 6

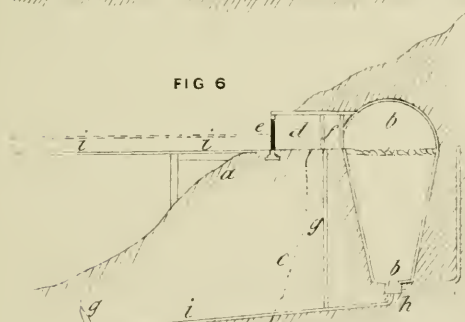


FIG 7

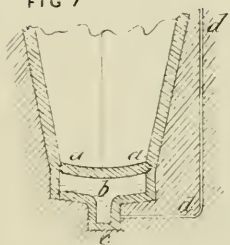


FIG 8



FIG 9



FIG 10

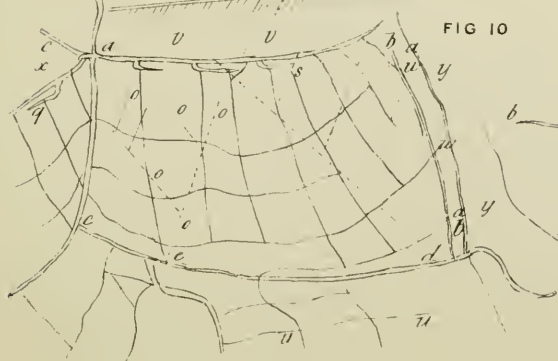
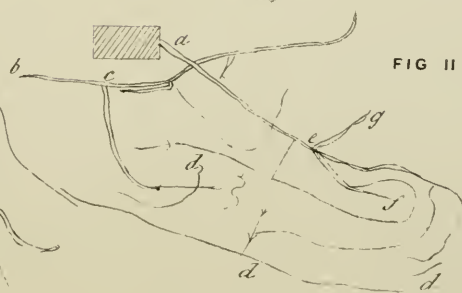


FIG 11



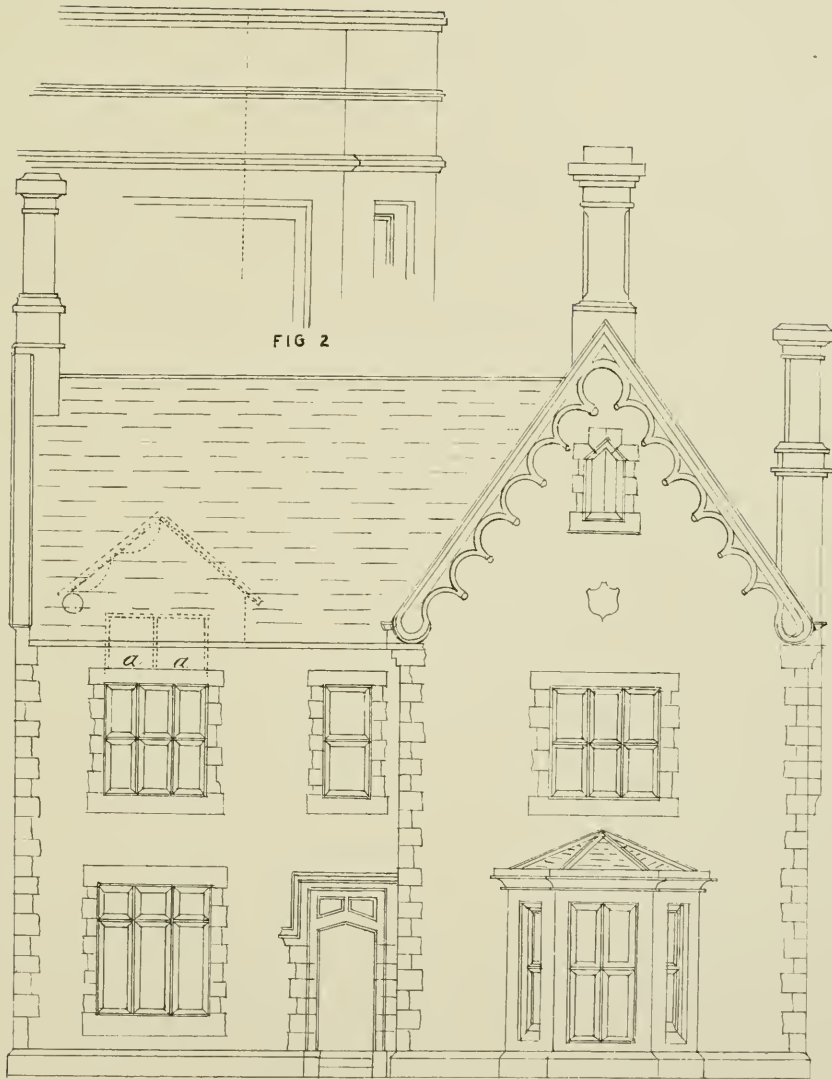


FIG 2





FIG 1

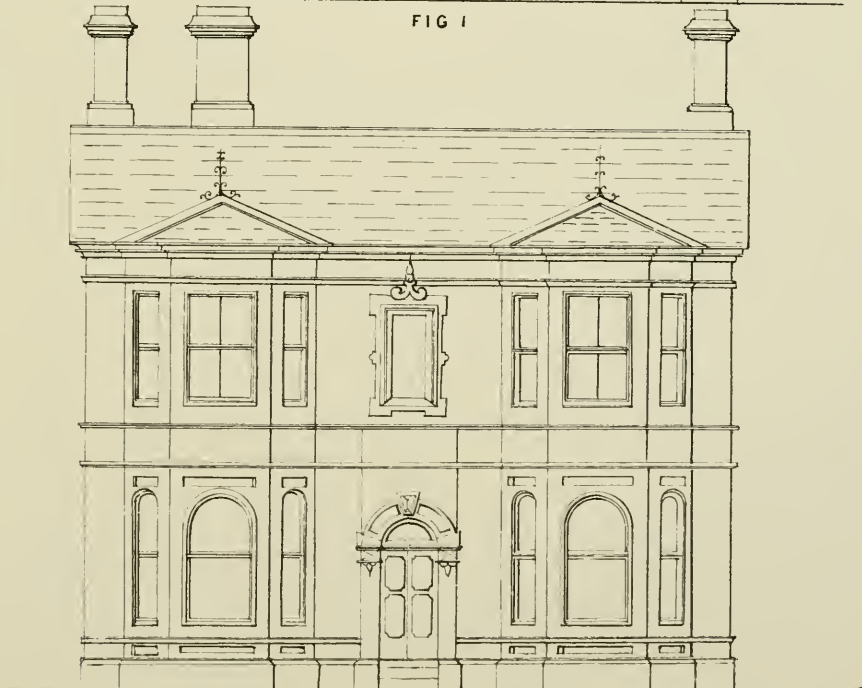
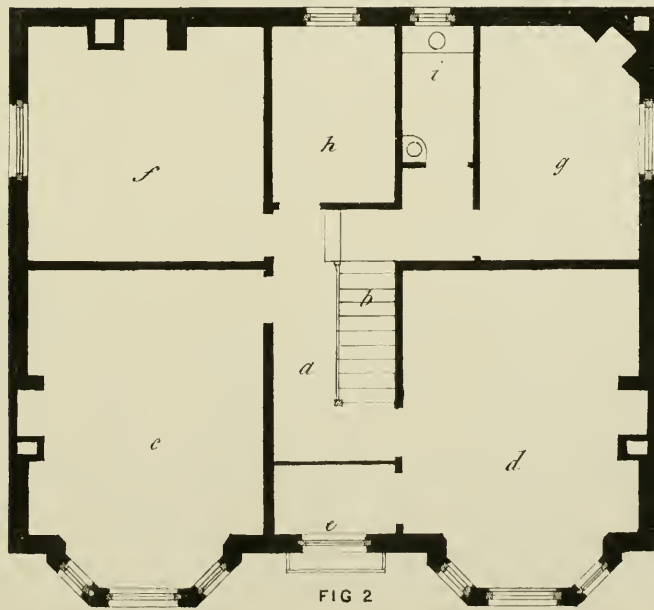
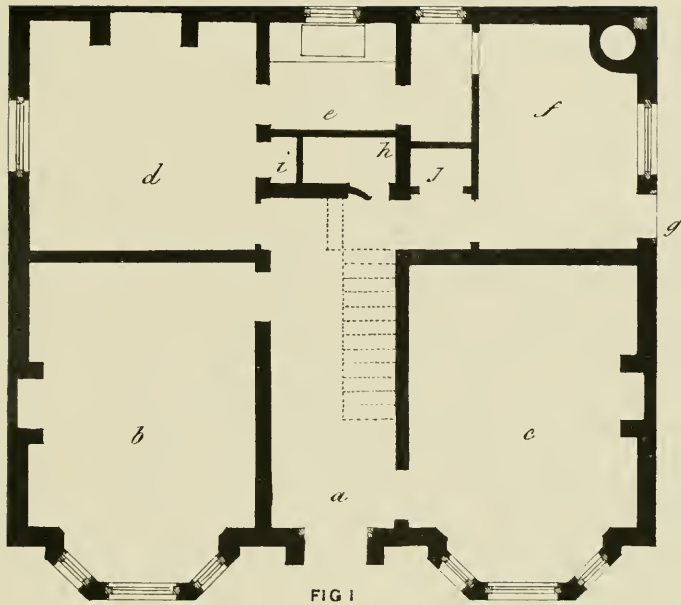


FIG 2





FRONT ELEVATION OF BAILIFF'S COTTAGE

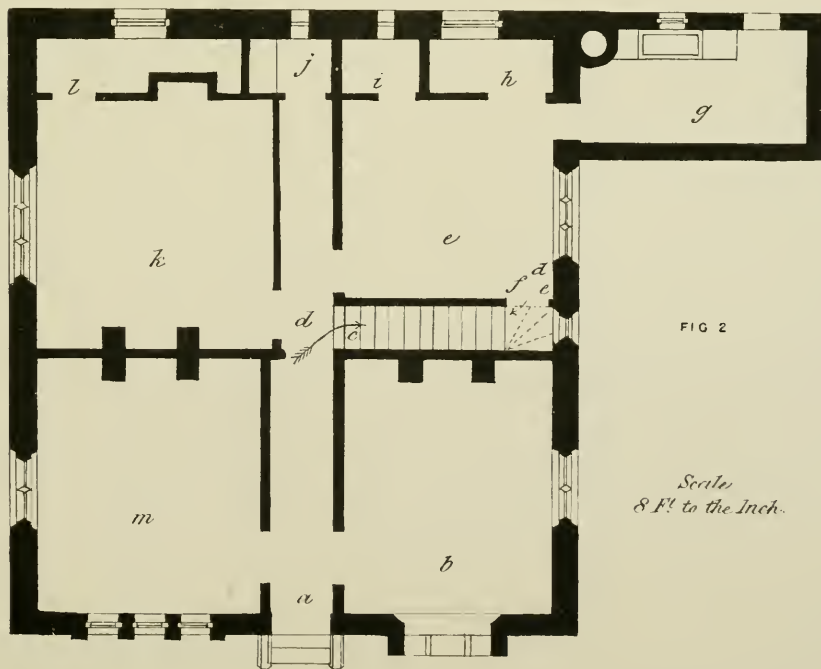


FIG 2

Scale
8 Ft. to the Inch.

GROUND PLAN



FRONT ELEVATION OF BAILIFF'S COTTAGE



ALTERNATIVE ELEVATION

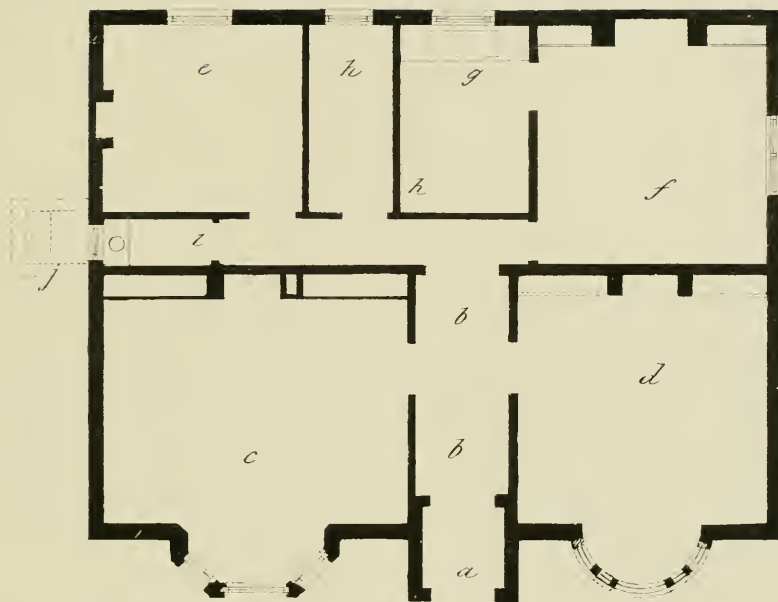


FIG 1

Scale. 8 ft. to the Inch or 6" = 1 Foot

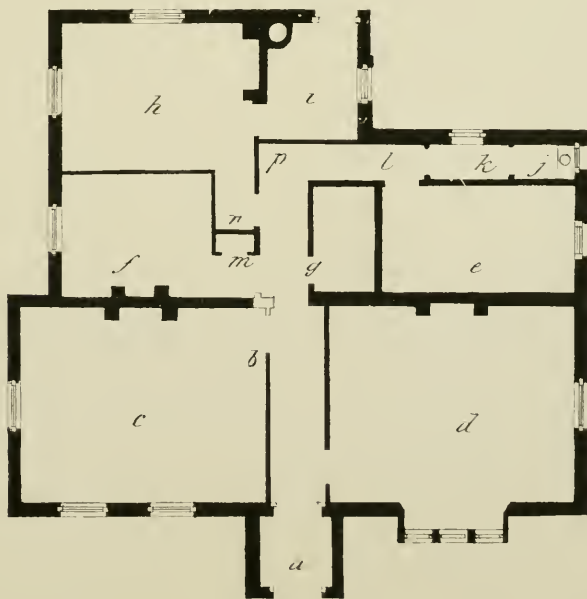


FIG 2

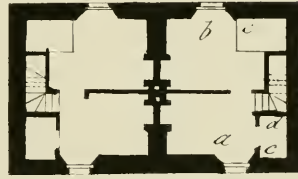
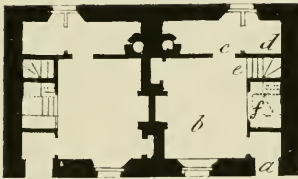
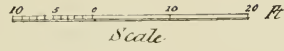
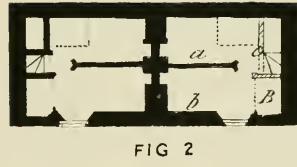
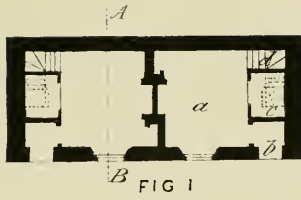


FIG 3

FIG 4

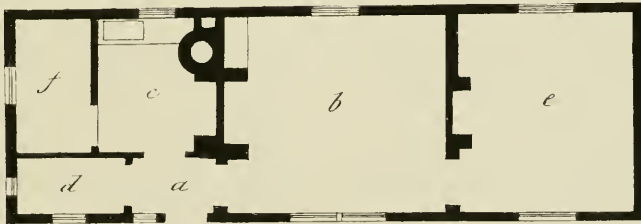


FIG 5

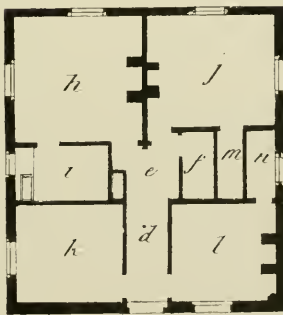


FIG 6

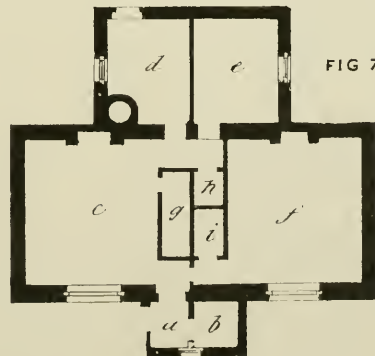


FIG 7

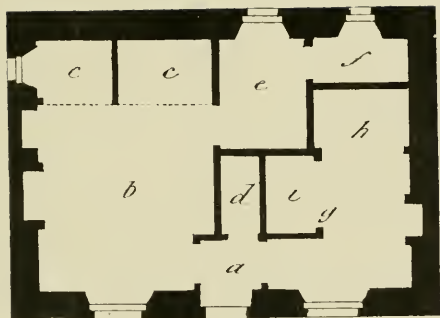


FIG 1

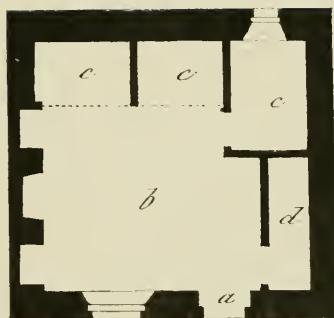


FIG 2

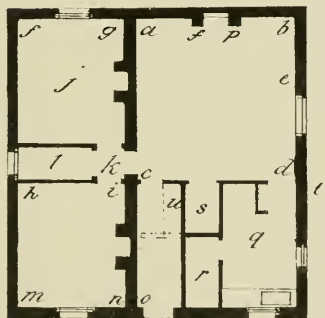


FIG 3

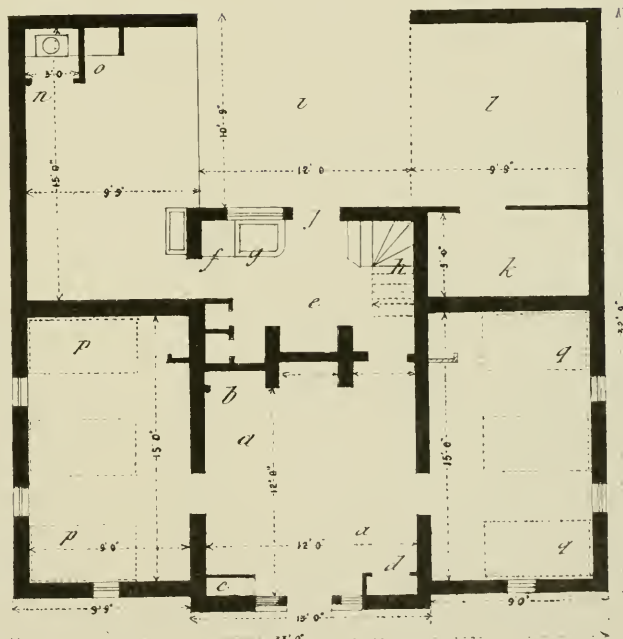


FIG 5

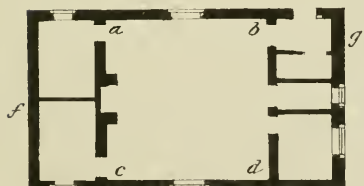


FIG 4

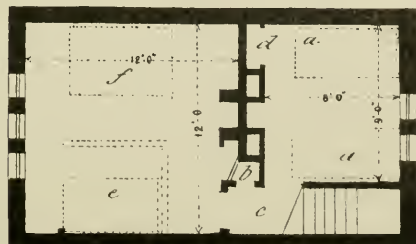


FIG 6

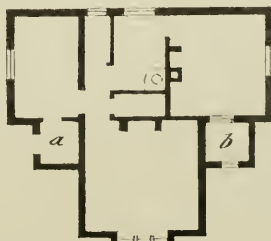


FIG 7

FIG. 2

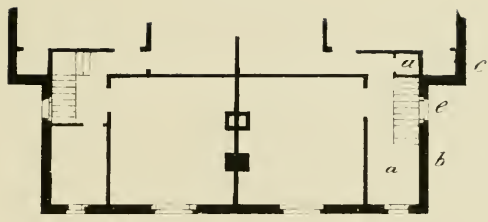


FIG. 1

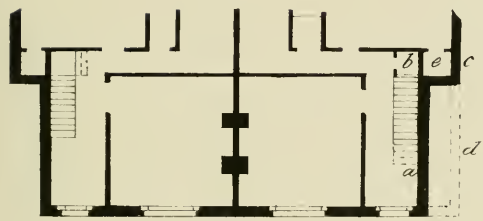


FIG. 4

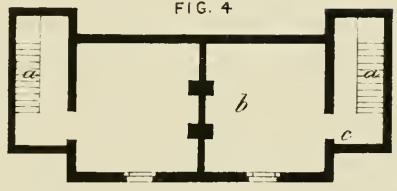


FIG. 3

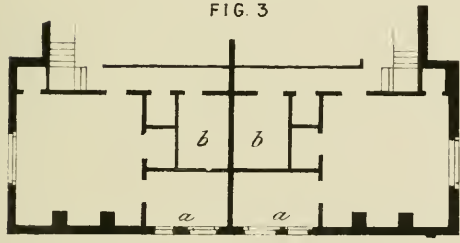


FIG. 5

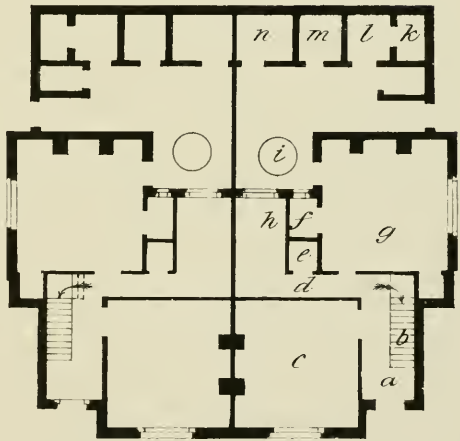


FIG. 4^A

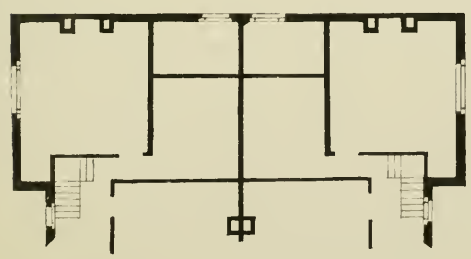
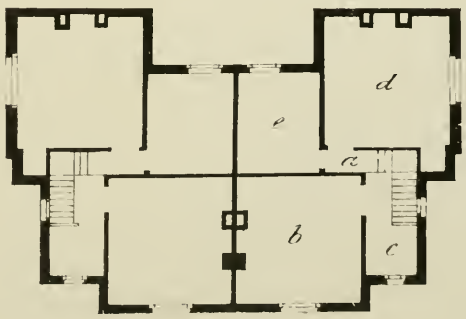


