



Nº 6130

PRACTICAL FORESTRY

PRACTICAL FORESTRY

AND

*ITS BEARING ON THE IMPROVEMENT
OF ESTATES*

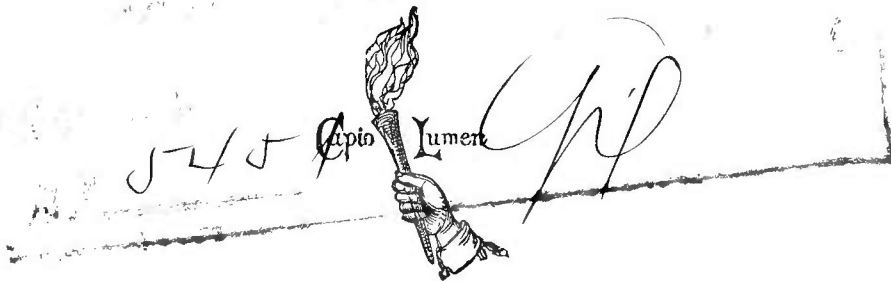
BY

CHARLES E. CURTIS, F.S.I.

PROFESSOR OF FORESTRY, FIELD ENGINEERING, AND GENERAL ESTATE MANAGEMENT AT
THE COLLEGE OF AGRICULTURE, DOWNTON; CONSULTING FORESTER TO THE RIGHT
HONOURABLE LORD O'NEILL, SHANE'S CASTLE, ANTRIM, ETC.

Second Edition, Revised

160



LONDON
CROSBY LOCKWOOD AND SON

7 STATIONERS' HALL COURT, LUDGATE HILL

1898

[ALL RIGHTS RESERVED]

Printed at THE DARIEN PRESS, Edinburgh

PREFACE TO SECOND EDITION.

THIS volume comprises the substance of a series of papers on Practical Forestry, which were contributed by me to the *Land Agents' Record*, and have been re-issued in the form of a volume in response to numerous requests.

My object has been to promote and encourage the study of Forestry among landowners, land agents, and the occupiers of land ; and further, to impress upon all students of land economy the advantages of practical knowledge of a subject vitally affecting national interests, which has been strangely neglected and ignored, there being few districts of the United Kingdom incapable of being improved by wise and judicious tree planting.

In these days of agricultural depression there is only too much reason for improvement and wise economy in the management of landed estates ; and the planting of land now unoccupied, or only partially cultivated, must materially enrich future generations and the whole body of inhabitants of these islands.

Since the First Edition of this work was issued, the subject of Forestry has made no great advance ; but nevertheless there are signs that many landowners recognise the importance of managing their woods on more definite lines, and of increasing their woodland area by wise and judicious planting, while principles of Forestry are now more widely taught at our Agricultural Colleges and more fully recognised as a branch of land management ; and it is satisfactory to note that a special certificate is now offered by the Surveyors' Institution to its members (by examination), to be obtained by candidates only upon the display of a sufficient theoretical and practical knowledge of Forestry. Another and very important step in the right direction is that of setting apart portions of the Crown Forests as models for landowners to follow. If "working plans" for Crown Forests are made, it must lay the foundation for a recognised system, which so far has been absolutely lacking.

CHARLES E. CURTIS.

26 GLEDSTANES ROAD,
KENSINGTON, W
September 1897.

CONTENTS.

	PAGE
CHAPTER I.	
PREFATORY REMARKS	I
CHAPTER II.	
OBJECTS OF PLANTING	7
CHAPTER III.	
CHOICE OF A FORESTER	11
CHAPTER IV	
CHOICE OF SOIL AND SITE	16
CHAPTER V.	
LAYING OUT OF LAND FOR PLANTATIONS	22
CHAPTER VI.	
PREPARATION OF THE GROUND FOR PLANTING	26
CHAPTER VII.	
DRAINAGE	32
CHAPTER VIII.	
PLANTING	41
CHAPTER IX.	
DISTANCES AND DISTRIBUTION OF TREES IN PLANTATIONS	55

	PAGE
CHAPTER X.	
TREES AND GROUND GAME	63
CHAPTER XI.	
ATTENTION AFTER PLANTING	67
CHAPTER XII.	
THINNING OF PLANTATIONS	71
CHAPTER XIII.	
PRUNING OF FOREST TREES	79
CHAPTER XIV.	
REALISATION	85
CHAPTER XV.	
METHODS OF SALE	89
CHAPTER XVI.	
MEASUREMENT OF TIMBER	99
CHAPTER XVII.	
MEASUREMENT AND VALUATION OF LARCH PLANTATIONS	108
CHAPTER XVIII.	
FIRE LINES	112
CHAPTER XIX.	
COST OF PLANTING	115
INDEX	123

PRACTICAL FORESTRY



CHAPTER I.

PREFATORY REMARKS.

IT is exceedingly difficult to avoid the too common practice of generalising on the now threadbare subject of agricultural distress and depression when writing about any matter affecting the management and improvement of landed property. To some extent, undoubtedly, this failing is a necessity, as approach in any direction we will the subject of improvement, be it ever so far removed from agriculture, the effect of the depression is manifest. The sinews of war, so to speak, have so far arisen from profits and rents arising from agricultural lands; and these having partially failed render it impossible to carry out improvements of any kind, except by the expenditure of capital drawn from the land by mortgage, or by the withdrawal of capital otherwise invested. Hence improvements are less general, and hence, too, arises the cry for employment from nearly all agricultural areas. No fault attaches, or, at least, no fault can be

located anywhere ; it is but the outcome of low prices and keen foreign competition.

We have no intention, however, of giving way to this depressed state of writing ; but rather, taking the standpoint of an optimist, endeavouring, in the following chapters on Forestry, to point out how, in the not very remote future, such a state of depression may be met, and, to some extent, defeated.

Landowners—*i.e.*, owners of purely agricultural land—have been too dependent upon rents emanating from the land, and not partially independent, as they might be, in such an emergency, on account of the profits arising from well-managed woodland.

Few will be inclined to cavil at the following statement—that our woods and plantations are not such a source of income and wealth as they might be. If the same enterprise bestowed upon our agricultural land in the expenditure of landlords' capital had been manifested in the expenditure of capital upon our woodlands, there would have been that proverbial second string so useful when found. Few landowners, however, have been able to meet these periods of depression by drawing upon their woods, without injuring very largely the interests of their successors. And yet where true forestry has been carried out the land has been found capable of yielding an annual return equal, if not superior, to arable or pastoral land of somewhat similar quality ; and with this advantage, that the yield is present when wanted without a large yearly expenditure, and without the risk arising from fluctuations and seasons. Too often, however, as is manifest to even a casual observer, our

woodlands are like banks, often overdrawn upon, and are not treated with that consideration which they deserve. The wholesale destruction of valuable timber to meet pressing demands has greatly marred the beauty and wealth of our woods; and if every proprietor were free to cut and sell as he pleased, *i.e.*, if he were without legal restraint, it is possible to believe that a very much smaller area would now exist.