FIG. 6



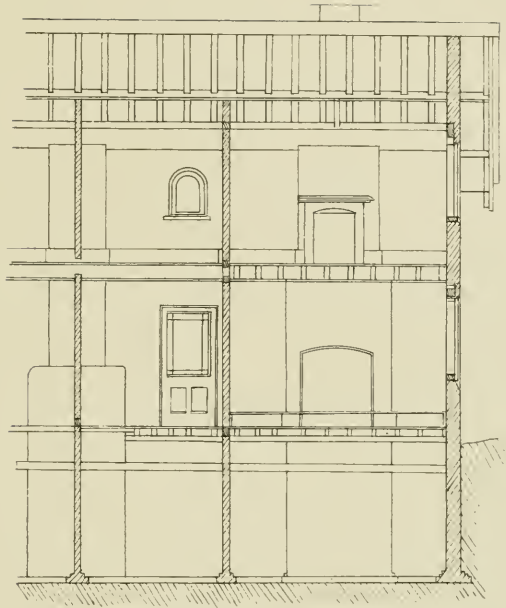


FIG 1

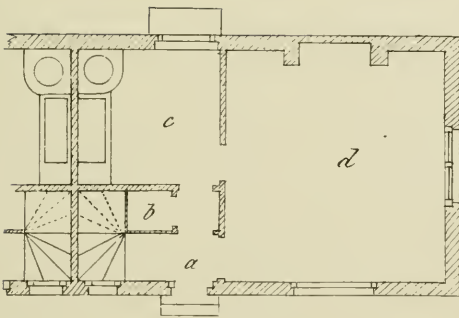


FIG 2

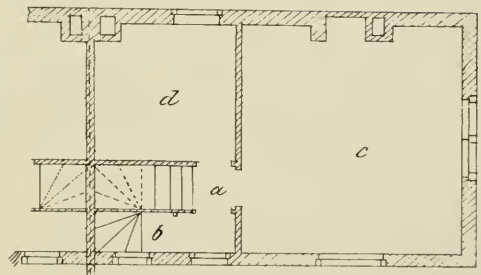


FIG 3

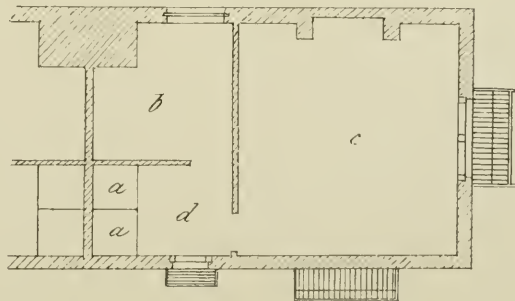


FIG 4

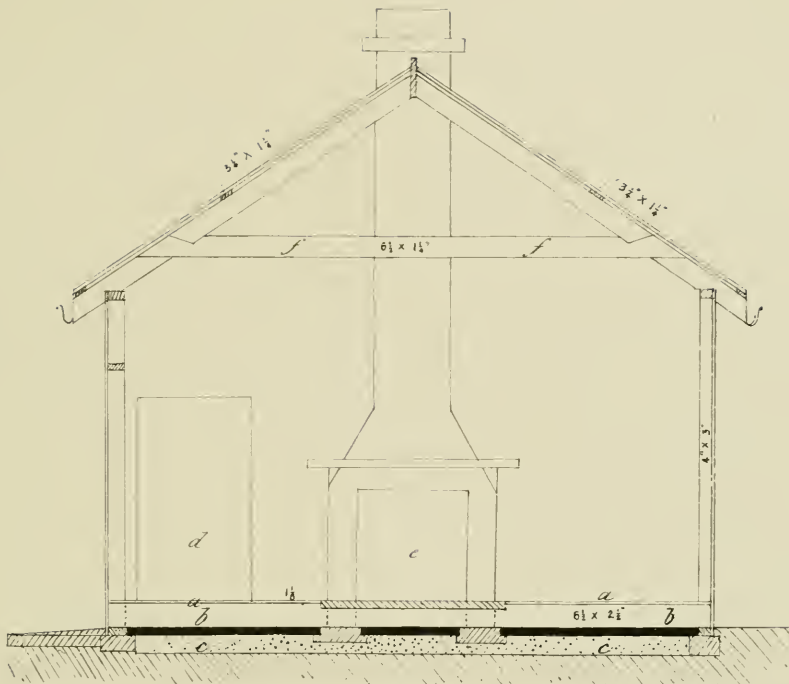


FIG 7

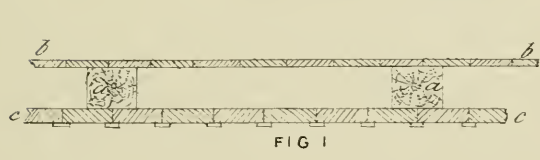


FIG 1

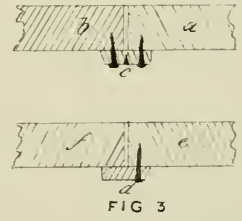


FIG 3

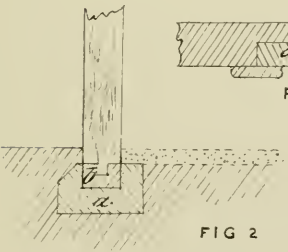


FIG 2

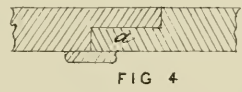


FIG 4

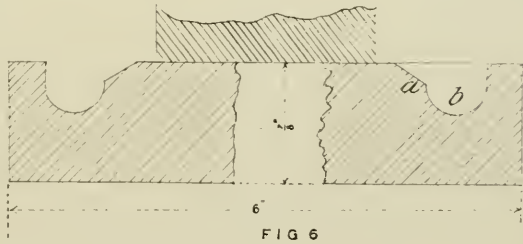


FIG 6

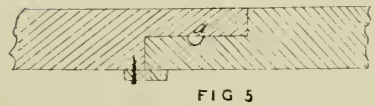


FIG 5



FIG 6
A

FIG 1

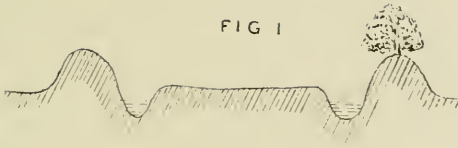


FIG 3

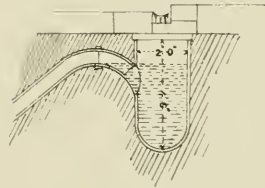


FIG 2

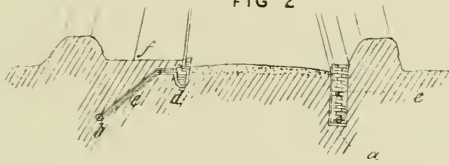


FIG 4

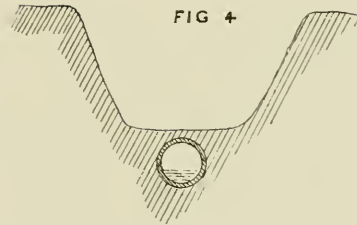


FIG 4A

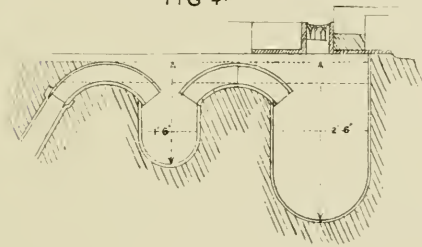


FIG 5

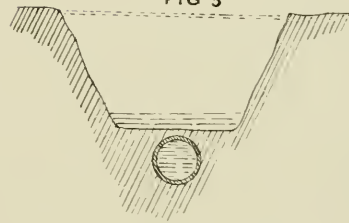


FIG 7

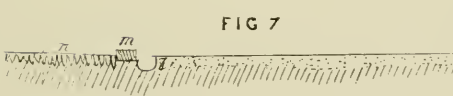


FIG 6

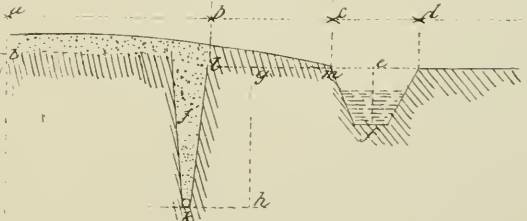


FIG 8

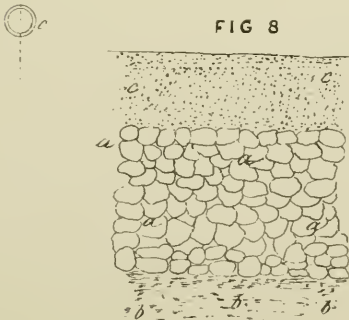
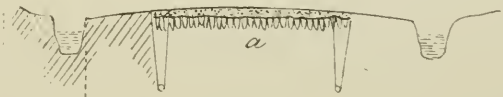


FIG 9



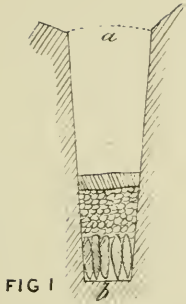


FIG 1

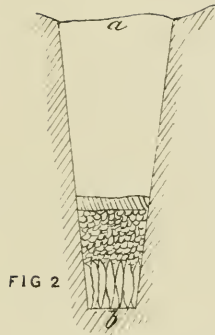


FIG 2

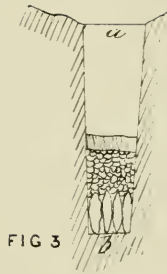


FIG 3

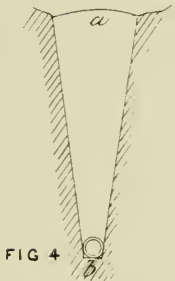


FIG 4

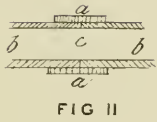


FIG II



FIG 5

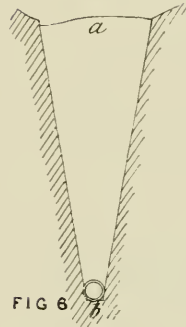


FIG 6

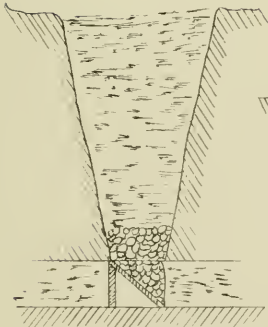


FIG 7

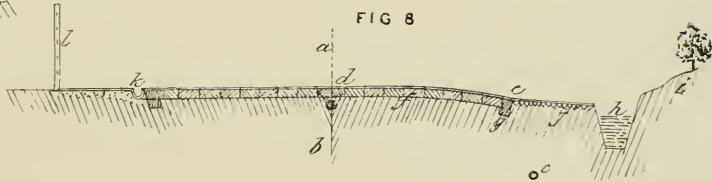


FIG 8

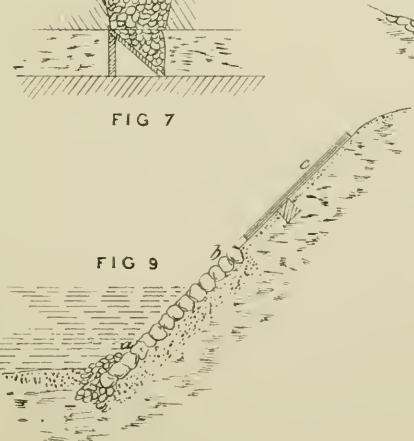


FIG 9

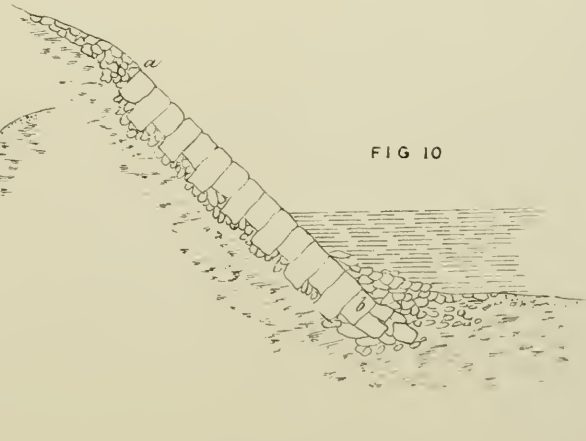


FIG 10

FIG 1

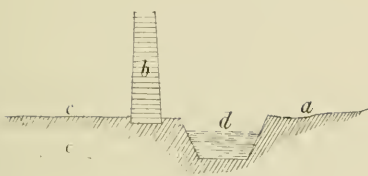


FIG. 2

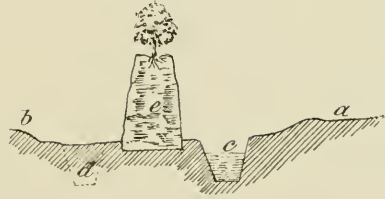


FIG. 3

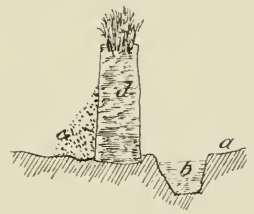


FIG. 4

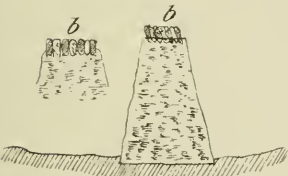


FIG 5

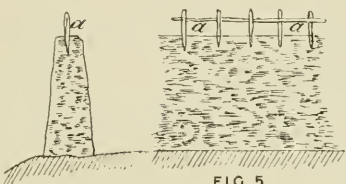


FIG 6

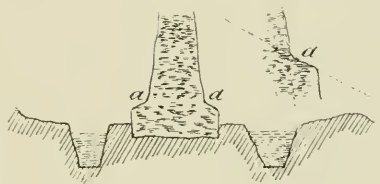


FIG 7

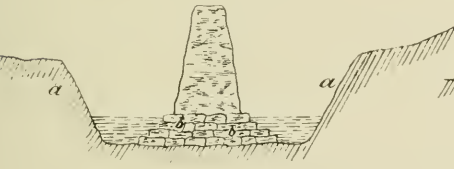


FIG 8

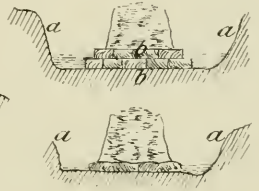


FIG. 9

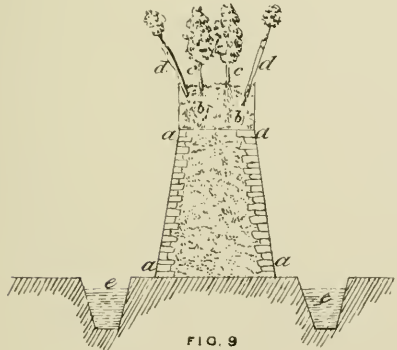


FIG 10

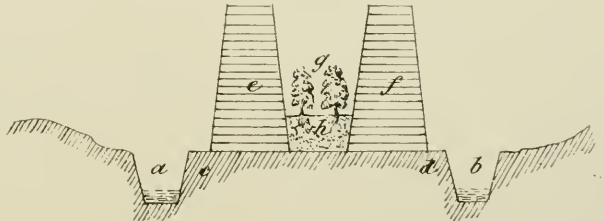


FIG 12

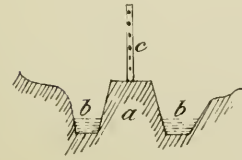


FIG 11

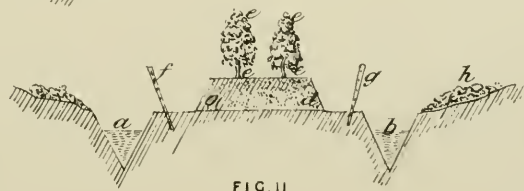


FIG. 13

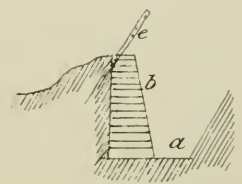


FIG. 1

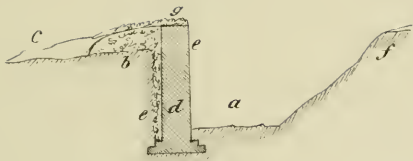


FIG 2



FIG. 3

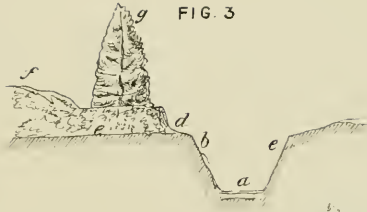


FIG. 4

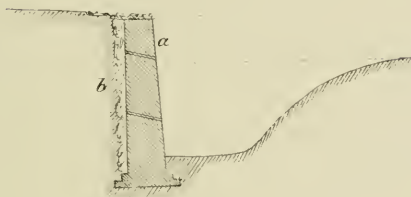


FIG. 5

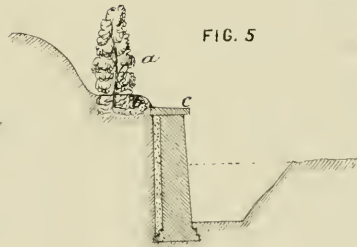


FIG. 6



FIG. 7

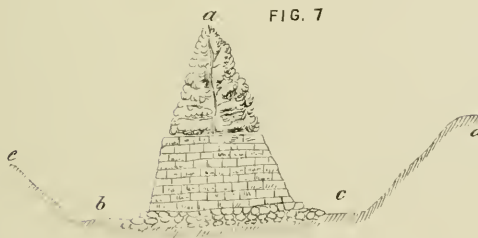


FIG. 8



FIG. 10



FIG. 13



FIG. 11



FIG. 9



FIG. 12

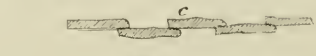


FIG 14

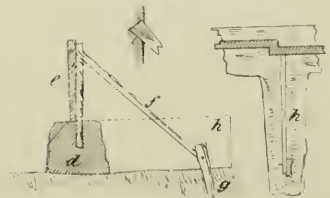
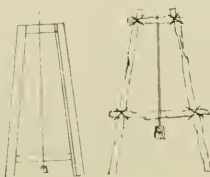


FIG 1

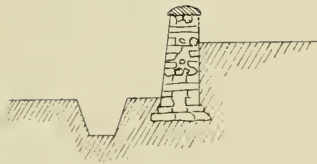


FIG 2

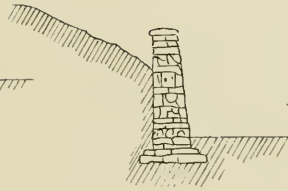


FIG 3

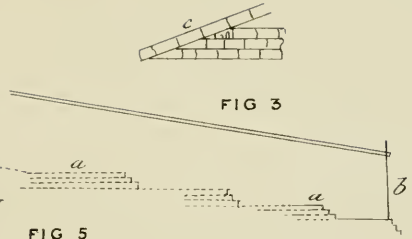


FIG 4

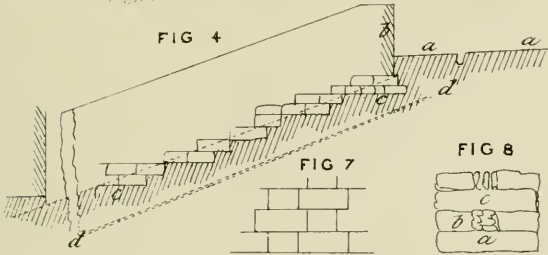


FIG 5

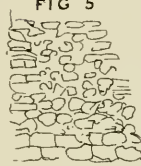


FIG 6



FIG 8

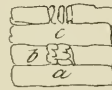


FIG 9

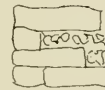


FIG 10

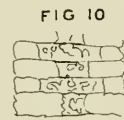


FIG 11



FIG 12



FIG 13

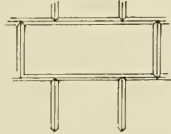


FIG 14

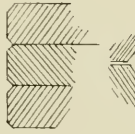


FIG 15

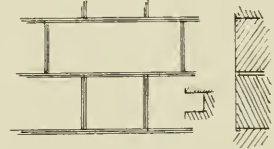


FIG 16



FIG 17

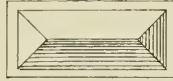


FIG 18



FIG 19

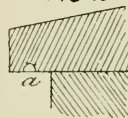


FIG 20



FIG 21

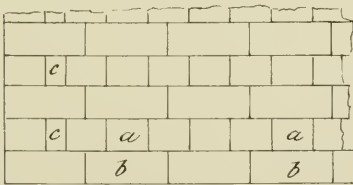


FIG 22

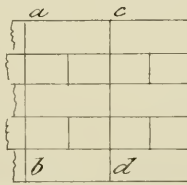


FIG 23

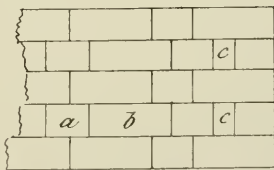


FIG 24

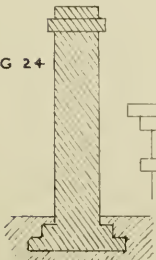


FIG 25

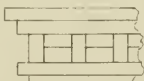


FIG 26

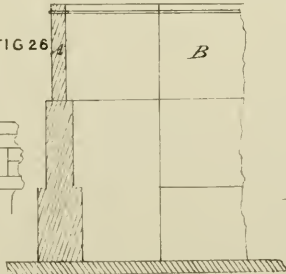


FIG 27

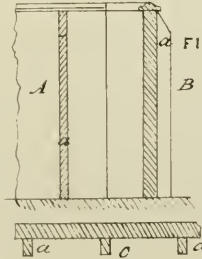


FIG 28

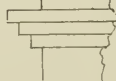
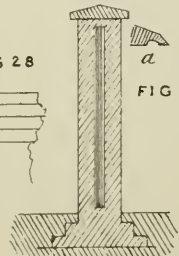


FIG 29



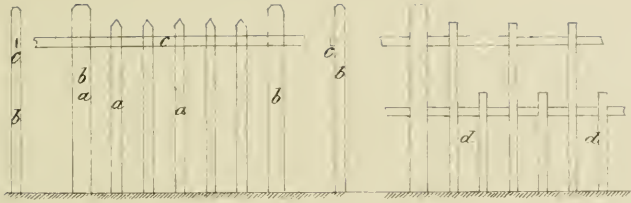


FIG. 1

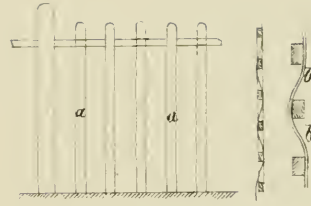


FIG. 2

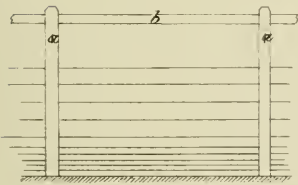


FIG. 3

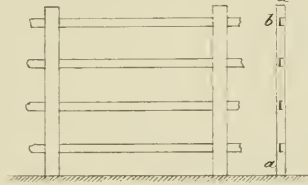


FIG. 4

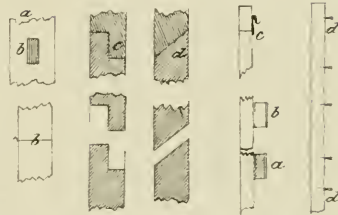


FIG. 5

FIG. 6



FIG. 7

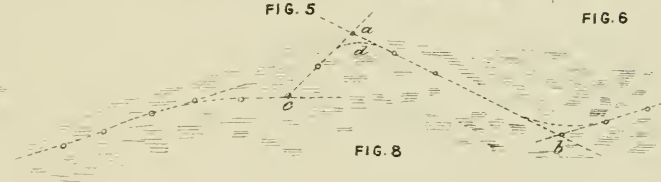


FIG. 8

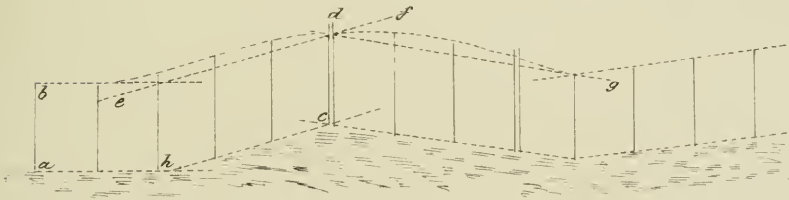


FIG. 9



FIG. 10

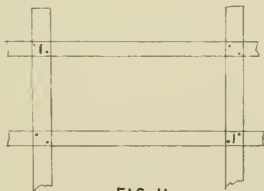


FIG. 11

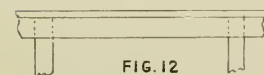


FIG. 12

FIG. 17



FIG. 13



FIG. 14

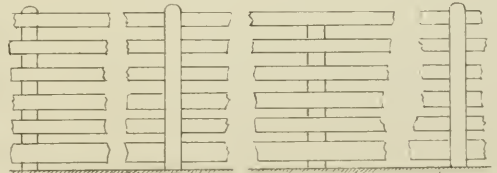


FIG. 15

FIG. 16

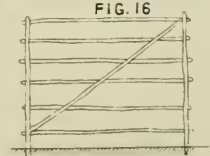
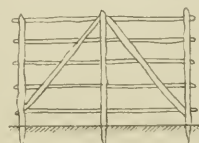


FIG 1

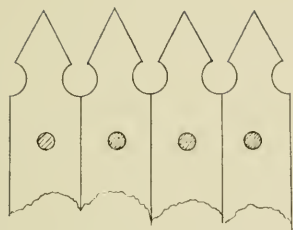


FIG 2

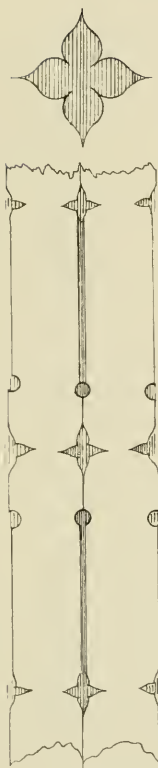


FIG 3

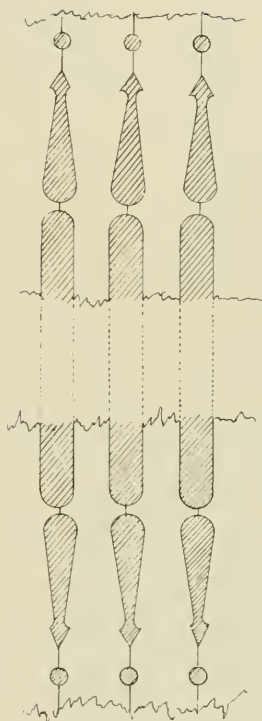


FIG 4



FIG 5

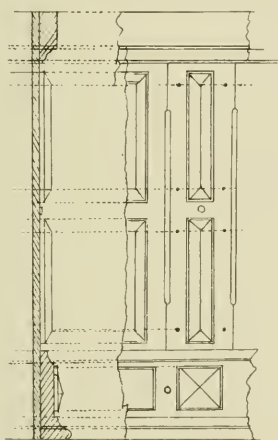


FIG 6

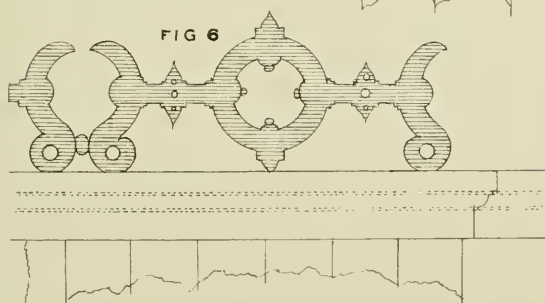


FIG 7

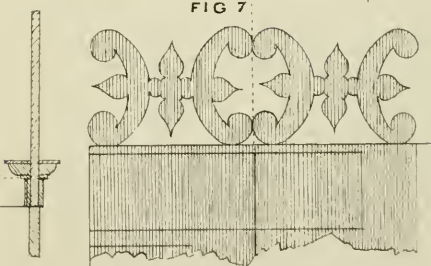


FIG 8

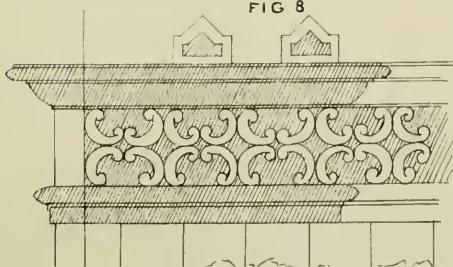


FIG 9

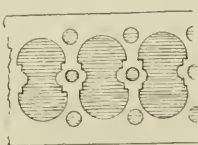


FIG 10

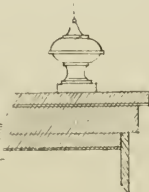
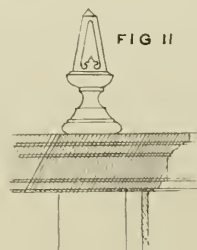