What is required is to encourage the judicious planting of new areas, and to preserve and improve carefully those in existence. To do this requires the employment of skilled foresters, and to obtain this class must be the mainspring from which all future success will arise. Efforts hitherto made by many landowners have been nipped in the bud by failure, and nine times out of ten these failures have arisen from deplorable ignorance in the men employed. Until the idea is exploded that any fool can plant a tree there can be little hope of success.

Perhaps of all branches of culture arboriculture is the one that needs most culture in the individual. He is not called upon to sow a crop which he will reap the following season, but to sow, tend, and judiciously thin a crop which is to stand through future and distant generations. He must be cognisant at least of the principles which govern plant life, although he need not be deeply learned in vegetable physiology. He must understand the nature of soils and their preparation for tree life; and, above all, must he be aware of the trees adapted to each. Wherein can a greater failure lie than in the wrong selection of trees? We venture to assert that, take

the country through, a really sound forester or woodman is but occasionally found. Many practical men there are who have acquired the knowledge they possess by simple practice, but who are otherwise absolutely disqualified from taking a leading part in large forest transactions. Until by thorough and sound teaching such a class is obtainable there is little hope of any great improvement in our system of arboriculture. Nothing succeeds like success, and if some extensive plantings could be carried out, and if they proved successful, no doubt many would follow suit, and a sylvan era would ensue.

We are a tree-loving people, and we revel in our beautiful glades ; but we are not a progressive people in this respect. We have not, in an equal degree, that energy manifested by our ancestors in the introduction of useful trees ; but we need not seek far for the reason. In those remote times they were dependent upon their own production, and were lavish in the use of it. Now we are supplied from countries east and west, north and south, and have thereby lost to some extent our independence. If this supply were stopped the old love of forestry would revive.

Our object, however, is not to moralise, nor to induce landowners to believe that this foreign supply is likely to cease, but to induce them, if possible, to improve their estates by planting for profit, for shelter, or for ornament. That the foreign supply will decrease, from an increased home demand, from recession from the port of embarkation, and from rise in freights, is a foregone conclusion ; but a conclusion remote enough to excite no alarm.

With regard to the objects of planting, direct profit is the most inductive; but shelter, wisely arranged, tends greatly to improve land for agricultural purposes, and undoubtedly increases the yield of wheat and other cereals, and also materially improves the condition of our flocks and herds. Ornament, too, is no mean factor in rural economy, and perhaps tends more to increase the capital value of land than either of the foregoing.

The principal hindrances to planting are, perhaps, the large capital required and the deferred return therefrom; the difficulty in obtaining qualified foresters, and the inertia in our landowners. The two former can be overcome by the sweeping away of the latter. Few improvements yield a speedy return, many never return any—*i.e.*, direct return—and few are so certain as well-conceived and well-executed planting. We do not for one moment recommend planting areas fit for profitable cultivation or grazing, but we do strongly recommend planting those areas now lying idle or unremunerative. We recommend it because we know by long personal experience that a return is certain and not unreasonably deferred. A man of middle age may plant with a reasonable hope of reaping some share of his enterprise.

We have just visited a large covered yard, the timbers of which were of larch, all home grown, and all planted by men now engaged on the estate. If soil and site are well chosen, thirty to forty years will bring larch to a useful maturity, and yield a large pecuniary return over and above the yearly income

derived from thinnings. If the above facts were well weighed by landowners, it would probably incite them to plant more than any sophistry.

Our object, then, in the following pages, is to endeavour, in a concise and practical way, to lay before the landowner and agent, and, we hope, the *bonâ fide* woodman, the true principles of practical forestry,—to eliminate science as science, but to merge it with practice, because we hold that, to ensure success, the two must run together. Neither can stand alone, and a forester possessing one or the other, but not both, is from a practical point of view a useless incumbrance. If we succeed in the most trifling degree in promoting a desire to learn, and so advance the grand scheme of national and private education in forestry, we shall be more than repaid.

Our object will be to carry the reader through a series of seasons and periods, and through the various operations in the plantations and woods ; to describe the processes of drainage, planting, thinning, pruning, and final realisation. To consider the selection of sites, soils, form, and size of plantations ; the selection of trees, and the objects of planting. Also to consider the necessary pains and precautions to secure beautiful and ornamental specimens.

At the same time, our object is to interest the forester, and to induce him to search further into the intricacies of this magnificent study by referring to standard works, which deal more thoroughly with detail than a work of this nature is capable of.

CHAPTER II.

OBJECTS OF PLANTING.

TO meet with success in any undertaking there must be an object in view. This is only stating an abstract truth. So it is in forestry: the landowner will have an object in view when he decides to plant. It may be to create new areas or to increase those existing; to provide shelter in exposed situations, to ameliorate climate, to beautify scenery, or to provide a source of future income and profit—to invest, in fact, a sum, with a view of its accumulation. One and all of these objects will present themselves to the mind of the planter, and if carried out with skill and with a true knowledge of forestry will undoubtedly succeed.

Let us analyse these objects somewhat, and endeavour to show how real they are, and how free from speculative dangers. Few will risk an outlay in times like these which will not, *prima facie*, show a reasonable prospect of return. Some there certainly are who will sink money unwisely, and find out too late that their so-called improvement has proved a delusion. These years of agricultural adversity have, however, checked this, and now there is a tendency to really develop to the full the latent properties of our landed estates. Perhaps of all improvements, as before

stated, planting is the most certain of success, and future generations will have cause to bless those who now invest their money in this way.

To plant a tree is one of the duties of every Englishman, and it is rapidly becoming recognised as a duty in all our colonies, with a view of replacing those vast forests denuded of trees. Consider the case of a treeless tract; what is more dismal and dreary? Those who have travelled over wide areas without a tree to break the monotony of the landscape, and who, after days of travelling, have found themselves in vast wooded districts, can appreciate true forestry. Apart from the actual value of the timber upon the land (which in itself does not increase the capital value of land, it being capitalised as an additional item), the increase in value which arises from its presence is a factor not to be lost sight of. It is a striking factor, as all know who have purchased or sold landed estates. There can be no greater inducement to purchase or retain an estate than the fact of its being well covered with ancestral timber. It is something which the millionaire cannot obtain at will; something which he may covet, but which, except by purchase, is beyond his reach; and although he purchases trees at so much a foot, the inherent value of their presence is the mainspring on which hinges the value of the estate.

On likely building sites, what gives such a value as the presence of timber? Timber not present cannot be placed there except by planting and the lapse of years. On bleak estates, or on such as would be bleak but for the presence of timber, does the timber

bear a simple market value? We need not multiply such instances. The fact that the presence of timber affects the value of landed property much beyond its commercial value is beyond dispute.

The object, however, will vary in accordance with the nature of the estate ; whether it is flat and fertile, hilly and sterile, exposed to winds, or liable to flooding, and so on. Planting more or less affects all these conditions. If land is flat, and fit for profitable agriculture, the benefit is reduced to the minimum. The income derivable from the estate will probably not be increased by the creation of woodland. The object then will probably be ornament, or shelter for stock.

If the estate is hilly and partially unfit for agriculture, the object will be to clothe the sterile hill-sides with wood, which will assist materially in improving the rest, by the effect upon climate and moisture. Land of this kind, yielding now, probably, no return, may be made, not only profitable, but a source of wealth. If exposed to cutting winds, shelter will be the object ; and this shelter, when obtained, will be equivalent to the removal of the estate many miles southward. If liable to sudden floods, owing to the presence of bare and unclothed hill-sides, the mischief will be stayed by judicious planting.

However, the main object, the main incentive, has been, and will always be, that of direct profit. Timber, as a crop for commercial purposes, is what is wanted, and the minor incentives will follow as a natural result. The one may be obtained from the other.

We know, personally, of tracts of land in the south of England, almost valueless, from a cultivation point of view, now yielding a handsome return from the wise planting of larch fir. If still in their naked state, these tracts, through the long period of depression, would have been as barren and useless as the Sahara itself. They now yield an income, and will continue to do so for many years; and when the present crop is reaped the land will be enriched and rendered fit for replanting or other purposes. Reclamation, as this implies, is by no means a mean object in many cases, and may especially be the case when dealing with dry and sandy tracts.

Objects then are manifold, and, if correctly estimated and carried out, the landowner and the nation will be benefited.

CHAPTER III.

CHOICE OF A FORESTER.

THE first thing that a proprietor will do, after having determined his object, will be to secure the services of a forester. This often is a difficulty of no mean character. As before stated, there are few really qualified men, but many so-called woodmen. This is only a natural result of lack of requirement. Where there is no demand, there is, as a rule, no supply; and few will take the trouble to acquaint themselves with a full knowledge of forestry who are not likely to be in a position to practise it. If once the land-owners show a determination to extend their plantations, and manifest an interest in the conservation of their existing woods, there will be an expressed desire by a class to obtain the necessary education.

Again, the wages or salaries given to foresters or woodmen have not been such as to secure the services of educated men. Men having a knowledge of chemistry, entomology, geology, vegetable physiology, and so forth, are not satisfied with £50 to £70 a year; and it is seldom that the return from our woods will meet a more extravagant salary.

Nevertheless it is possible, and not improbable, that

this false economy has had something to do with the unsatisfactory condition of our woodland. Perhaps, if more intelligence had been exercised we should not now see so much that is really wanting in the sense of a true systematic course of forestry.

We have, in our somewhat long experience, seen forestry at home and abroad, and have seldom seen that display of knowledge and system which we all desire to see. We have seen, too, the deplorable state of large areas of woodland through absolute neglect on the one hand, and extravagance and ignorance on the other. The former is apparent in the weakly timber, the decaying and moss-grown stems, the drains stopped and overflowing; the latter in the sweeping away of all good timber, to meet pressing emergencies, and in the existence of ill-grown and faulty timber of little or no commercial value. When called in to advise we have too often had to find fault with past mismanagement, and to point out the necessity of a long series of years of reclamation and improvement, unattended by present remuneration.

This state of things can only be remedied by the introduction of a class of men really intelligent and possessing a fair knowledge of the sciences attaching to the subject, as well as a practical knowledge of ordinary field-engineering and woodmen's work. More than this, the forester must, if he is to organise and control large forest operations, qualify himself in nursery work. Forestry on a large scale can never pay without a forest nursery, and to place this in the hands of an ignorant man is folly of the greatest

magnitude. Nothing can be more fatal to success than planting ill-developed and meagre-rooted trees. To purchase the trees, or to plant by contract, are also means to ensure failure. The latter plan, however, if really good nurserymen are employed, is better than employing unqualified home men.

There are different grades among foresters. There is the professional expert—unfortunately too few in number; the land agent, often very ignorant of this special branch of his profession; the head gardener, often employed on estates as head woodman (if, however, he has not been specially educated for the class of work, his ignorance is very apparent); and, finally, the labouring woodman. This class we have all over the three kingdoms, and it consists of most excellent and able men. Their skill, however, is to carry out instructions, and not to initiate; and men of experience able to direct are what we really need.

The professional expert, if he deserves the name, is a factor in woodland economy of the greatest importance. The principal drawback to his employment is the remuneration which he naturally expects; but this, though large, is not necessarily a continuing expense. His advice on the whole or on any part may be sought and obtained without his services being retained. His experience is wide, his knowledge extensive. True economy would be often exercised if this class of forester were consulted.

The land agent, whom we would naturally expect to possess the necessary skill and knowledge, is often deficient in it, in fact he is seldom proficient. It is not his fault, it arises from the lack of opportunity to

gain the knowledge. His knowledge consists principally of measuring and valuing.

The gardener, as a rule, is a faulty woodman. His services, however, may be found useful in the nursery, and in the ornamental planting near the mansion.

Among the ordinary woodmen we have found the most willing and able men, men anxious to learn and willing to carry out directions. Many of them make most excellent foremen; and we would rather carry out extensive plantings, and other branches of forestry, with their direct aid, than employ a more advanced woodman as intermediary.

What then should guide the proprietor of a landed estate in his selection of a forester? It must depend greatly on what his intentions are. If he is himself fairly qualified and willing to conduct the operations, he will find one of the latter class the best, and sufficient. If he has not the necessary skill, he will do best to consult and employ a professional expert, who will on his part employ probably one of the same class. If his agent is qualified, he will consult him, and place confidence in him. The choice of a gardener we do not under any circumstances recommend. Then, he will naturally ask, what are the qualifications needful?

The true forester should be a man of education, possessing a fair knowledge of, at least, elementary science,—and this term is comprehensive, *i.e.*, it should include botany, vegetable physiology, geology, and entomology; also a knowledge of land drainage, simple surveying, timber measurement, and of commercial values and uses of hewn timber. He must

also be skilled in nursery work, and in all the practical duties of a working woodman. He should be able to wield the axe, and use with skill and judgment the pruning-chisel or knife; and, above all, he should possess that common sense which is absolutely essential in the control of men.