FIG 11



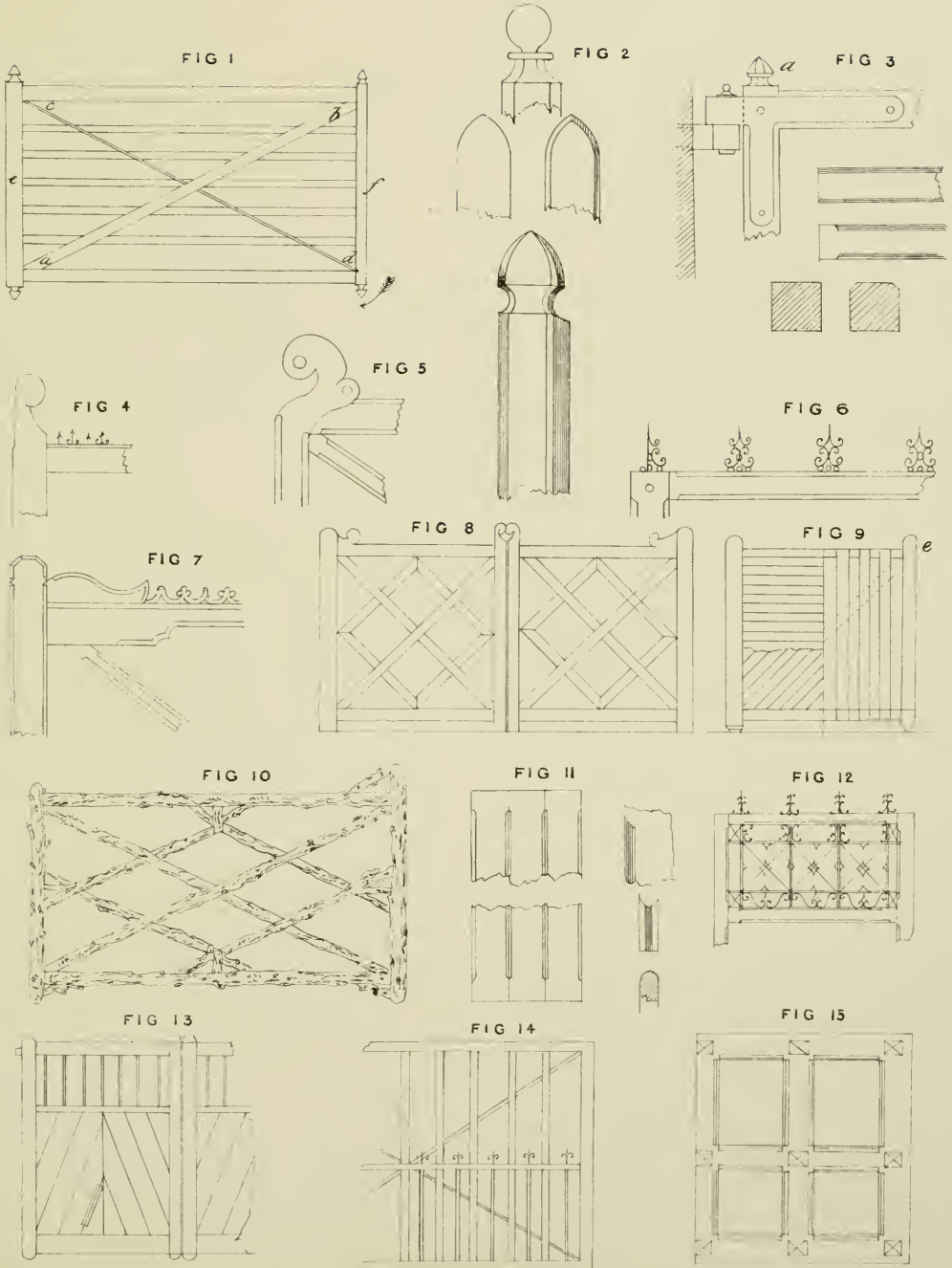


FIG 1

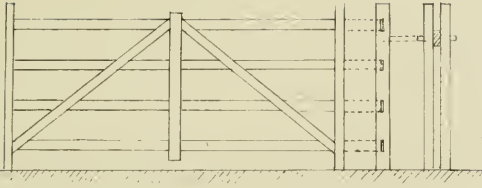


FIG 2



FIG 3



FIG 4

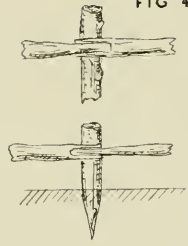


FIG 5



FIG 6



FIG 7



FIG 8

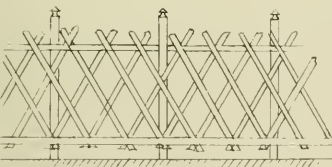


FIG 9

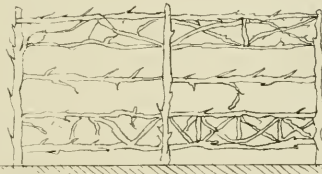


FIG 10

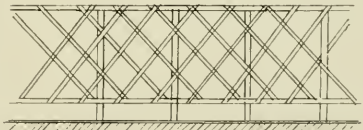


FIG 11

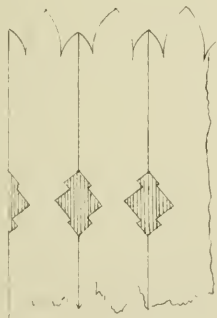


FIG 12

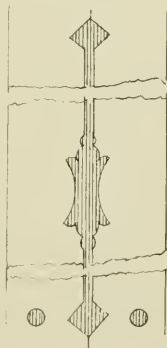


FIG 13

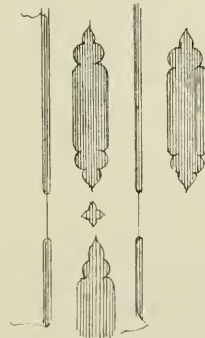


FIG 14

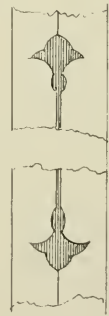


FIG 15

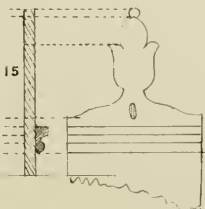


FIG 16



FIG 17



FIG. 1

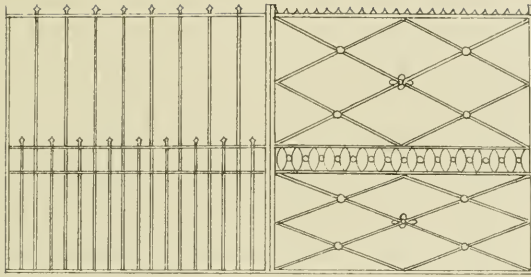


FIG. 2

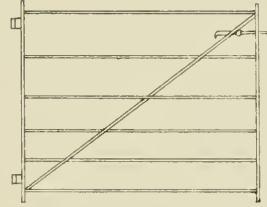


FIG. 3

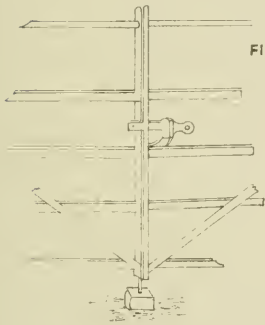


FIG. 4

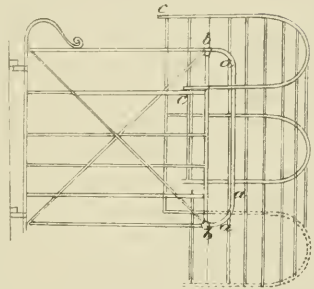


FIG. 5

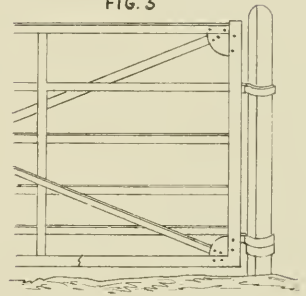


FIG. 6

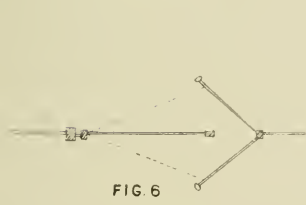


FIG. 8

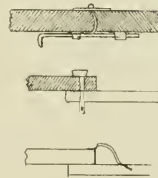


FIG. 9

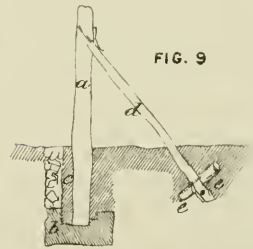


FIG. 12



FIG. 7

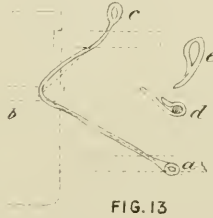


FIG. 13



FIG. 14

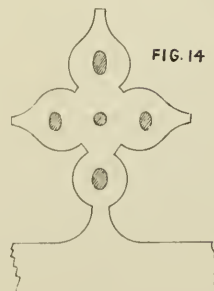


FIG. 15



FIG. 10

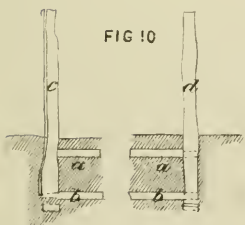


FIG. 11

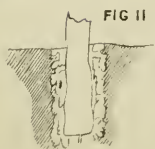


FIG 1

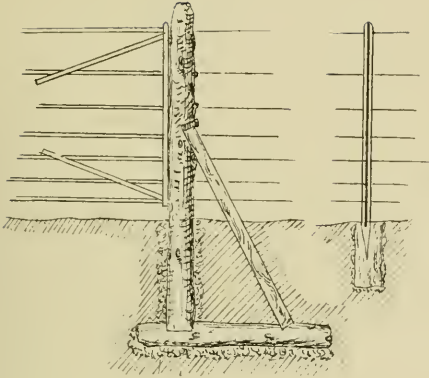


FIG 2

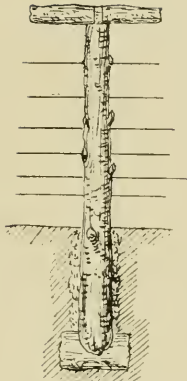


FIG 3

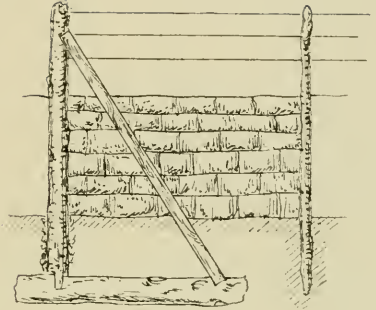


FIG 4

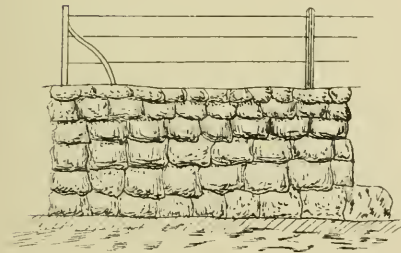


FIG 5

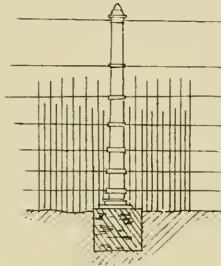


FIG 6

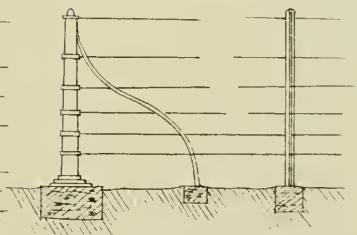


FIG 7

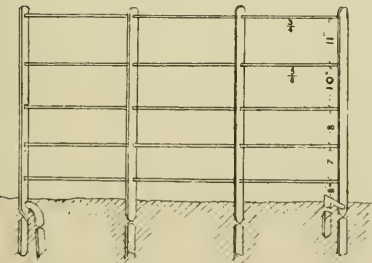


FIG 8

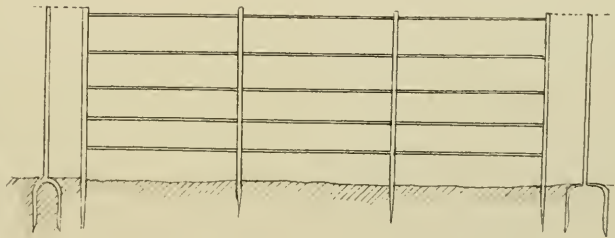


FIG 7

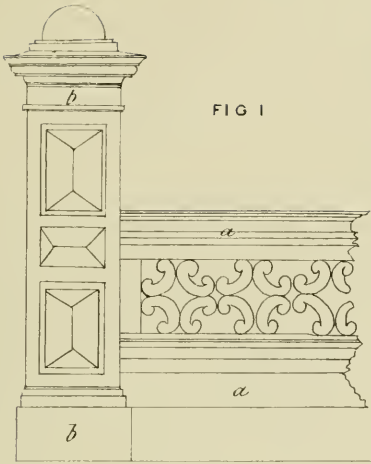


FIG 1

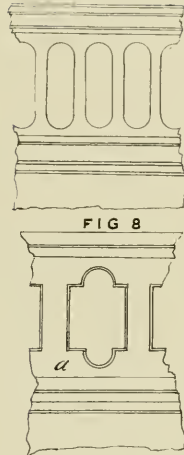


FIG 8

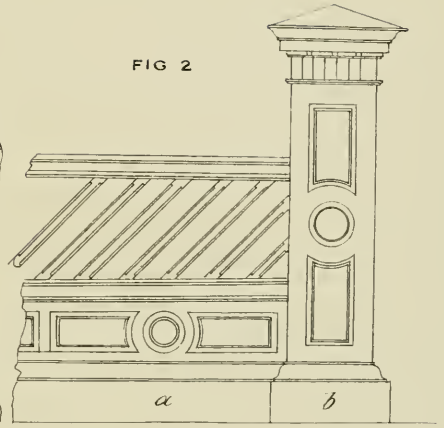


FIG 2

FIG 3

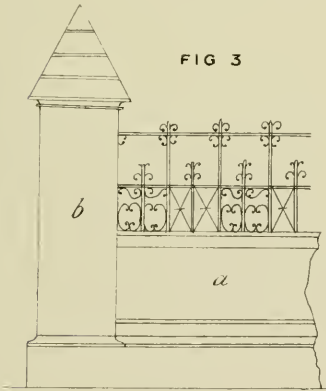


FIG 10

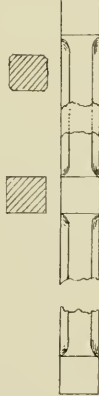


FIG 4

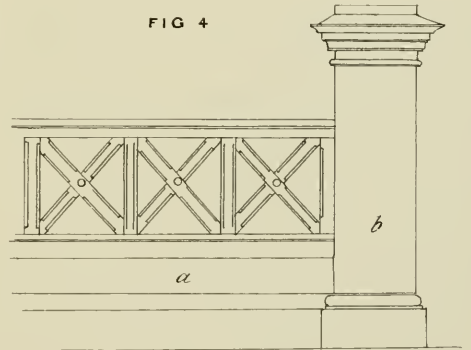


FIG 5

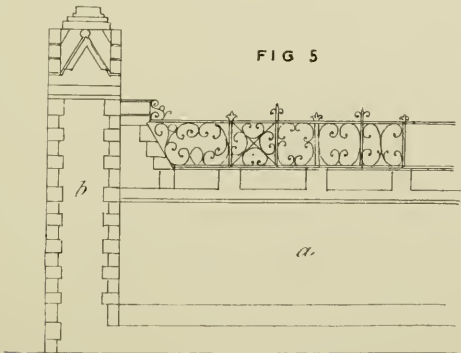
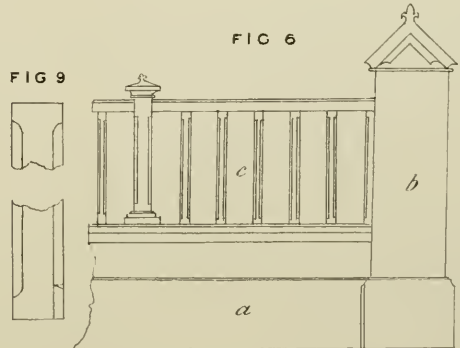


FIG 6

FIG 9



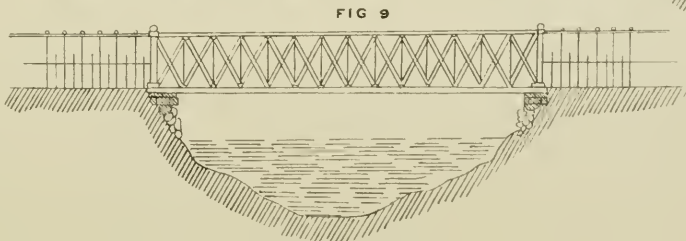
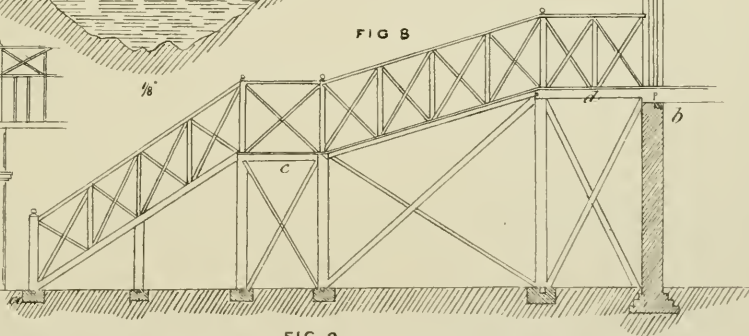
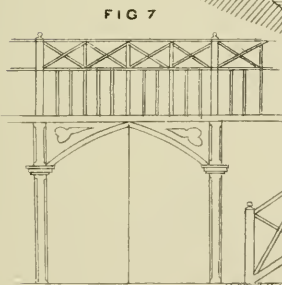
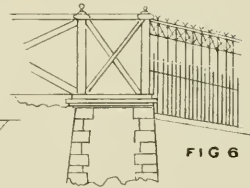
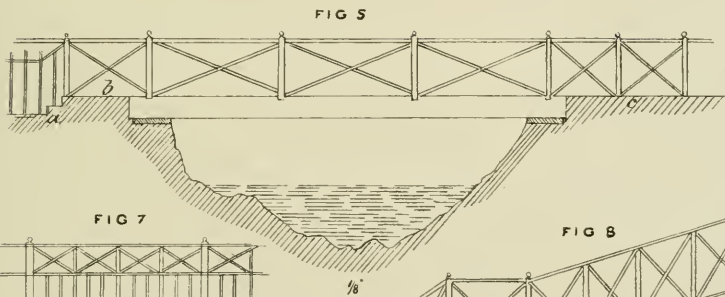
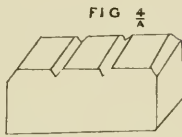
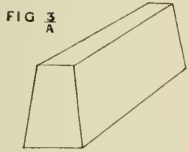
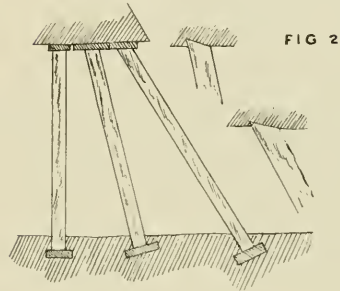
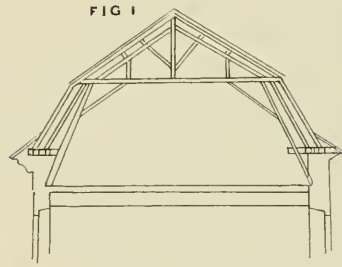
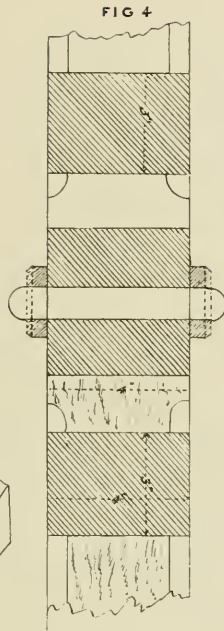
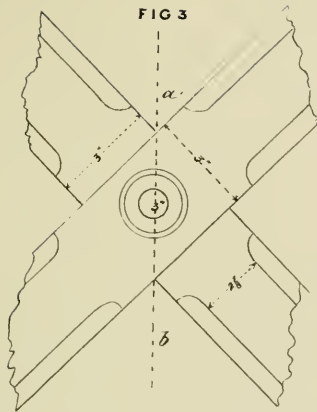


FIG. 1

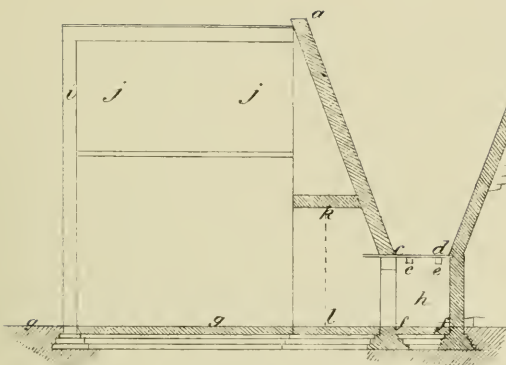


FIG. 2

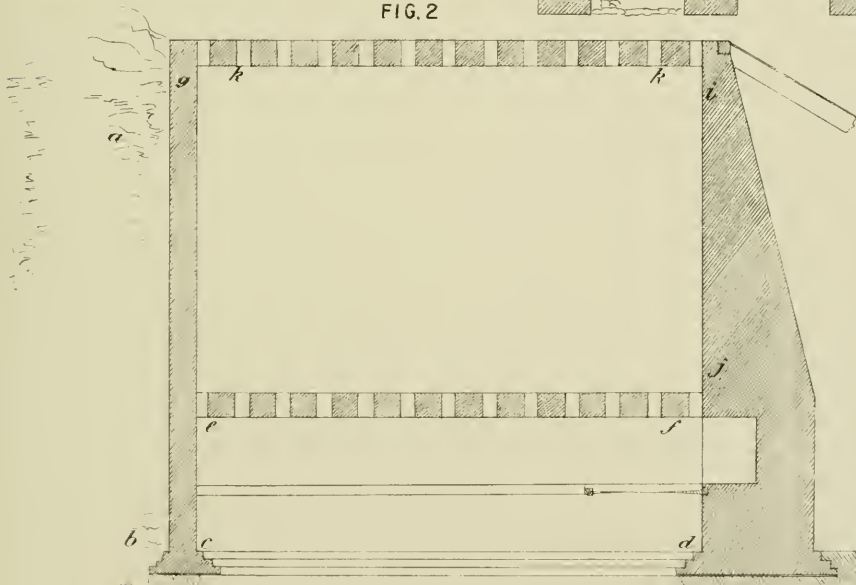


FIG. 3

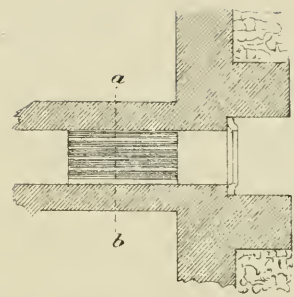


FIG. 4

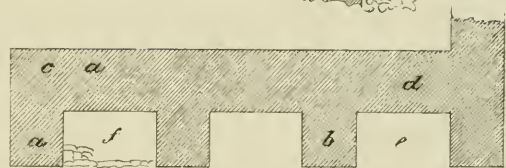


FIG. 5

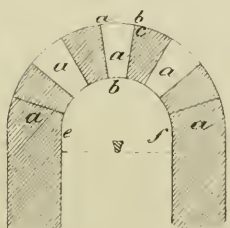


FIG. 7

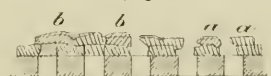


FIG. 6

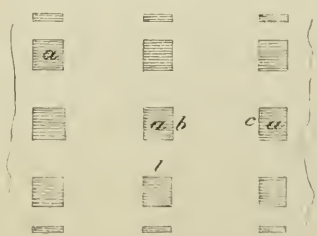


FIG. 1

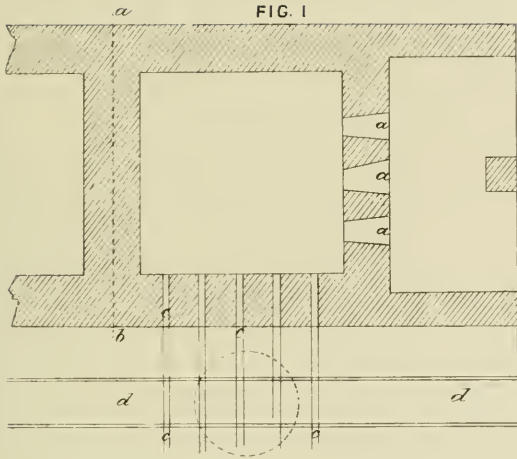


FIG. 2

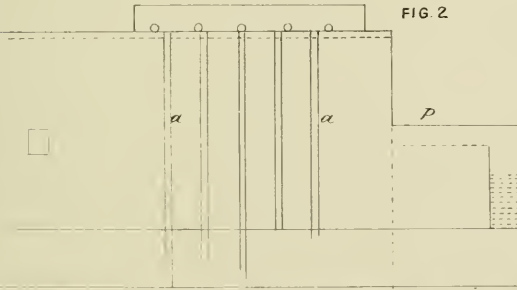


FIG. 3

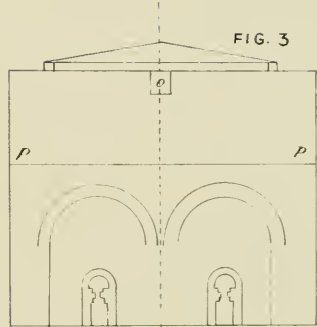


FIG. 4

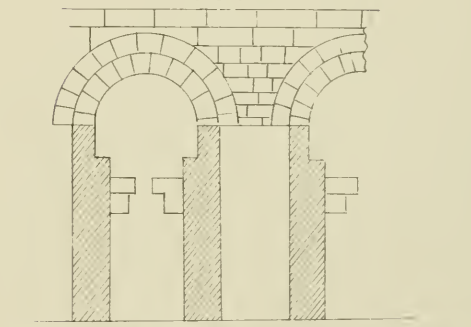
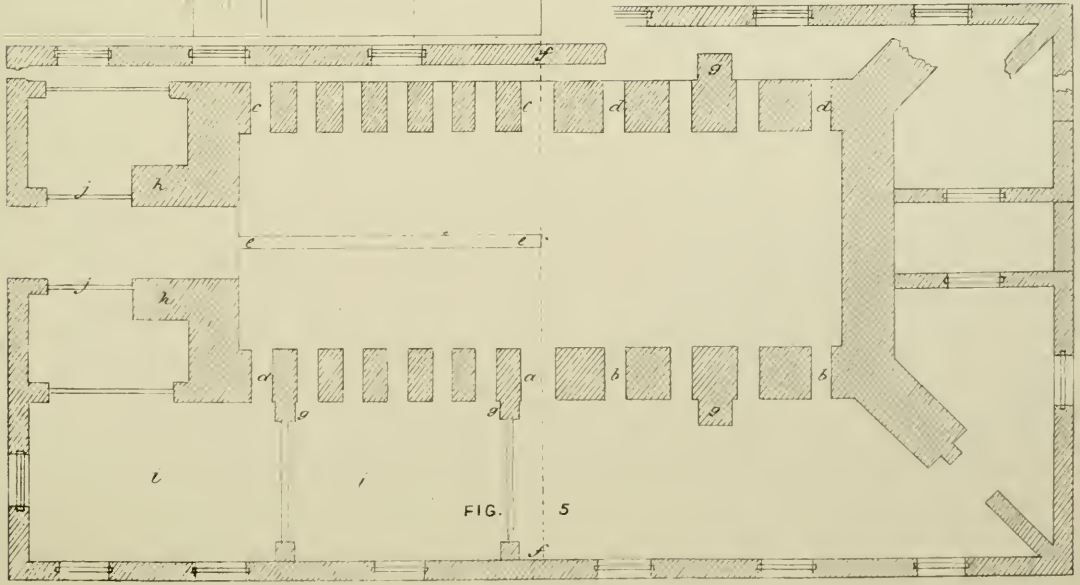