A man cannot be perfect, and we do not imply perfection; but we do urge, and strongly, the necessity of employing able and intelligent men. The work to be performed is work of a high order, failure is a matter of grave consequence, success means prosperity to future generations. If the actual planting is successful—*i.e.*, if the trees planted live—the work is not complete, the work is progressive. All cannot continue to grow together like a crop of corn; there must be skill in the thinning, skill in the pruning, skill in the training throughout.

We recommend all those seeking a working forester to apply to one or more of our best nurserymen; and there are many. They will probably be able to recommend a good man, who, from their personal knowledge, has been well and thoroughly trained.

Certificates of merit they can seldom obtain, except from private sources; but we hope the day will come when planters will seek and employ only those who hold some certificate of professional knowledge emanating from an acknowledged source.

CHAPTER IV

CHOICE OF SOIL AND SITE.

IT would be possible, under this heading, to write very fully of the subject of geology, but we fail to see the benefit which would accrue from it. As before stated, it is of great importance that the forester should possess an elementary knowledge of geology; but that he should be a geologist, in the true acceptance of the term, we do not for one moment imply.

It stands to reason that he should know something of the earth's crust with which he has to deal; how this crust has been formed, and how, by volcanic agency, each separate layer has been brought to the surface for the use of man. He should know, too, sufficient of the subject of structural or solid geology to follow intelligently the various diversities of surface soils.

He should be able (when called upon to deal with areas outside his own locality) by reference to a geological map, to obtain an idea of the nature of the soils likely to be found thereon. Not that structural and surface geology are so closely analogous as to render it possible to infer that one exists on account of the presence of the other, but that there will be a

modified resemblance, the knowledge of which will be of service when dealing, in the first instance, with large pending operations.

The origin of soils has been so often written about, that it seems unnecessary to reproduce the subject here; we may, however, remind the reader that soils, so called, are the disintegrated surfaces of the underlying formations, not necessarily partaking of the exact character and ingredients of that immediately underlying or adjacent; because most of our deep soils are the drifts from the detritus of the denuded or exposed surfaces of the stratified rocks, which have been collected and arrested from time to time by natural agencies, thus filling up the crevices caused by the unequal and diversified surface of the crust below. For an example we may turn to the soils of the chalk formation, where we find a great variety, and of various depths. These soils are mainly composed of the plastic clay and sand of the tertiary formations which have filled up the pits and fissures of its surface.

It must be clear that if every exposed surface of stratified rock, by its disintegration, yielded a universally similar soil, as it would do if not exposed to further action, we should have, in place of the diversified soils, soils of fixed type and character, often of little or no value. It is the blending of the various ingredients which give the value to the surface soils, and which we take advantage of in all our acts of culture.

This natural blending, attended by the accumulation of the residue of organic substances, yields fertile

or unfertile soils in accordance with the presence or absence of one or more of the ingredients; and in accordance, too, with the amount of that vegetable residue, the absence of which would render the most perfect mechanical mixture of little cultural value.

The agriculturist, dealing as he does almost entirely with the top or surface soil—*i.e.*, the soil which has been exposed to mechanical and climatic influences—can by inquiry find out what his soil contains, and also what the plant which he desires to grow requires, and by adding the ingredient or ingredients which are wanting grow pretty much what he desires. Not so the arboriculturist. The subsoil to him is of almost equal value, and will require his consideration quite as much as the surface soil. Neither can he, by adding chemical compounds, fit the soil for growing trees otherwise unadapted to the purpose.

It is nevertheless important that each should know whether he is dealing with fertile clays, rich loams, sandy loams, sands, or thin calcareous soils; and also know that all soils, of whatever nature, are formed of clay, sand, and calcareous matter, in varying proportions, and that in accordance with these proportions we have clays, loams, sands, and marls, and other intermediate classes of soils.

Clays may be fertile or barren in accordance with the plant-food which they contain, and in accordance with their mechanical condition. If well drained, they become a very storehouse of good things, and are the backbone of husbandry. If not, there is no class of soil so useless.

Loams are a mixture of clay and sand, and vary as

these preponderate, ranging from clay loams to sandy loams. They differ, as a rule, from fertile clays in possessing less organic matter, iron, and alumina, and more phosphoric acid, carbonic acid, and silica.

Marls are a mixture of clay and lime, and vary as above, as one or the other ingredient is in excess.

Calcareous soils are usually thin, and are composed of the *débris* of the underlying stratum, with a greater or less amount of organic matter.

With all these soils, and their modifications, the forester and agriculturist have to do; there is, however, this essential difference, the latter has greater command of it than the former. The latter may choose the soil to the plant, or the plant to the soil, but the former can only adapt the trees to the soil. Herein is a great difference. The agriculturist, too, as long as the subsoil is porous, naturally or artificially, thinks or concerns himself little about it. He deals with the surface, which is his storehouse. The forester, on the other hand, must concern himself with both, and especially with the subsoil. It will not be sufficient to examine the surface and then decide upon the tree to plant; he must seek lower, and ascertain what the trees will have to draw upon in years to come. As an instance of this, and to show the importance of it, we may mention a case in which we were personally concerned. On inquiring into the death of an ornamental tree, we found the top soil to the depth of about eighteen inches perfectly dry sand, not sand in the true sense of the word, but a dry fine soil like dust; immediately below this, and with no blend, the soil was a yellow clay, wet and

cold. This shows that without investigation the one cannot be judged from the other.

It is seldom that the forester will have to deal with the best and most fertile soils; these are otherwise profitably employed. He will be called upon to plant hillsides, rugged slopes, poor soils, unremunerative under the plough, cold clays, swamps, heath-lands, and so on. He will have, in almost every instance, to select his trees to the soil and site arbitrarily chosen for him; and herein will be the foundation of future success or failure.

Too much stress cannot be laid upon this important initial step. Let him, by not recognising the class of soil and its condition, or by choosing trees unadapted to the soil and site, fail in this respect, and his reputation as a forester is lost. The money he has expended will have been thrown away, and the whole work brought into contempt.

For instance, let him plant in a dry exposed site a spruce fir, and what is the result? A tree not known to its species. On the other hand, let him plant a spruce in its natural habitat, a low-lying damp spot, free from stagnant water, and he will have a tree which will delight future generations.

Again, let him plant the soft-wooded, fast-growing trees, on poor soils and in exposed sites, and what will he obtain? Stunted and distressed specimens of noble trees. When if he plants the same on well-chosen soils, he will secure those lovely specimens which go so far to render our woods and glades such centres of beauty.

Site and soil in this respect run together, and he

must adapt his trees to each. In planting slopes he will choose his trees not only with regard to the soil, but with regard to the aspect; also with regard to exposure to prevailing winds. The object, too, he will consider in his selection of trees, whether that object is ornament, commerce, shelter, or for prevention of floods. He must bear in mind that he has little control over the soil, so that he cannot undo by future action an error committed in the present. The control which he possesses over the soil will be mechanical only—*i.e.*, by the change of condition brought about by drainage, by retention of water through planting, by the retardation of the drift of soil on hill-sides, and so forth. Chemical changes will, of course, arise through these natural and artificial agencies, but not by direct application of chemical dressings. True, to some extent, direct application of manures may be made in cases of planting special trees for ornamental purposes, on land naturally unfit; but on a large scale this cannot be done.

CHAPTER V.

LAYING OUT OF LAND FOR PLANTATIONS.

IT may be as well before proceeding with this section to point out the meaning of the various expressions, *forests*, *woods*, and *plantations*. The term *forest* in this country can only be correctly applied in a few instances—viz., the New Forest, the Forest of Dean, and other large tracts of Crown lands, and perhaps to some of the large tracts of woodlands in the north of Scotland. The exact area which deserves the style of forest is open to opinion. Some say no area under 10,000 acres should be so styled; but this, in so limited an area as this country possesses, is perhaps excessive. The term forest in English is synonymous with the Italian *foresta*, and French *forêt*, and the terms are applied to an extensive wood or large tract of land covered with trees. In English law, however, the term implies an open space set apart for the chase, and does not necessarily imply the presence of trees.

The term *wood* implies a tract of *natural* woodland, and area is of little or no consequence. The term *plantation* signifies an area *planted* with trees for commercial or other purposes, and is also independent of area. Forests and woods are already laid out, *i.e.*,

their boundaries are determined; therefore we use the term, "*Laying out of land for plantations.*"

This laying out is a matter of considerable importance, and deserves the careful attention of the forester. It will, however, be determined by the object he has in view, or by the magnitude of his operations. If he is laying out the land for planting large areas for commercial purposes, or for the prevention of floods over large districts, the form of his plantations will be governed only by the natural boundary. If, however, he is planting smaller areas for purposes of shelter or ornament, the outline is of grave consequence.

It should be carefully borne in mind that if fine commercial timber is required the area cannot be too large. Timber of good girth and quality cannot be successfully grown in narrow and exposed lines and belts. From their earliest stages of growth, in these positions, trees never rest, but have to fight their battle with the elements. The roots are seldom quiet, the rind or bark becomes hide-bound, the timber gnarled and stunted. To obtain really good timber the areas must be large, so that natural protection is obtained. To more fully secure this the outline may be so arranged as to throw off the force of the prevailing winds; and trees of thick growth planted on the outsides may still further assist this end.

As before stated, when the areas are large we would allow the boundary to form the outline, only qualifying it when it becomes exposed to more than ordinary winds. But when dealing with large or small masses not necessarily naturally defined we recommend a

form which will serve both to shelter the plantation itself and secure shelter for the surrounding land. This can be done by laying out *convex* lines on the exposed boundaries, Upon these bends, when the wind strikes, the force will be weakened, there being the least resistance. Straight or *concave* lines on these exposed sites would have no power of expelling or throwing off the wind, and it would rush through the plantation, carrying destruction with it. If this once takes place, the success of the planting will be marred throughout the remainder of its existence. Straight lines are unnatural, and seldom beautiful. There is, however, one exception to this almost universal rule, and that is in laying out avenues or vistas. Here it is important that the eye should take in at once, at one glance, the whole of the beauty which it is intended to create. Further, the greatest extent of the new plantation should be laid off against the prevailing winds, and also on the highest and most exposed position.

This being then the form required on the exposed sides, we obtain the reverse, *i.e.*, the *concave*, on the unexposed sides, which gives the greatest amount of shelter both to the live stock and the cultivated land, and also secures throughout a uniform line of beauty. It may be necessary, from the natural contortions of the ground, to sometimes bring a *concave* line to the exposed surface; when this cannot be avoided the forester must secure safety by choosing such trees as are deep-rooted and umbrageous, and plant these thickly, say at least six rows deep, along the whole line so exposed. These will resist, rather than

throw off, the power of the wind. The most universally useful trees for this purpose are, in conifers, the Austrian pine, the Corsican pine, and, on the sea coast, the pinaster. In hardwoods, the sycamore, giant maple, and the beech are best.

When laying out plantations on long lines of undulating slopes, it is as well, as far as possible, to follow the natural lines and bends ; and when pastoral or arable valleys intervene, draughts, which are so frequent in these, may be overcome or moderated by an occasional convex bend into the valley

Again, in laying out plantations it is necessary to lay off vistas and roads ; the former should be so arranged as to secure at various spots the most beautiful views ; and to do this well requires the eye of an artist, which all foresters cannot be expected to possess. We apply the term artist to the person who can see and appreciate the beautiful in nature, not necessarily one who can deftly use his pencil and brush. The laying off of roads must accord with local circumstances and demands. We have perhaps alluded with sufficient explicitness to this important branch of a forester's work. Much of his future success will depend upon the accuracy of his conception ; and he will not regret the extra labour involved if he succeeds in averting the evil consequences which arise from winds sweeping through plantations.

CHAPTER VI.

PREPARATION OF THE GROUND FOR PLANTING.

FOR every corn crop we find some preparation of the ground is made, but for the growth of timber we often find no preparation made at all. Why is this? Is it that it is not needed, or is it on account of the expense? The latter undoubtedly is the chief reason, as the expense attaching to the most simple planting is somewhat heavy, and naturally nothing should be done to increase this which can possibly be avoided.

Nevertheless, we venture to hold the opinion that if more regard were paid to preliminary preparation, even at the risk of adding somewhat to the cost, we should have timber of finer quality, and reaching an earlier maturity. We have, however, to deal with what is practicable, not with what is theoretically right.

When planting for ornament, or for early shelter, too much pains cannot be taken to prepare the ground. It is both expedient and wise to be liberal in the early stages; but when dealing with large areas for commercial purposes, a heavy and unnecessary preliminary expense is unwise. The question of preparation will, when practically considered, fall into

a very narrow compass; and will resolve itself simply into the matter of drainage and clearing of heavy natural herbage.

If the land in question is dry, *i.e.*, naturally dry, and free from heavy herbage, no preparation whatever is needed. If, however, the land is wet, it must be drained. This is a *sine qua non*. No tree will grow on wet land. By wet land, we mean land containing stagnant water, or land which does not permit of sufficiently rapid percolation.

What does drainage do? may be asked by the novice. There is a great deal of ignorance upon this all-important operation. It is known by most that the act of draining relieves the land of its superfluous water, and here, too often, the knowledge stops. What besides does it do? It gives a depth of soil capable of storing up plant food. It allows, as the water percolates, the free circulation of warm air, which assists in the oxidation of the ingredients in the soil. It increases the capacity for the storage of heat, by enabling land to absorb the sun's rays, thereby enabling the soil to maintain tree life and vigour well into the winter, which allows of the ripening of the young wood before the frosts set in—a fact too important to lose sight of or pass by.