FIG. 5



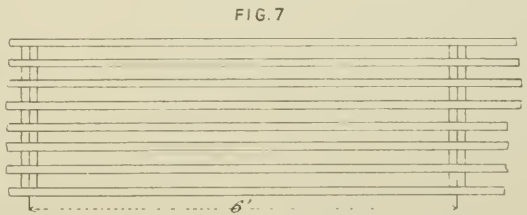
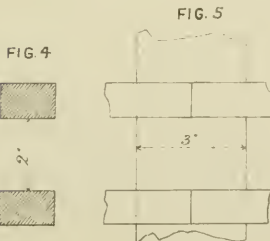
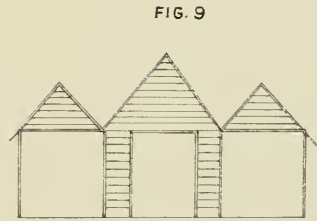
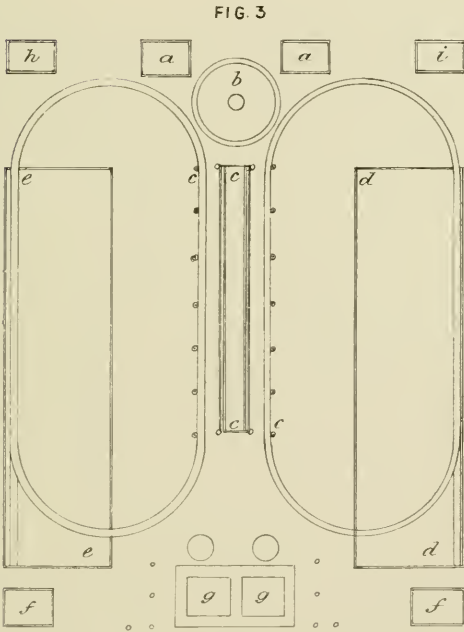
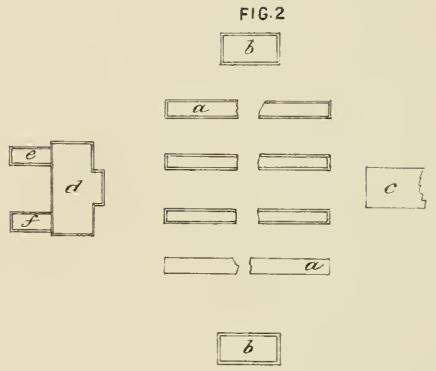
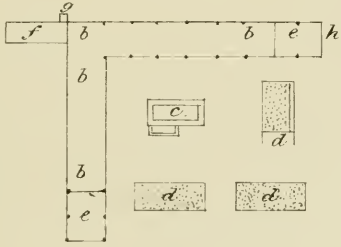
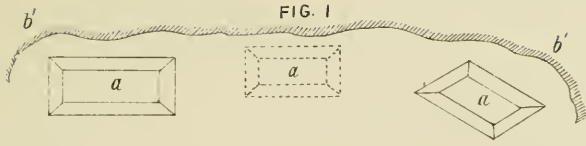


FIG 1

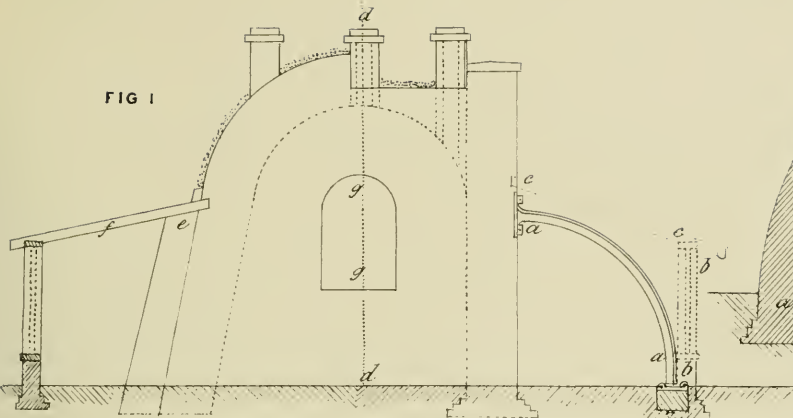


FIG 2

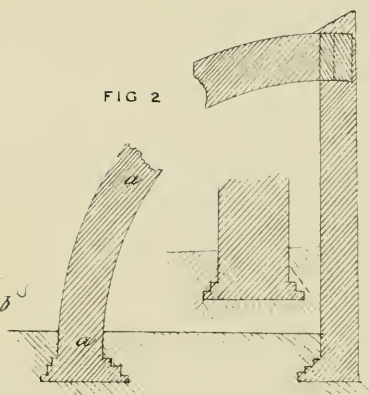


FIG 3

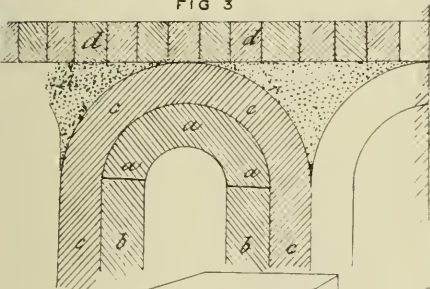


FIG 4

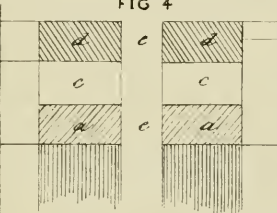


FIG 5

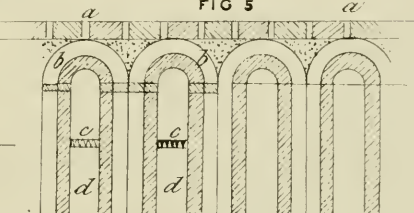


FIG 7

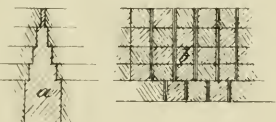


FIG 6

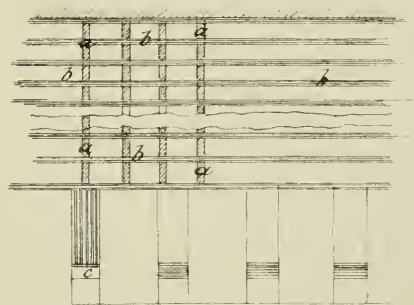


FIG 13

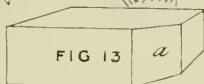


FIG 8

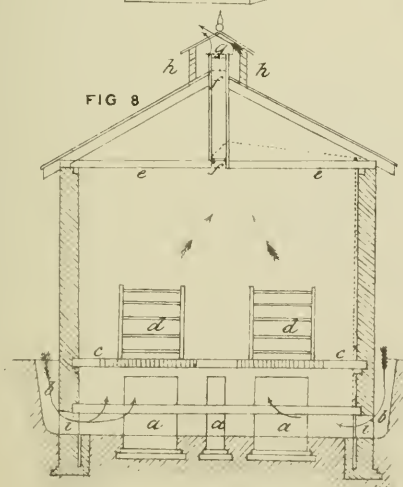


FIG 12



FIG 9



FIG 11

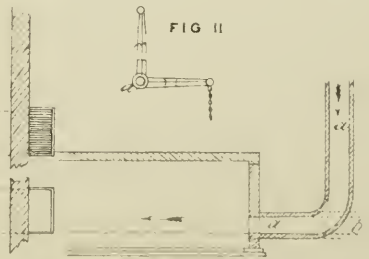


FIG 10

FIG 1



FIG. 2



FIG. 2



FIG 3



FIG 4

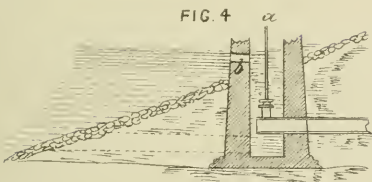


FIG. 5

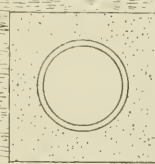
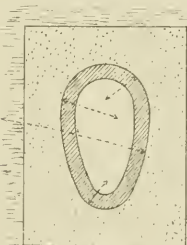


FIG. 6

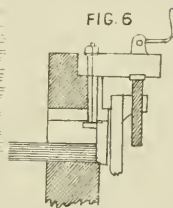


FIG. 7

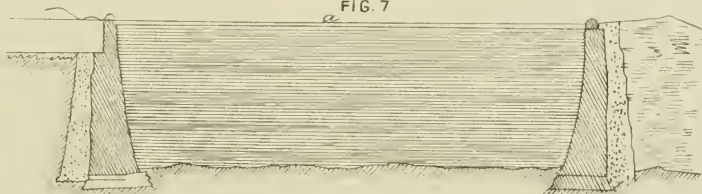


FIG. 8

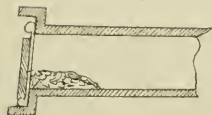


FIG. 9

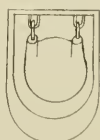
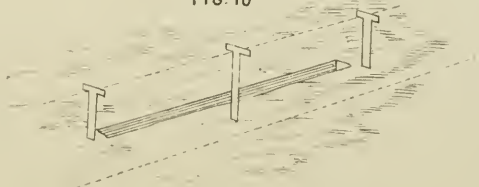
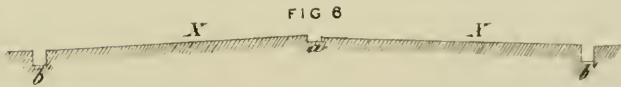
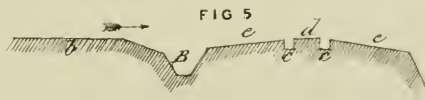
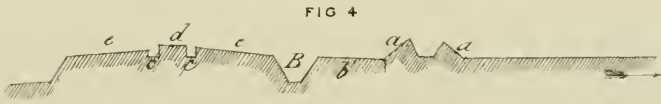
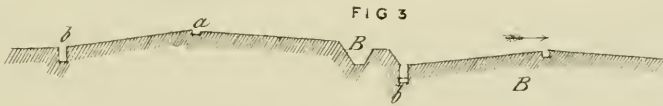
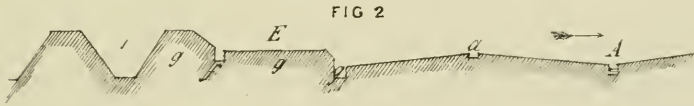
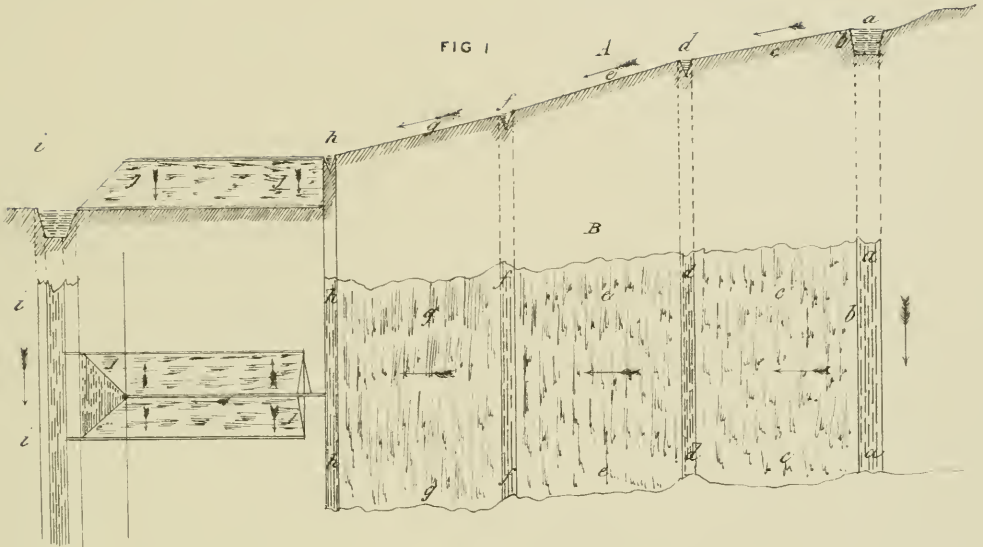