Compare this state of the soil with the same in an undrained state. The soil is water-logged, which is equivalent to saying that it contains no air. Plants cannot live without water, but they need air too, and can only thrive where both can be obtained. Full and complete drainage does not render land too dry, for the deeper and more thorough the drainage the

greater the depth of porous soil, and the greater its power to absorb what the rain-water brings in solution. The soil, too, is cold, for the temperature is always low when there is evaporation ; and evaporation there must be if the water can escape in no other way. Heat cannot be transmitted through water, therefore the sun's rays have no power to penetrate the already filled interstices of the soil. To prove this it is only necessary to ask the forester to try by experiment himself. Let him take the temperature by a thermometer six or eight inches below the surface on drained land, and at a similar depth on that undrained, he will find probably a difference of 8 or 10 degrees.

The expense, however, attaching to extensive drainage operations is so great as to render it a matter for serious consideration. It is nevertheless for planting not so costly as that for agricultural purposes, and for the simple reason that we require only open drains and sometimes even only grips. Covered drains for planting purposes are not only unnecessary, but are detrimental. Pipes or stone drains will soon be completely choked with root-fibre, and will in a few years render the whole system absolutely useless. In agricultural drainage the whole system will often become choked by the roots of trees (which follow the flow of water) finding their way into the drains which pass near. We have found this when draining for planting. When we have been seeking for an outlet we have come accidentally upon mains, or main-feeders, of old agricultural systems which have been so completely choked by root-fibre that the whole of that part dependent upon these drains has been water-logged

and completely incapable of performing its functions. The water contained in the soil and drains has been on occasions so great as to render it necessary to stop operations until the flow has ceased. We have known nearly a whole day required for this, which shows the quantity of water stored up.

When meeting with these obstructions, it has been necessary to follow up long lengths of drains before the fibre can be fairly got rid of, which adds considerably to the cost of drainage. This also shows how necessary it is in pipe-drainage to cut down or avoid all kinds of trees near any portion of the system, and also proves the necessity of open drains when draining for arboricultural purposes. It may not be out of place here to quote on this point the opinion of that well-known authority on drainage, the late J. Bailey Denton, expressed in his "Retrospect of Forty Years' Experiences," p. 56:—"The mischief done to drainage by tree roots is very considerable. Within this last month I have known £40 expended in clearing pipes of roots in a property of only 600 acres of heavy clay land. The drainage was executed in the years 1862-3, since which time the tenant has had reason to complain of the want of effect. Had the trees within reach of the drains been removed at the time the drainage was done, all objection might have been avoided, or had the drains been examined as soon as water was seen rising to the surface, the evil might have been discovered and removed. As it was, however, the stoppages accumulated until the cost of the remedy reached the amount stated."

Before treating in detail this important subject, it

may be well to point out the preparation needed on land from which a crop of timber has been taken. When trees of any kind have been thinned to their full extent, and when those left have reached their full growth, it is necessary to cut away completely the residue, and so to leave the land naked, and therefore unprofitable. To grub up the stumps, and clear off the *débris*, requires a heavy outlay; and yet, if the land is to be reclaimed for the purposes of cultivation, this must be resorted to. Nevertheless, in some instances, this may be done to advantage, as the vegetable residue will be found so great, that with an application of lime the land may be rendered very valuable for agricultural purposes. If this is done, it will probably be when the land is fairly level, and in proximity to roads, and so on. If the land is hilly, or naturally of poor quality, replanting will probably be the most satisfactory course to pursue. On land of this character, provided proper trees are selected, planting may take place at once with but slight preparation. If, however, the land is wet or damp from lack of drainage, or from stoppage of drains, drains should be immediately made or reopened, the soil being spread over the surface after the *débris* has been burnt or otherwise destroyed, and the land left fallow for at least a year or two. This will give time for the purification of the over-burdened soil, and for the natural growth of trees that may follow.

All *débris*, whether brambles, fern, deadwood, bark, lop and top, and so forth, should be carefully destroyed, as its presence harbours injurious insect pests and fungi.

One thing, however, is necessary to ensure success, and that is a careful selection of trees adapted to the soil and site. We cannot, to secure this, do better than follow Nature's plan, which is the natural reproduction of its own species. If the primæval forests are examined, it will be found that cleared spaces soon fill up by the growth and development of the seeds deposited in the soil from the trees which have been standing there. And when we consider that this has been the case for an untold number of years, it proves the capability of the soil to grow repeated crops of a similar character; it does not, however, prove that the land is capable of supporting a growth of a new character. Failure, therefore, may be expected, and looked for, if we depart in our new planting from this natural course.

We do not, however, for one moment wish to dogmatise on this point, as we know the rule is not without exception; and that trees of a different kind will follow successfully a reaped crop. Nevertheless, it behoves the forester to bear this in mind, and not to be too sure, that the soil will second his efforts in any vagarious departure from Nature's beaten track.

CHAPTER VII.

DRAINAGE.

WE will, for our purpose, suppose that the area to be drained is practically level, and that the outfall cannot be determined with sufficient accuracy by the eye. If the land is undulating in character it is often easy at a glance to determine the exact spot for the outlet, and also the precise direction for the main drain or drains. We use the term drains because it is often necessary to make several, both on account of undulations and extent of area. On fairly level ground one sub-main may be sufficient for (say) 15 acres; if the area is greater than this it is usually better to make two or more. It is impossible to lay down any rule as to the number required when the land undulates; but the same rule may apply, viz., that 15 acres, if obtainable, may be made to flow into one drain; but this must be left to the discretion of the forester.

We must also at the outset draw attention to the fact that great care must be exercised in determining the amount of drainage required, both as to depth and frequency of the drains; because the removal of unnecessary earth increases needlessly the cost of drainage, which ought instead to be reduced to a minimum, bearing in mind efficacy. Often too many

or too few are opened, which leads to waste on the one hand, and inefficacy on the other. Returning to our level area, we find it necessary to determine the outfall by instrument, and we prefer to any other the improved dumpy level for this purpose. The method is to place the level in a suitable position near the centre of the piece to be drained, and having adjusted it, send a man round the boundary with the levelling staff. He will hold this up, as directed, at the points judged to be the lowest, and the forester will take the levels, entering each reading upon his note-book, and striking out with his pencil each entry when cancelled by the next or some future higher reading. For instance, let the reading at a certain spot be 7·85, and let the next be 8·32; the 7·85 being no longer required, a lower spot having been found, is struck out, and so on. Having, by taking readings all round the area (if necessary), determined the exact spot for the outlet, it is marked by a twig or a cut in the turf; and the work of determining the *direction* of the main drain will follow.