FIG. 10





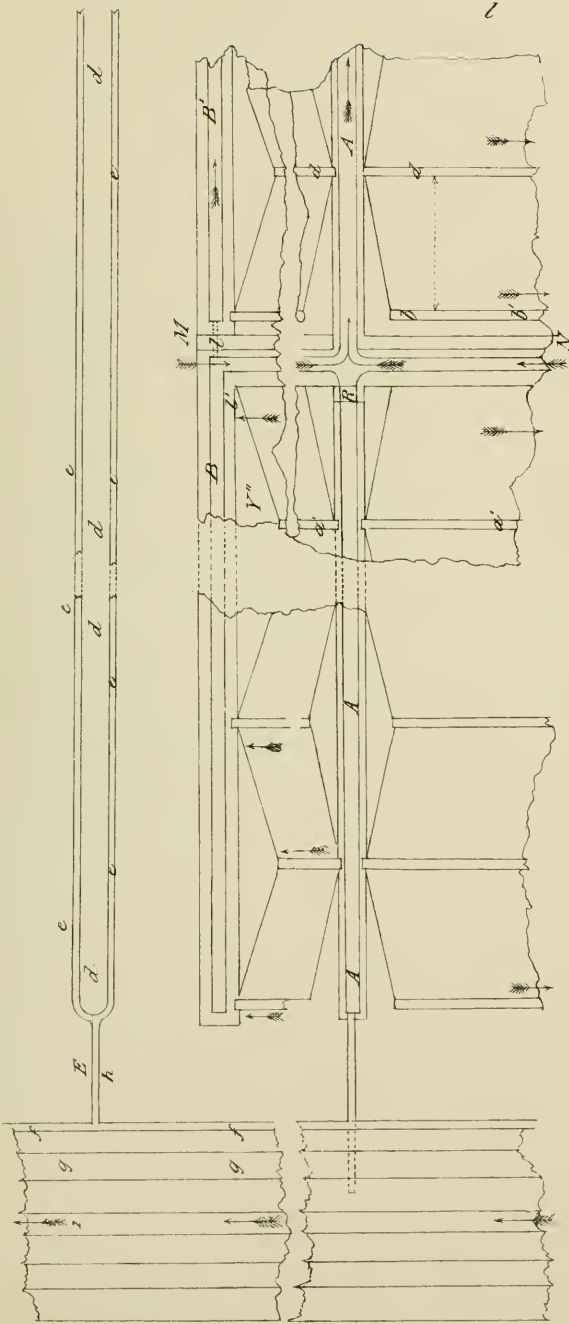


FIG 1

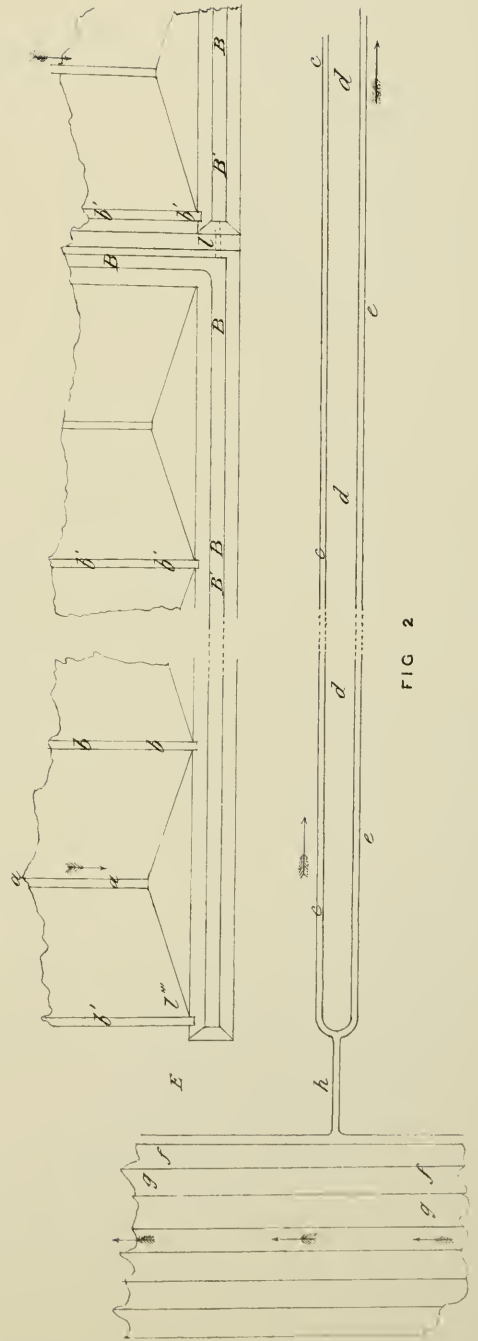


FIG 2

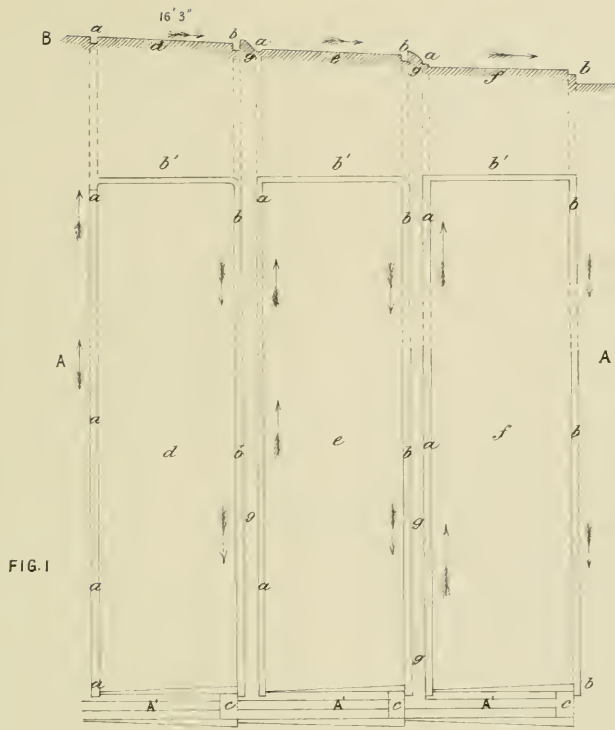


FIG. 1

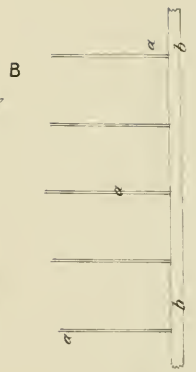


FIG. 6

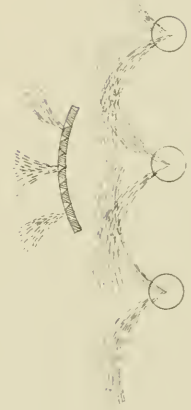


FIG. 5

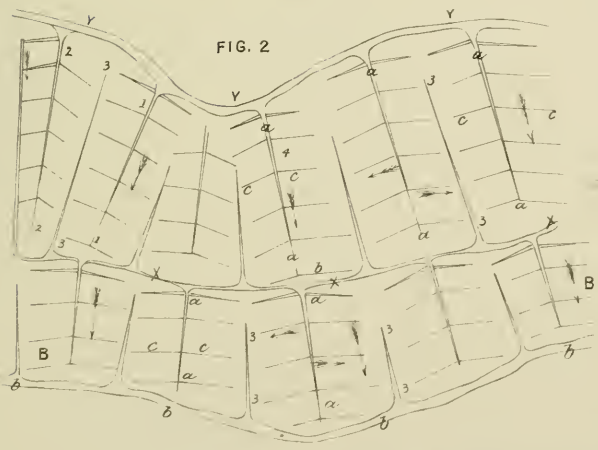


FIG. 2

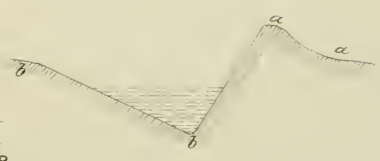


FIG. 3

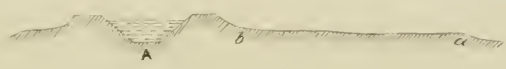


FIG. 4

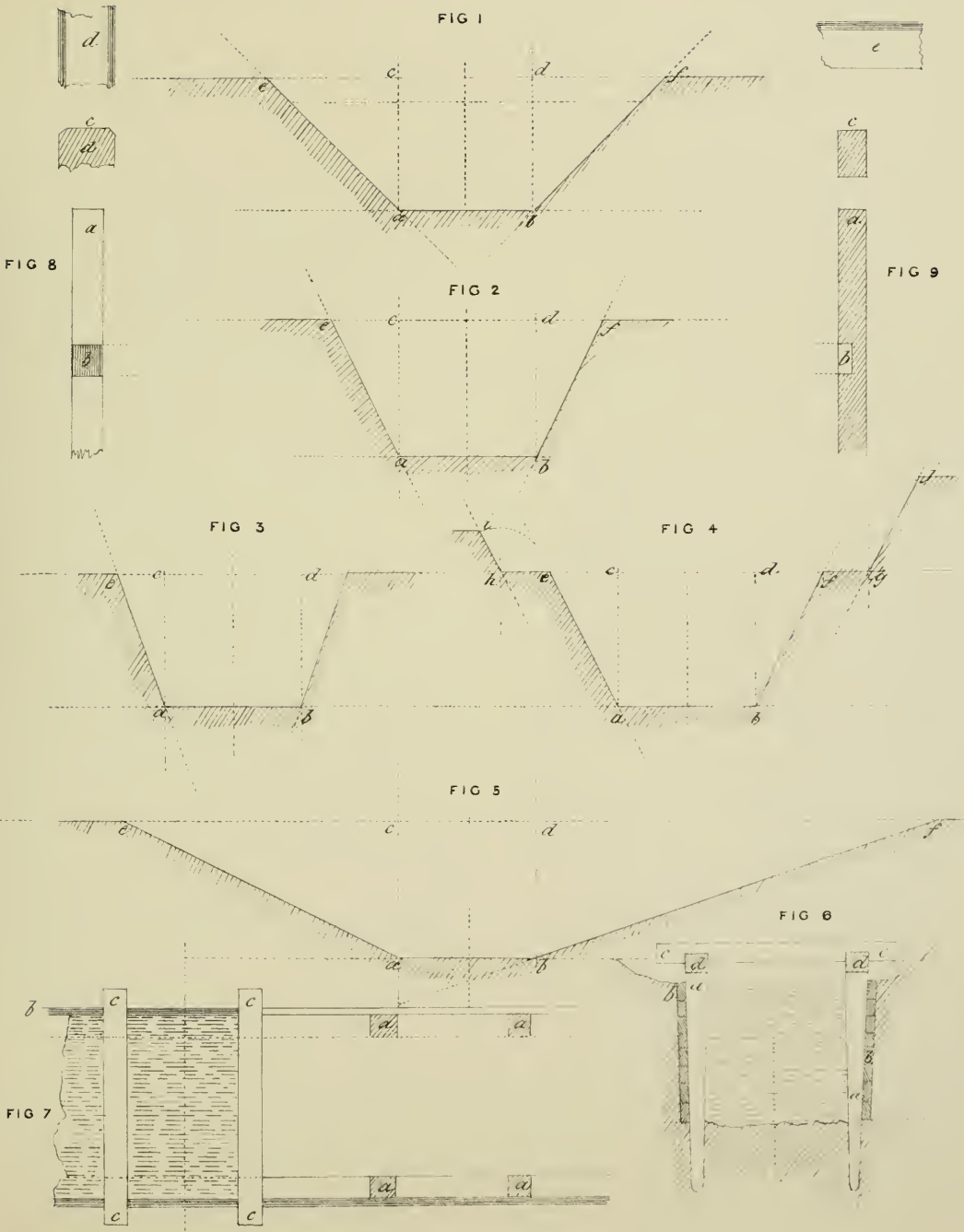


FIG 1

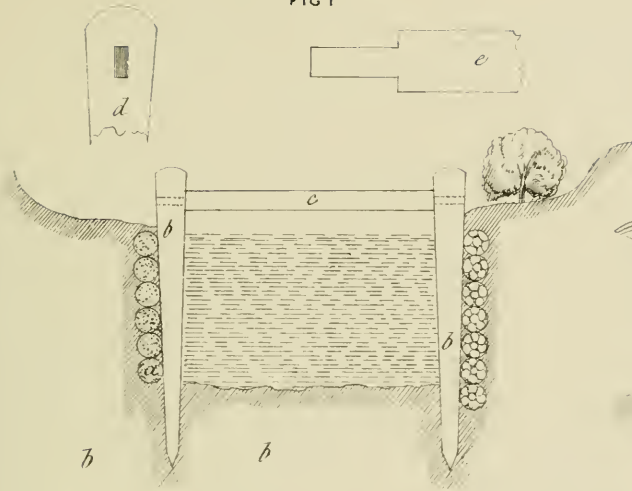


FIG 2

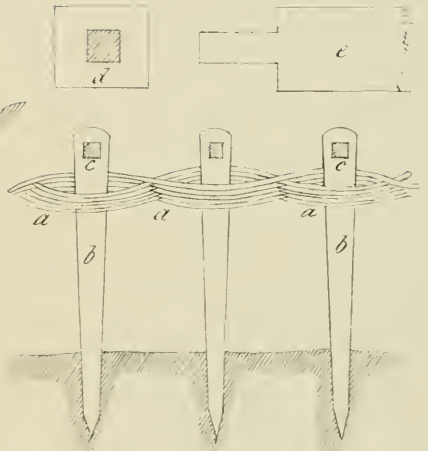


FIG 3

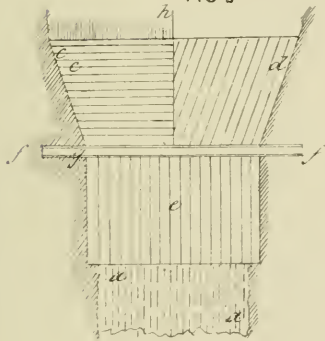


FIG 4

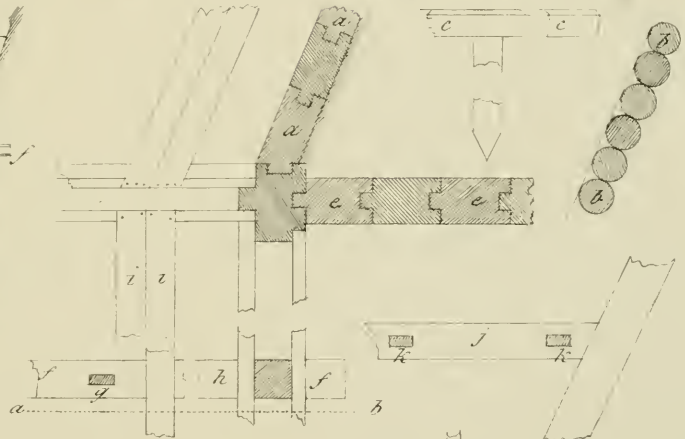


FIG 5

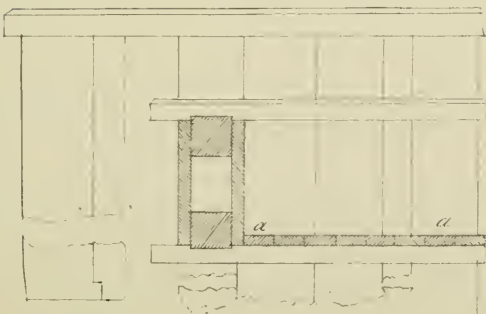
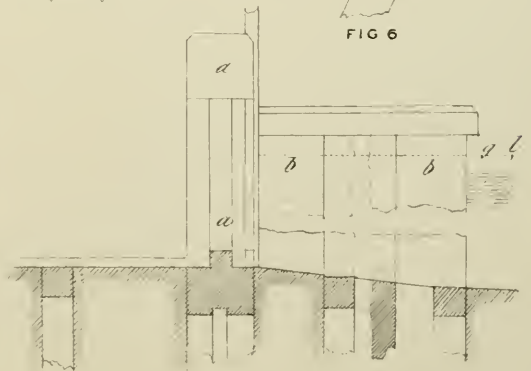


FIG 6



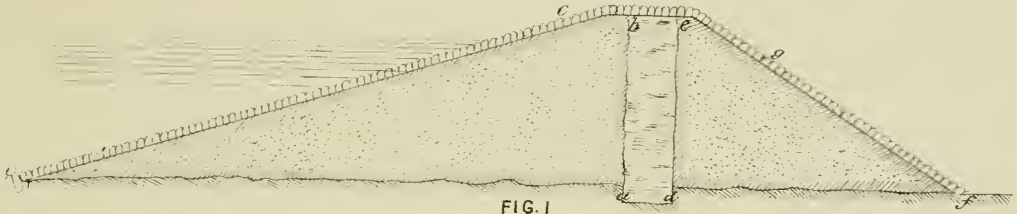


FIG. 1

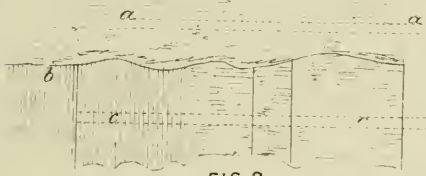


FIG. 2

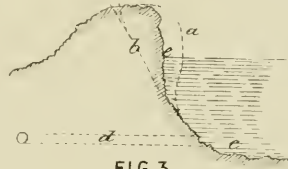


FIG. 3



FIG. 4

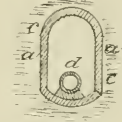


FIG. 5



FIG. 6

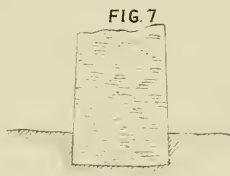


FIG. 7



FIG. 8



FIG. 9

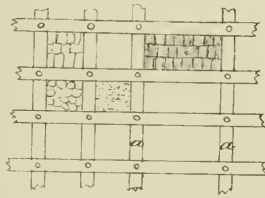


FIG. 10



FIG. 11



FIG. 12

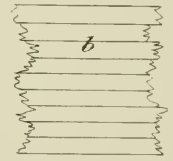


FIG. 13

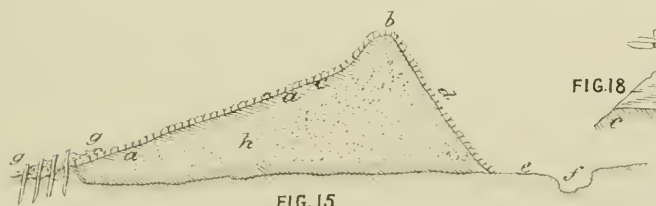


FIG. 15

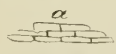


FIG. 18

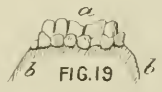


FIG. 19



FIG. 16



FIG. 17

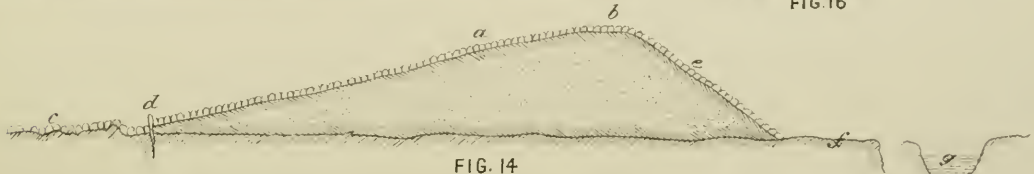


FIG. 14

FIG 1

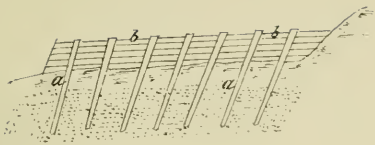


FIG 2



FIG 3

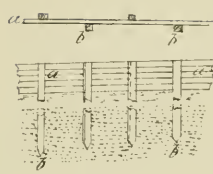


FIG 4

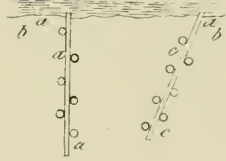


FIG 5

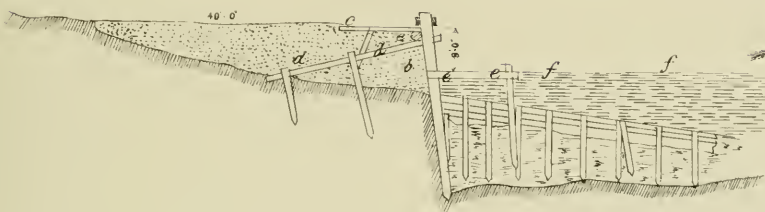


FIG 13



FIG 14

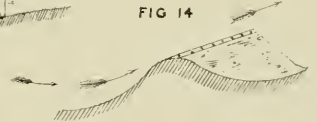


FIG 6

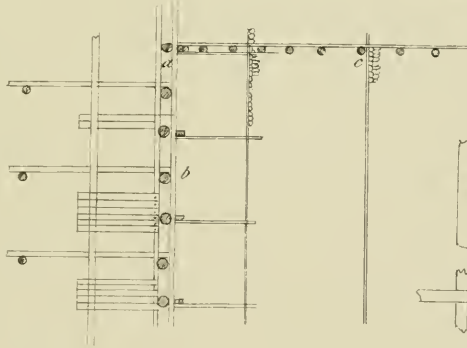


FIG 7

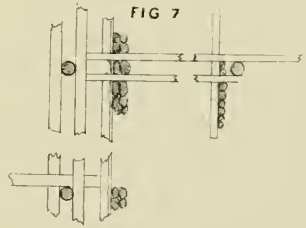


FIG 8

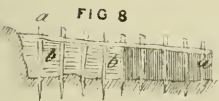


FIG 11

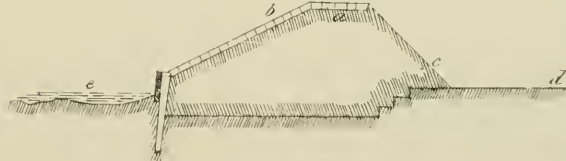


FIG 9



FIG 12

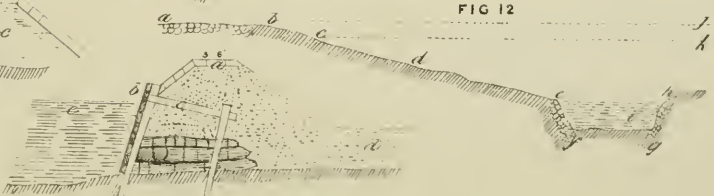
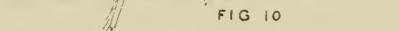


FIG 10



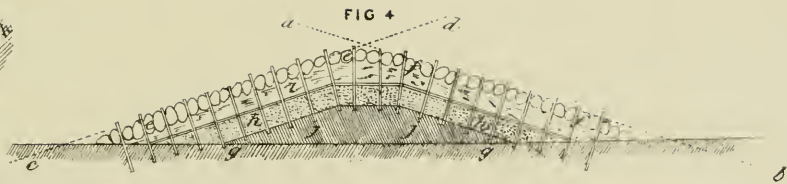


FIG 1

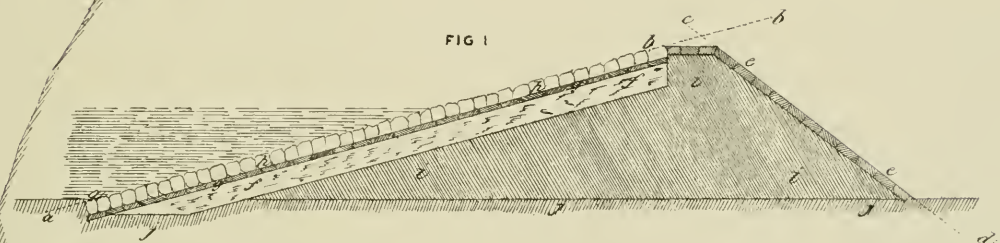


FIG 5.

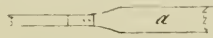
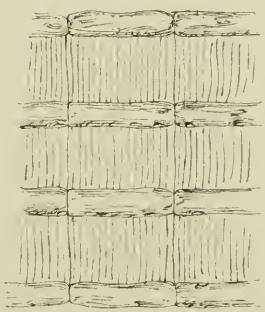
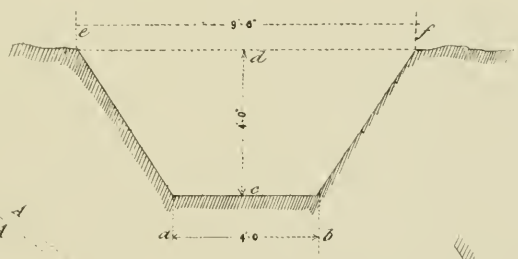
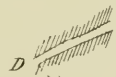


FIG 3



FIG 5.



FIG 1

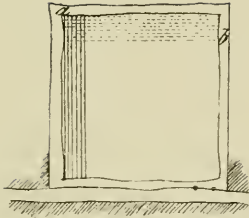


FIG 2

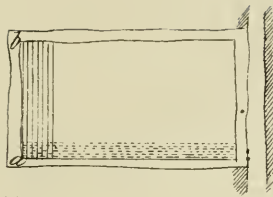


FIG 3

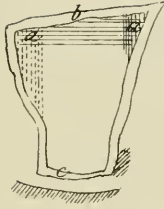


FIG 4

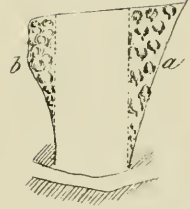


FIG 5

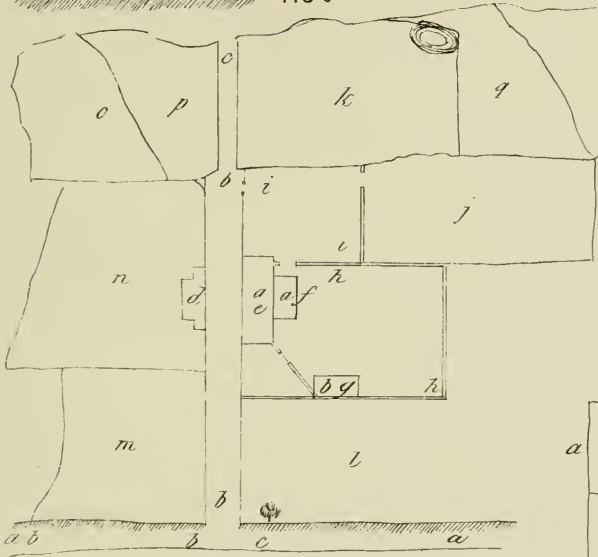


FIG 7

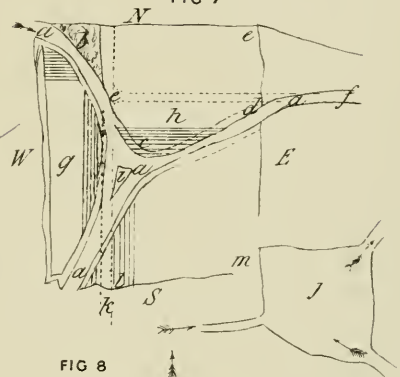


FIG 8

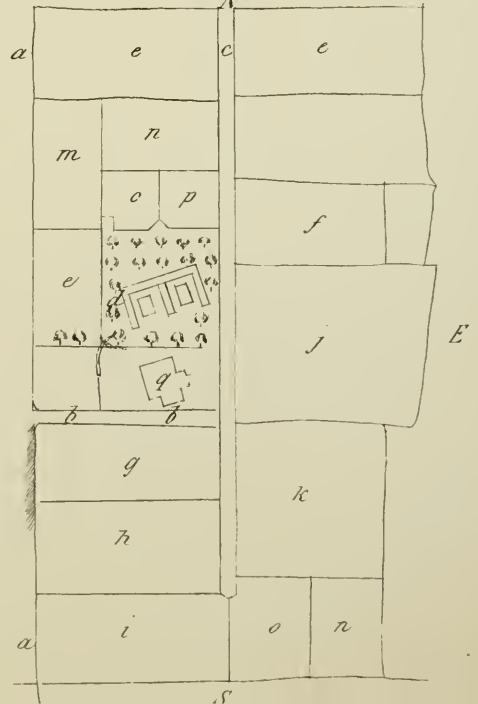
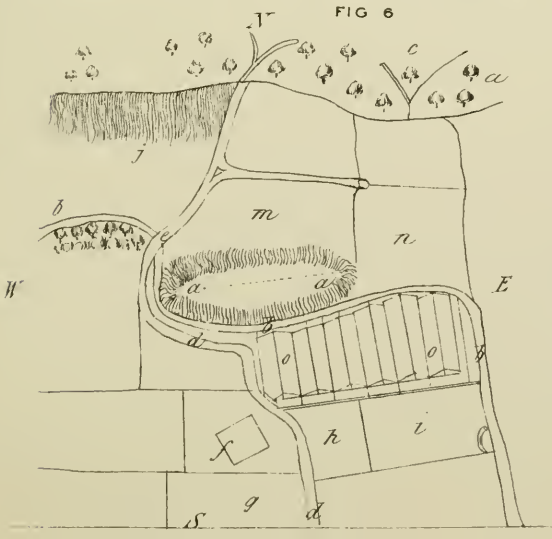