It is, of course, a foregone conclusion that the forester has, before taking these levels, made himself acquainted with the best means of disposal of the water. He has ascertained the presence or absence of streams, brooks, burns, rivulets, and so on; or of ditches, road-side water courses, or even of main agricultural drains (the discharge of surface drains into closed drains we will allude to hereafter). Into such a means of discharge he will cut his main drain, commencing, of course, at the lowest end, so that the water may flow from the workers. The direction

should be in the line of lowest ascent from the outfall. There being more water to discharge from the mains than from the minor drains a less fall is required, as the greater the quantity of water the more rapid will be the flow. The main drain should never be against a hill, as the flow would be too rapid, and therefore inefficacious.

The correct fall, too, will need the careful consideration of the forester. Water will find its own level, and, therefore, theoretically, the slightest fall will cause a flow; but something more than this will be required to carry off with sufficient speed the discharged water, and to overcome the capillary attraction which would otherwise keep the soil, notwithstanding the drainage, in a constantly wet state. Under no circumstance should the fall be less than 1 in 400, and in clays 1 in 300 will not be found too great. If there is sufficient natural fall, the drains may be of uniform depth; if not, a fall must be made when cutting the drain. This can be done by increasing the depth at the outlet, and decreasing it gradually as the work proceeds.

The length of drains will also engage attention. On flat, or fairly level ground, the main drain may be longer than under other circumstances, so that an increased flow may arise from an increased bulk of water. But main drains, as a rule, should be shorter than the minor drains, and the latter should not exceed 10 or 15 chains in length.

The depth is a matter of great importance, but must be left very much to the discretion of the forester, and in accordance with the soil he is draining.

It is impossible to lay down an inflexible rule, but we may take 3 feet as a minimum, and 4 feet as a maximum. If the soil to be drained rests on an impervious bottom, and is not deeper than 3 or 4 feet, it may be cut through, so that the bottom of the drains may be formed of the said impervious sub-soil.

In draining bog, too, or mosses, it is best to cut through them if possible ; but this may be a work of time, as it is not always possible to complete such drainage in one operation, owing to subsidence.

To lessen the expenditure, shallow drains are sometimes, in fact often, cut, and the work performed is inadequate, and failure and disappointment result. If the soil requires drainage it is wise economy to do it thoroughly, as it is only by giving ample depth of porous soil that really good timber can be grown. Every inch in depth of drained land gives something like 100 tons of available soil to the acre, a fact too often lost sight of.

Roots cease to penetrate when they reach the wet stratum, and branch off laterally in all directions. They thus take little hold, and the trees fall with the slightest gale of wind. This is often evident among spruce fir growing on partially drained land. We have seen large areas completely destroyed in one night. This would have been prevented by a greater depth of drainage.

The distance between the drains is another matter of great importance. As before stated, if too near it results in extravagance, if too far apart in inadequacy. It must be borne in mind that depth will not compensate for distance. This has been rendered,

unfortunately, only too evident in those areas drained some few years ago, when the reverse was the opinion.

The forester, by trial holes, should find out for himself the exact distance suitable to the soil he is draining ; but the following figures may assist him :—

Strong clays	-	4 to 6	times the depth.
Loams	-	6 „ 8	„ „
Light loams	-	8 „ 10	„ „

If the surface soil is rendered wet by springs, these springs should be tapped by an auger, and the water thus tapped carried off by the drains.

On low-lying land where an outlet is difficult to obtain, the drainage may be secured by digging a hole through into the underlying rock, and draining into it ; but this can only be successfully carried out where the rock or substratum is porous.

The depth of the sub-mains should be always 6 inches deeper than the minor drains, so as to permit of a fall of water into them, which gives an increased impetus and secures the washing away of impediments. If they flow in on the same level there is a tendency to stagnation throughout the whole system, without the fall is considerable.

Another matter of importance is the arrangement of the minor drains. They should be so laid out that they run with the greatest slope, and discharge alternately into the main. If they discharge opposite one another, the *débris* brought down by one is likely to choke the other ; whereas in a correct system each drain in the upper reaches, so to speak, should assist the flow of the next, and so on, thus securing a uniform flow throughout.

By cutting the minor drains against the slope the drain becomes active on each side—*i.e.*, it drains to its full extent on each side ; whereas if laid obliquely, it can only drain the upper side, and therefore more drains will be required. There is, however, a limit to this ; if the slope is too great there must be a slight deviation from the right line, or a sub-main must be cut obliquely, so shortening the minor drains. The width of these open drains at bottom should be from 8 inches to 1 foot ; the former representing the minor, the latter the sub-main drain. If less than this they are difficult to keep clear. At the top they should be such a width as to secure a correct slope ; and this slope will increase with the friability of the soil. The natural angle of repose will follow in due time by the wear and tear of the elements, so that it need not be too closely studied in the first instance. The “batter” or slope of the sides will depend on the nature of the soil, but it will range from 1 in 1 to 1 in $1\frac{1}{2}$, *i.e.*, if the drain is cut in a clay soil, and is 3 feet deep and 1 foot wide at the bottom, the sides may slope 1 in 1, and the width of the top will consequently be 7 feet. On land with little natural fall all minor drains should enter the main at an angle of, say, 67° ; this assists materially the uniform flow of water. One thing is obvious, and will greatly assist the forester—that is, the whole of his operations being open, and the flow visible, he can correct his work from time to time as it proceeds. This, however, should not lead to hap-hazard and inferior work. The previous plan and arrangement should be as carefully studied as if he were engaged in covered pipe-drainage.

We have in the early part of this section drawn attention to the discharge of open drains into the pipe system already existing. This may be, and will be sometimes, found the most convenient method of discharging the water from the whole or portion of the forest area to be drained. We strongly advise the forester not to adopt it if he can avoid it. If he cannot, he must take precautions to prevent the *débris* from the open drains stopping the pipes. This can be best done by building with bricks or stone a well at the point of discharge deeper than the inlet to the pipe, which permits of the collection of soil and heavy *débris*; and by hanging an iron grating in front of the pipe branches and leaves are also kept back. These wells should be frequently cleared. If this plan is resorted to there need be little fear of stoppage.

The cost of forest drainage will be a matter of concern, but to say that it will cost so much is simply beyond our power. It will depend entirely upon the soil to be drained, and the obstructions met with, in the form of stones and old tree roots, and the cost of labour in the district. Having, however, ascertained all this, a fair estimate may be formed by arranging a price per rod, and ascertaining the number of rods in an acre, which may be done as follows:—

Divide 29,040, the number of half yards linear at 1 foot apart in an imperial statute acre, by the product of the number of half yards in the rod of which the number is required, multiplied by the given distances apart in feet, and the quotient will be the number of rods in a statute acre. Example.—Required the number of rods, of $5\frac{1}{2}$ yards, in an imperial acre, the

distance between the drains being 24 feet. The product of 11, the number of half yards in the rod, when multiplied by 24, the distance apart between the drains, is 264; then the quotient of 29,040, the number of half yards linear at 1 foot apart in an imperial statute acre, when divided by 264, is 110—the number of rods of $5\frac{1}{2}$ yards sought.