FIG 6



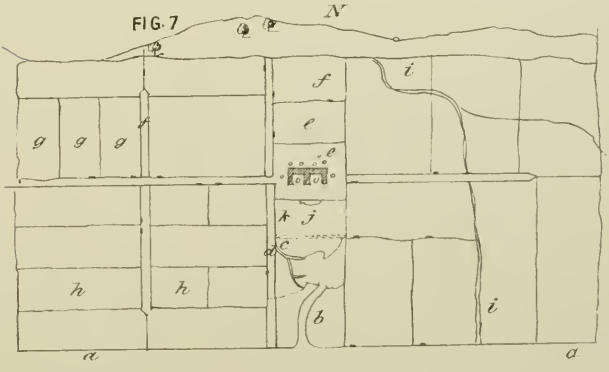
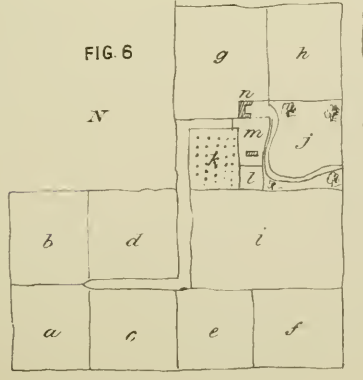
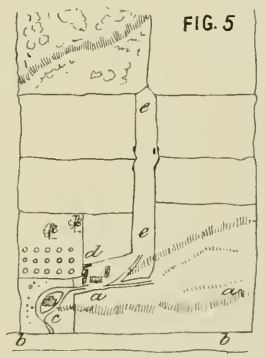
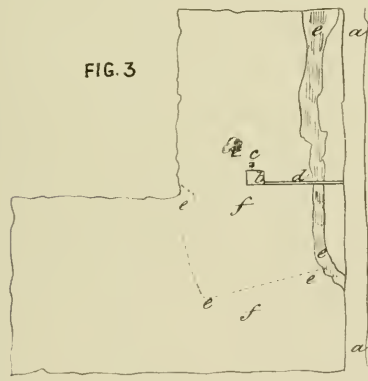
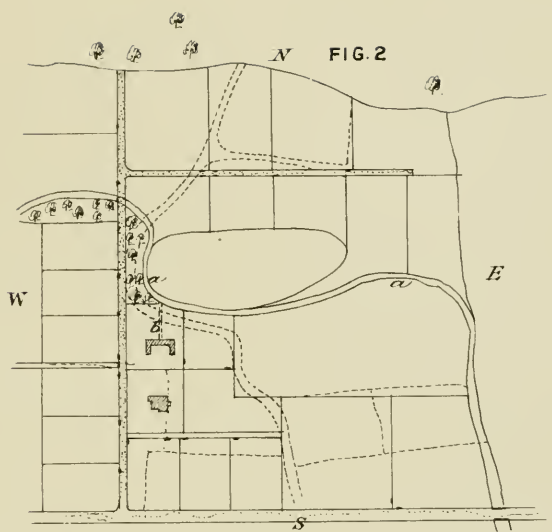
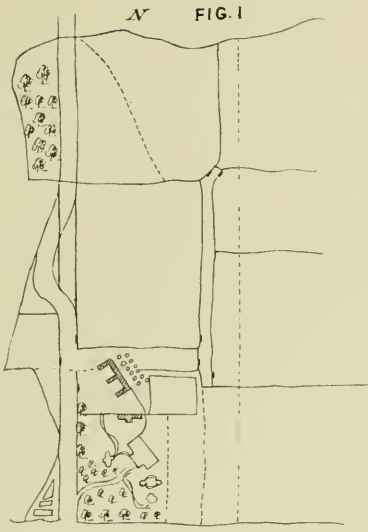




FIG 2

FIG 1

FIG 4

FIG 3

FIG. 1

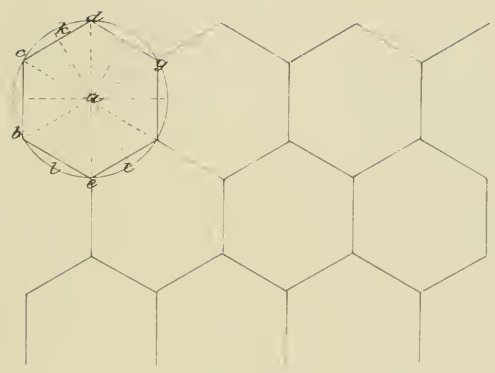
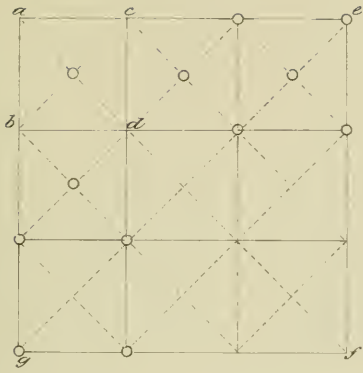


FIG. 3

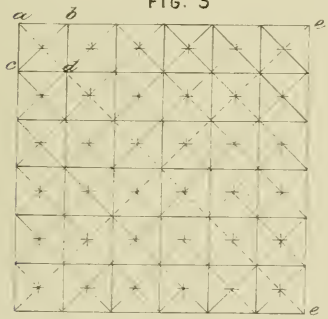


FIG. 4

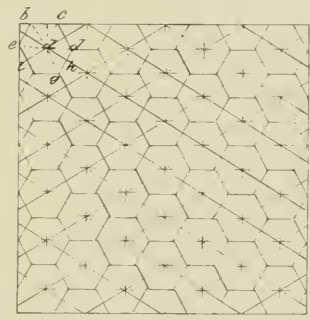


FIG. 5



FIG. 6

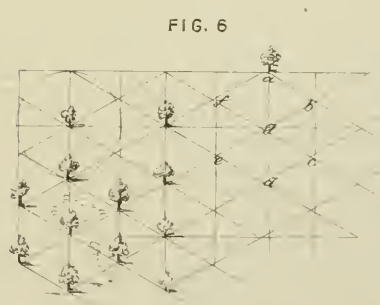


FIG. 7



FIG. 8



FIG. 9



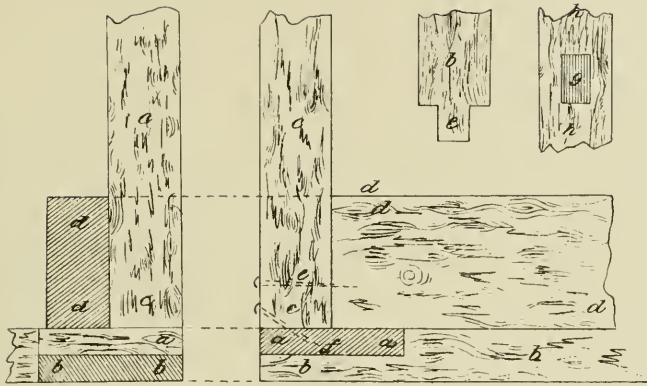


FIG. 1

FIG. 2

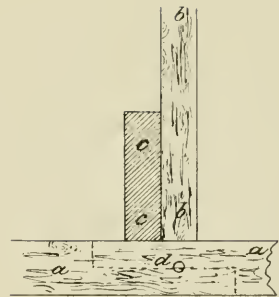


FIG. 3

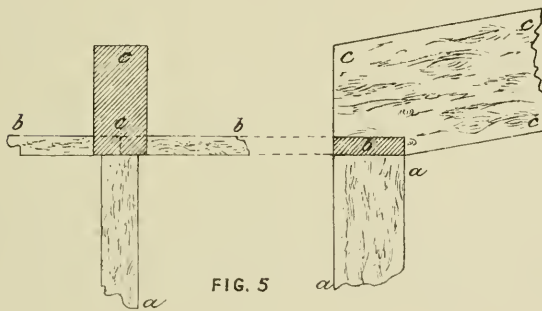


FIG. 5

FIG. 4

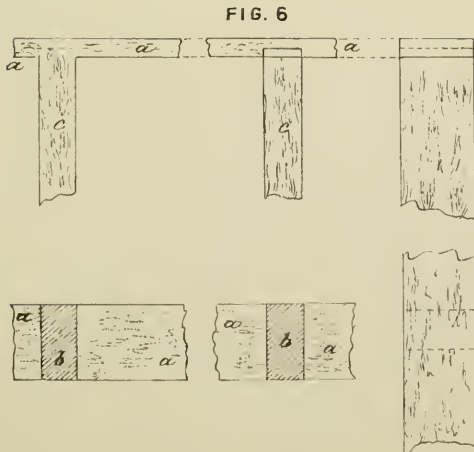


FIG. 6

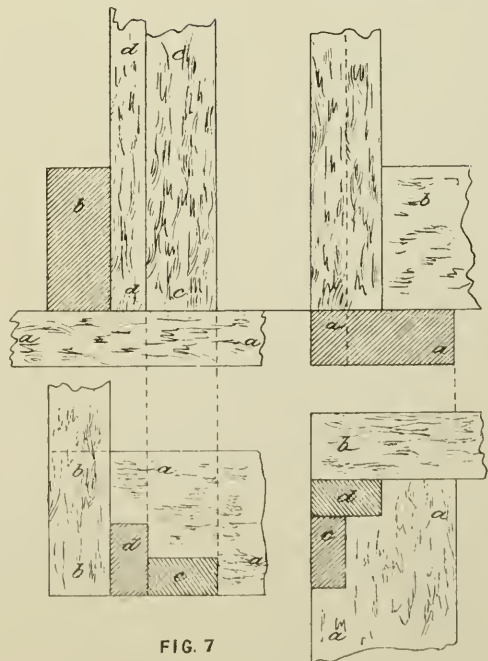


FIG. 7



FIG. 1

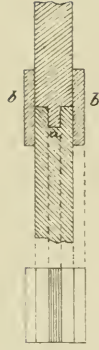


FIG. 2

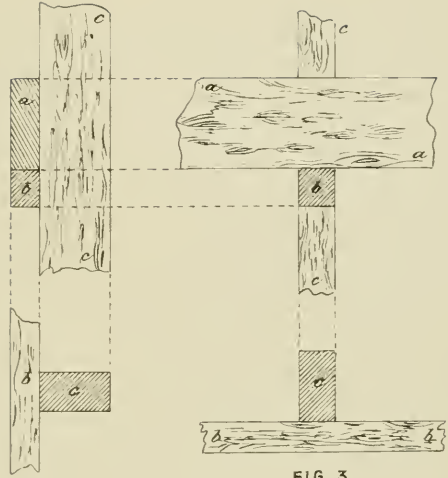


FIG. 3

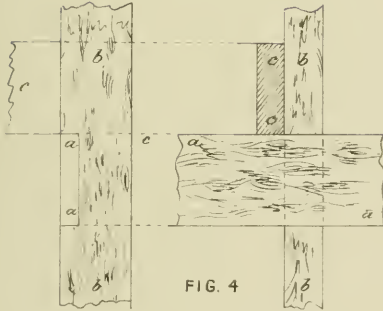


FIG. 4

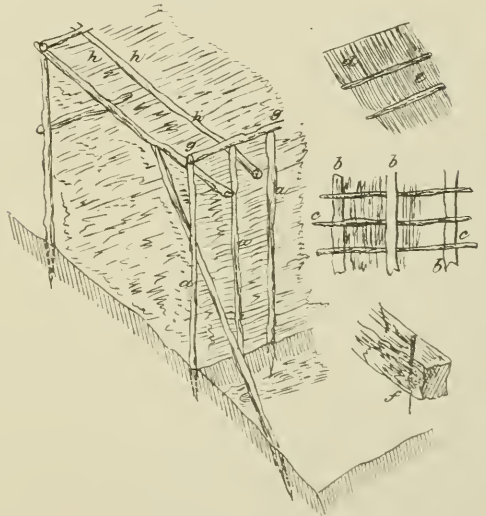
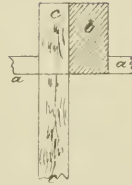


FIG. 6



FIG. 5

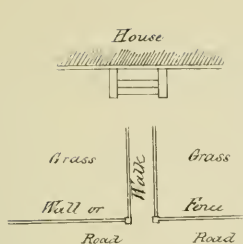


FIG 1

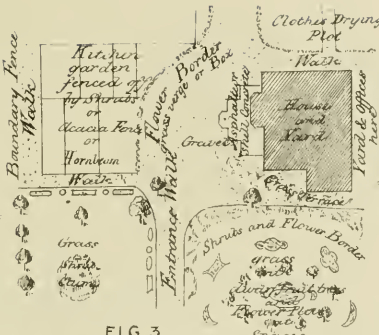


FIG 3



FIG 2



FIG 4

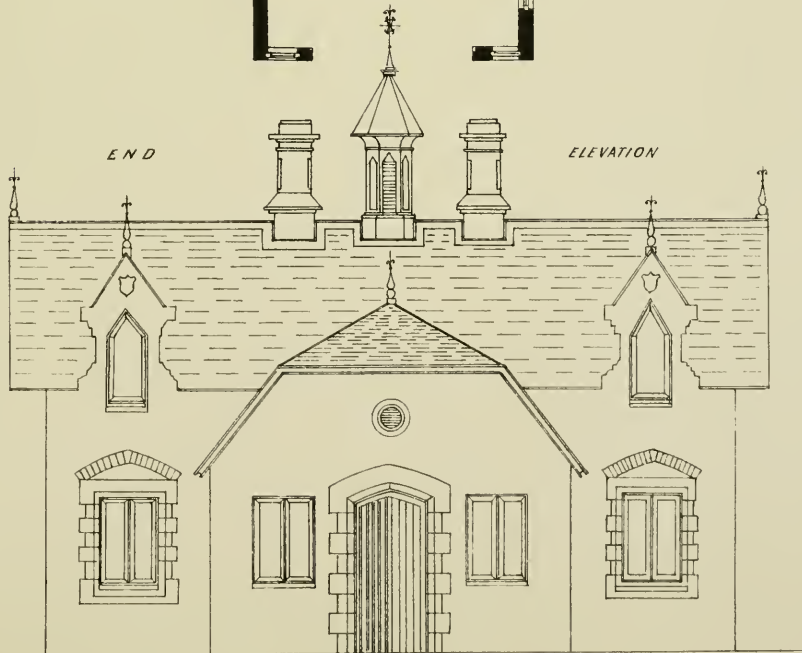
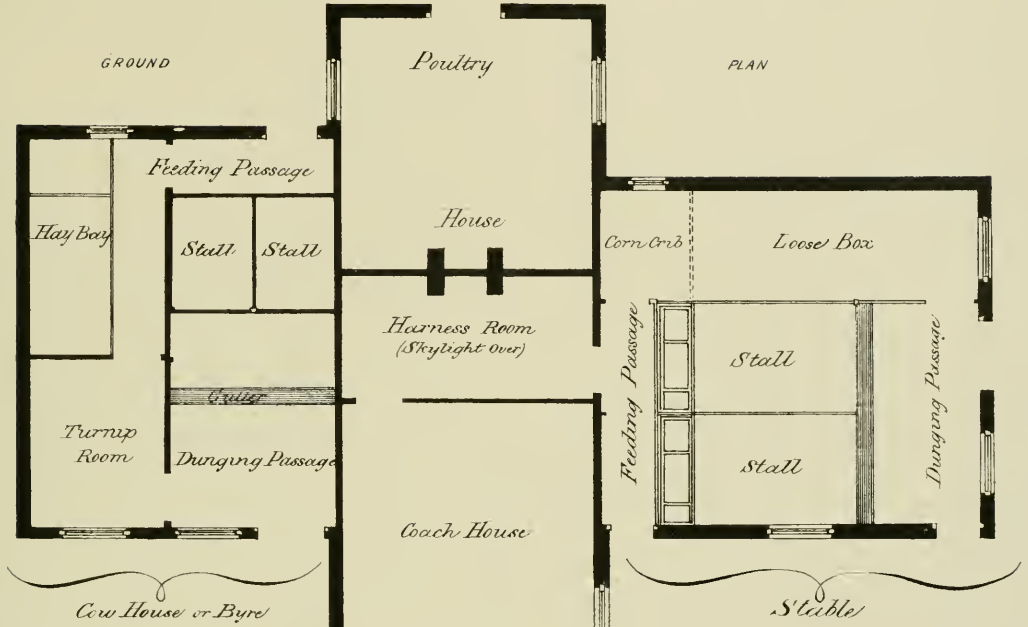


FIG 5



FIG 6

COACH-HOUSE, STABLE, COW-HOUSE AND POULTRY HOUSE



Scale - 8 ft. to the Inch

DIAGRAM PLAN OF DOG KENNELS, &c.

Seats, about 3' to the Inch. True Scale 20' to the 1"

Doors in Plan Fig. 1 indicated by breaks
 in Wall lines as thus _____
 Windows by Teds in the
 Brackets as thus _____
 Huntsman's Cottage Site at AA below.

Readings 29 feet wide to wall of Existing Ground

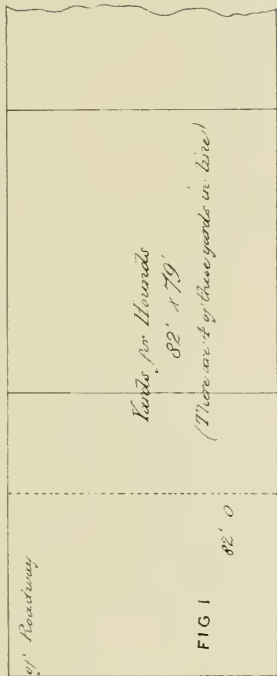


FIG. 1

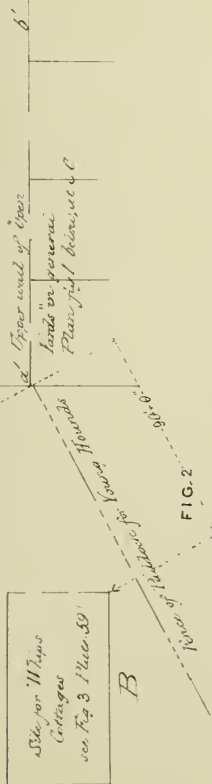
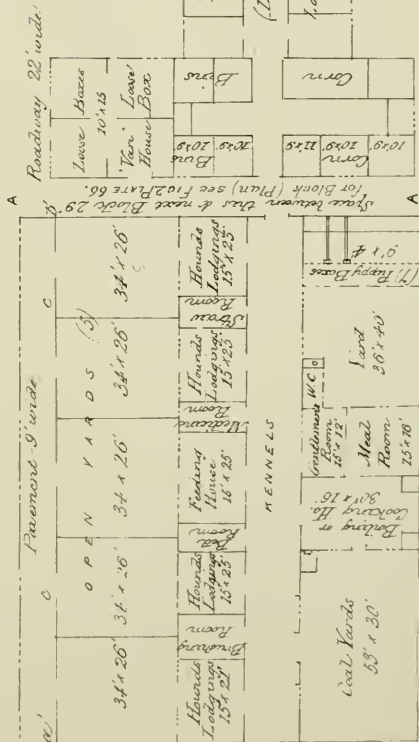


FIG. 2



MENNELS

Furthest 9' wide

Roadway 22' wide

Roadway 29' wide

for Block (plan see next Plate 66)

Space between Bars & next Block 29'

for Block (plan see next Plate 66)

Space between Bars & next Block 29'

for Block (plan see next Plate 66)

Space between Bars & next Block 29'

for Block (plan see next Plate 66)

Space between Bars & next Block 29'

for Block (plan see next Plate 66)

Space between Bars & next Block 29'

for Block (plan see next Plate 66)

Space between Bars & next Block 29'

for Block (plan see next Plate 66)

Space between Bars & next Block 29'

for Block (plan see next Plate 66)

Space between Bars & next Block 29'

for Block (plan see next Plate 66)

Space between Bars & next Block 29'

for Block (plan see next Plate 66)

Space between Bars & next Block 29'

for Block (plan see next Plate 66)

Space between Bars & next Block 29'

for Block (plan see next Plate 66)

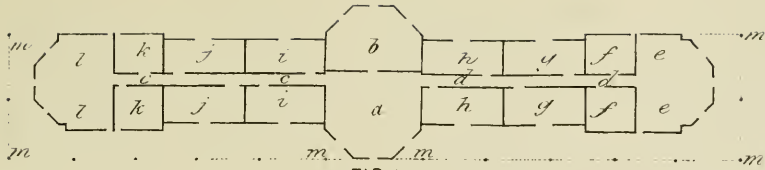


FIG 1



FIG 2

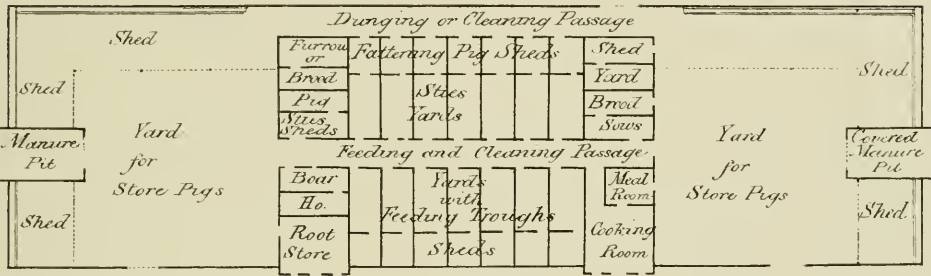


FIG 3.

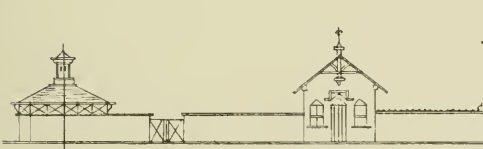


FIG 4

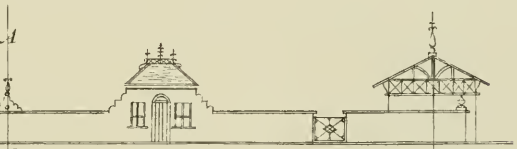


FIG 5

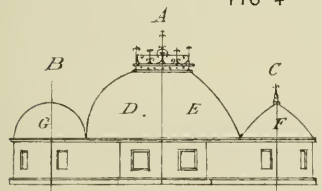


FIG 6

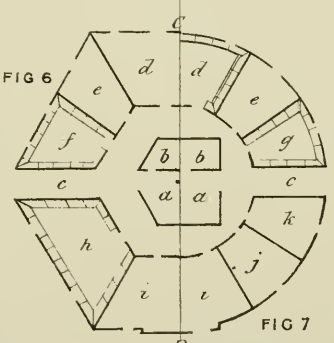


FIG 7

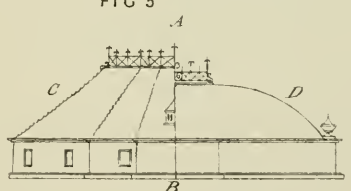


FIG 8

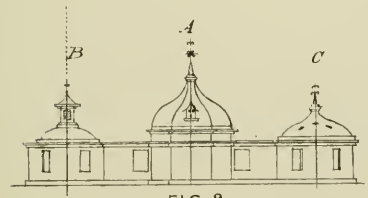


FIG 9

Scale on Plate 72



FIG 10

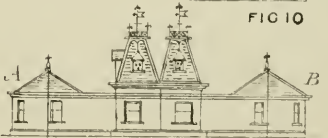


FIG 11



FIG 12

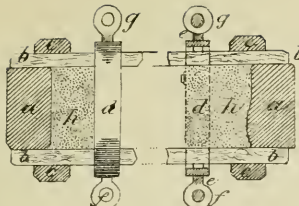


FIG 1

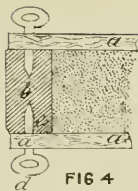


FIG 4



FIG 5

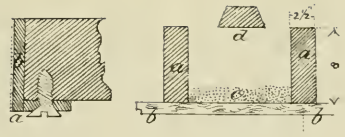


FIG 10

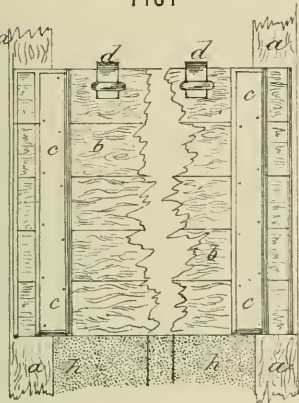


FIG 2

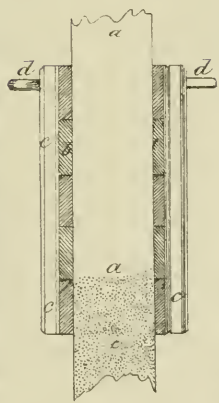


FIG 3

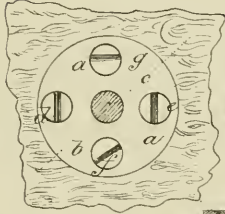


FIG 6



FIG 11

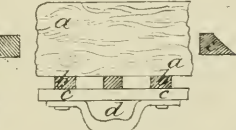


FIG 12

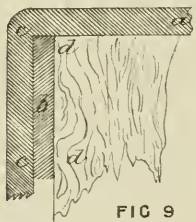


FIG 9



FIG 13

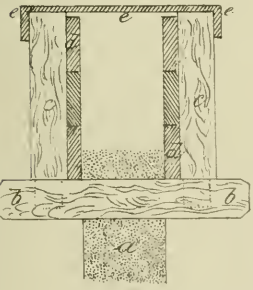


FIG 7

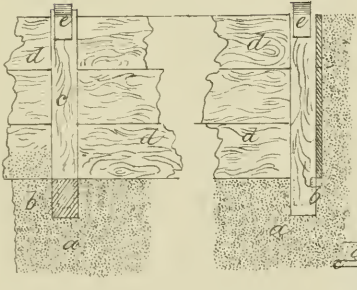


FIG 8

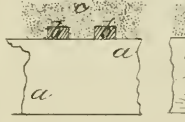


FIG 14

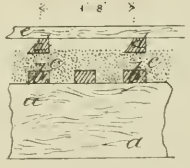


FIG 15

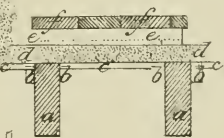


FIG 16



FIG 17

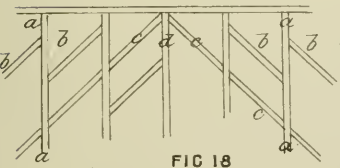


FIG 18

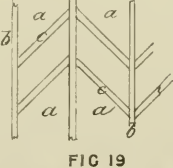


FIG 19

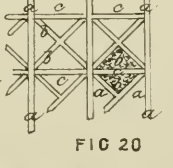


FIG 20

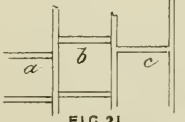


FIG 21

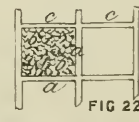


FIG 22

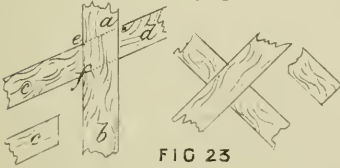


FIG 23



FIG 24

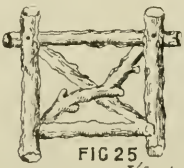


FIG 25

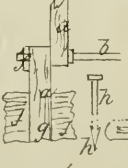


FIG 26

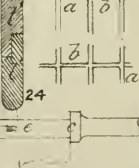


FIG 27

Scales Figs 1 to 17 - 3/4" = 1 Ft. Figs 18 to 22 - 1/8" = 1. Fig 6 1/2 size. Fig 27 1-1

FIG 1

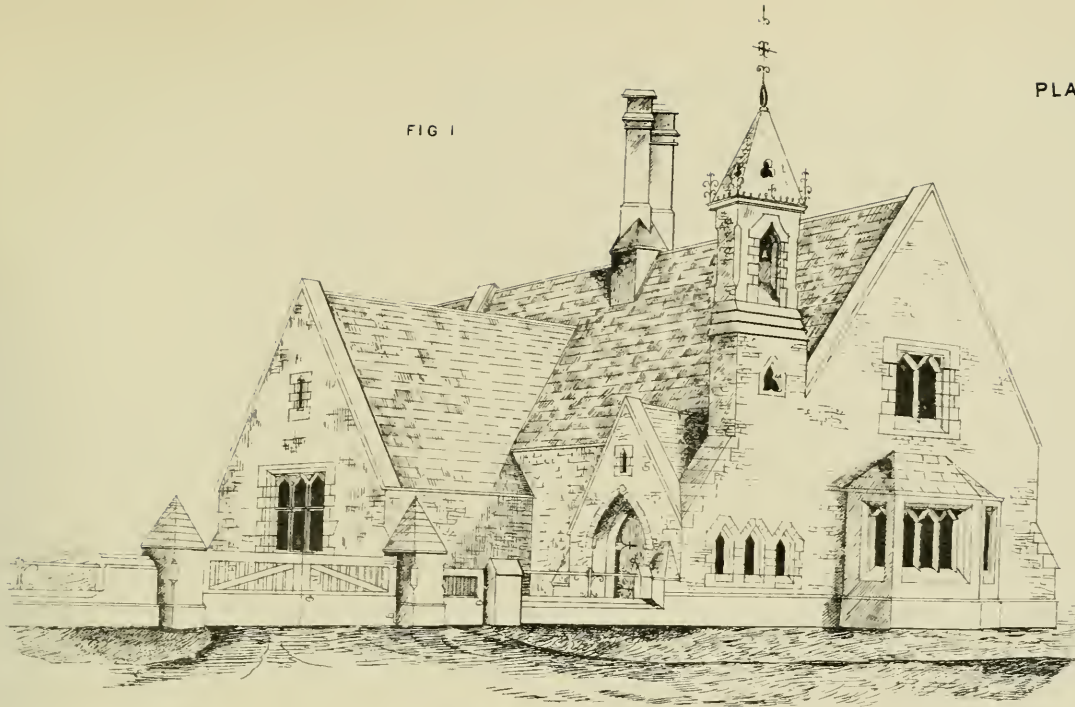
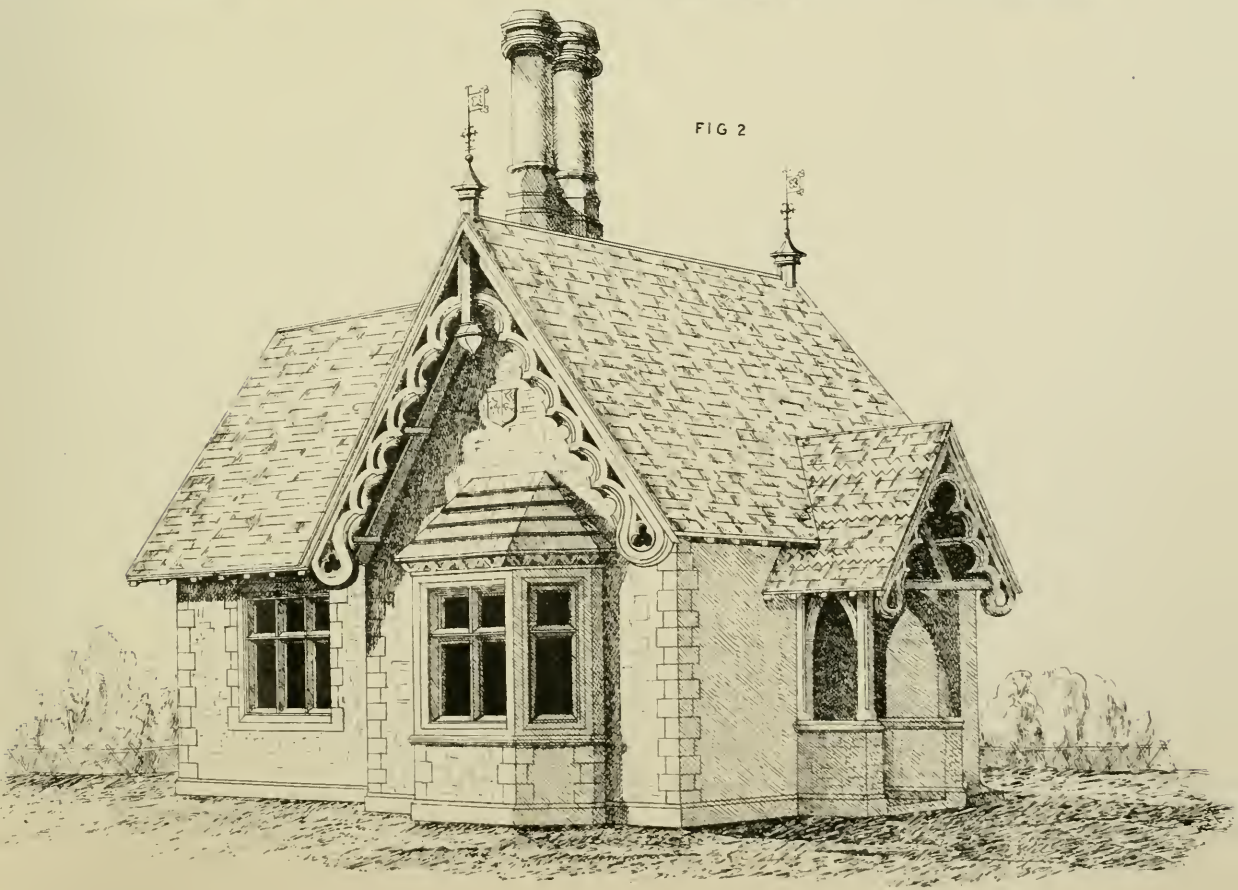


FIG 2



GROUND PLANS OF LODGES
IN PLATE 75

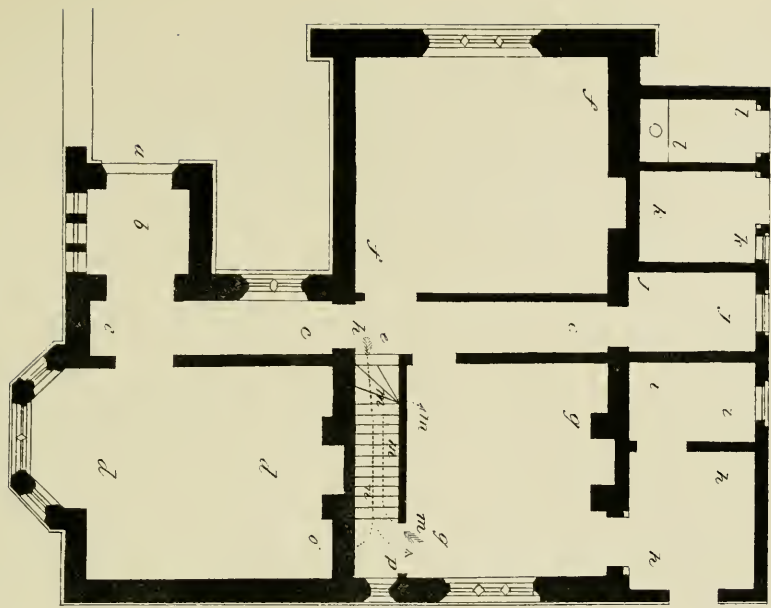


FIG 1

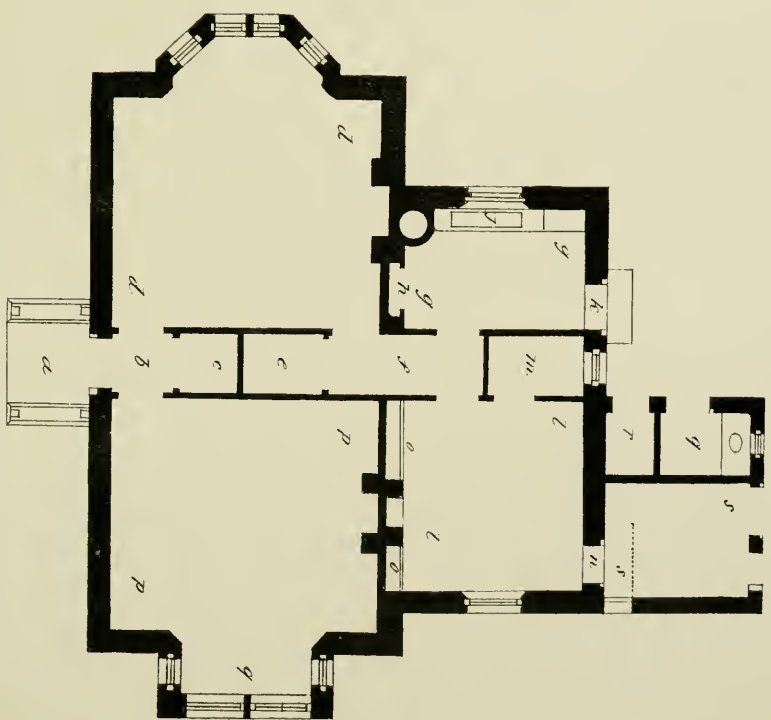


FIG 2

Scale, 1/8" = 1 Foot

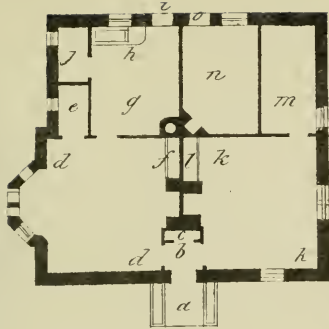


FIG 1

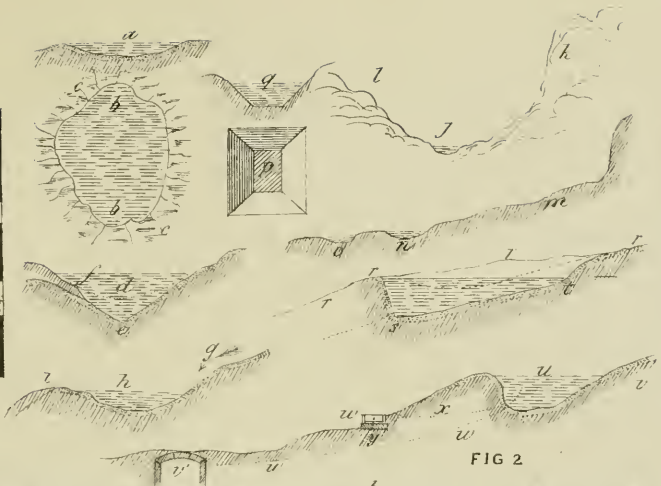


FIG 2

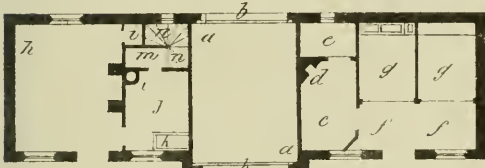


FIG 3

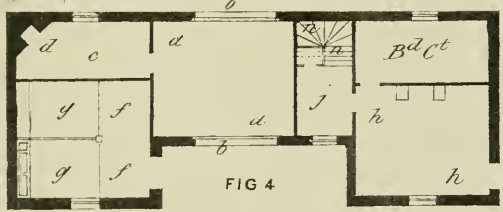


FIG 4



FIG 5



FIG 6



FIG 7

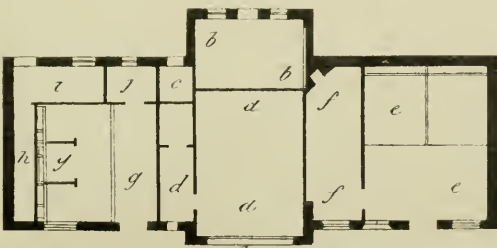


FIG 8



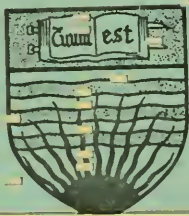
FIG 9

DUE DATE

old book

PRACTICAL SUBJECTS FOR THE IMPROVEMENT

AGRICULTURE FORESTRY LIBRARY



LAN
1887
LIBRARY