Having obtained this, and knowing, by his own observation, what a good man can open in a day and the wages given, the forester can arrive at a fair idea of the cost per acre. It may assist the forester to know that a labourer accustomed to the work will throw out about 12 cubic yards of earth a day where no “hack” is required, and, if 3s. is taken as a day’s wage, 3d. per cubic yard will be the cost. Where the soil is light and there are no boulders, 2d. or $2\frac{1}{2}$ d. may suffice; but where boulders or other obstructions do occur, it may easily run to 4d.

We follow, however, and strongly recommend others to do the same, the principle of day work in most forest operations. Choose good men and pay them liberally, and secure constant and reliable oversight, and the interests of the employer and the future success of the planting will be best secured. The object of a good forester should be to do good work, and not to hurry over it for the sake of cheapness or effect. This is the reason why planting by contract so often fails. There is a tendency to hasten the work, which leads to work of an imperfect character being performed.

We shall have again to allude to this when dealing with planting by and by.

Having completed the drainage, the soil thrown out

should be carefully spread over the surface to be planted. No lumps or heaps should be left lying about ; and if any stones have been taken out, these can, if fit, be broken for roads, or used for other fitting purposes.

If the work of drainage has been commenced and carried on through the autumn and winter, the land should be ready for planting in the early spring ; if not, it will be best to wait until the following autumn. We, however, prefer on such land—*i.e.*, drained, heavy land—spring planting. As a rule it will succeed better than autumn planting, but there is no fixed rule to guide the forester.

CHAPTER VIII.

PLANTING.

HAVING prepared the ground, by drainage or otherwise, the forester will, when the proper season arrives, commence planting. We will, therefore, now consider as fully as is necessary the processes applicable to the various sites and conditions.

The subject of seasons will perhaps first engage the attention of the forester before proceeding with the actual planting. When large areas have to be planted, he will naturally choose the earliest period compatible with safety. He will have to consider the nature of the soil which he has to plant, and also the state of the young trees in the nursery. On a wide area the soil will doubtless vary, and he will therefore choose that which is dry and friable for autumn planting, reserving the clay land, especially if it has been recently drained, until the spring. The season may be said to commence with November and end with April; but sometimes it is possible to commence during the latter days of October and to continue into the first week in May.

It is, of course, quite improbable that he will be able to plant all through this extended period; but if his plans have been well laid, he will be able to take

advantage of every opportunity, and, in the meantime, employ his men in some other branch of forestry. He will find it impossible, successfully, to carry out the planting of large areas if he is obliged from time to time to discharge his men ; it is therefore absolutely essential that he should so arrange his forest work that, be the weather what it may, he can always profitably employ his staff. If a day, or even half a day, is suitable, he should take advantage of it.

There should, too, in planting, be no fixed plan with regard to regularity. The soil to be planted should be chosen with regard to season—*i.e.*, to secure uniformity and regularity, soil unfit for planting should not be planted. The future success of the plantation depends so much upon the care and skill exercised at this initial step that we cannot dwell upon it too impressively. Each individual tree must be planted with care ; there must be no hurry or undue haste to complete the task. The season must not be forced, and no forester should at the commencement determine where he will finish. He must be satisfied to do what he can in accordance with the strength of his staff and the diversities of the season. It may be well here to mention the importance of employing good men. The forester should, for the actual planting, select his best and most careful men, sending others, not so reliable, forward to dig the holes. Again, he should employ his best man as foreman, and let him be constantly with the planters, not planting himself, but watching carefully each man under his control. He may keep by him some trees, and occasionally, if necessary, replace any ill-formed or badly-rooted tree

with another, or tread in, but not allow his attention to be distracted from his chief employment. If a man plants carelessly or neglects warnings, let him be sent to dig holes. This carefulness applies to all systems of planting. We are, however, digressing somewhat, and must return to the matter in hand, and deal with it in regular order. The subject of planting naturally embraces selection and distribution of trees, transfer from nursery of the trees required, digging the holes or notching, and the actual process of planting. It will, however, suffice for this purpose to consider only the subject of hard woods and conifers, and that of permanent trees and nurses.

The connection between the nursery and the plantation we shall also touch upon briefly when necessary, in so far only, however, as it bears upon the necessity of supplies. Therefore the principal items left are those of preparation for planting and the actual process itself. As we have in previous sections drawn attention to the necessity of selection of trees, it is hardly necessary here to say more than that it is essential to success that this selection should be made, also that the distribution should be based on scientific grounds. We must presume that this has been arranged; that the distance between the hard woods or deciduous trees has been determined; the kinds of nurses chosen, their distances and distribution, and so forth.

With regard to the supply of trees from the nursery, it is necessary to be here a little more explicit, as we may not again have the opportunity of pointing out how important it is that a good organisation should

exist between the source of supply and the work in progress. Previous to the planting the nursery has been, we may, of course, assume, carefully inspected, and its power of supply tested. It is known how many trees of each kind are required, and how far the nursery can supply the want. The trees in the nursery by transplanting have been fitted for this special requirement. The strength of the staff is known, the number of trees they can plant in a day is known, the kind of trees required is known, the method of conveyance has been decided upon, and the men and boys told off to assist the nurseryman. The forester will appoint a careful man on the ground to receive the trees as they arrive, whose duty it will be to supply the planter and carefully heel in those not required. He will allow no trees to lie exposed more than a few hours in front of the men, and at night his duty will be to collect all not planted and lay in by their heels until the morning, letting them be the first to be planted next day. If the area to be planted is large, and the distance from the nursery great, it is a good plan to arrange previously some temporary nurseries on or near the site; but this is not necessary in ordinary cases.

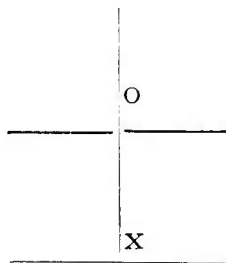
No trees but those well-developed and well-rooted should be planted out, and if any unfit escape the nurseryman they must be thrown out by the planter and returned to the nursery. By care they may be fitted for planting out at some future period.

We must consider two methods of planting, viz., notching and pit-planting: the former is resorted to in hill land, and where the herbage is short and the

soil thin ; the latter, in rich and deep land, or where there is much rank herbage. In the former, small trees are required, say, two years seedlings or one year transplanted ; in the latter, one or two year seedlings, two or three years transplanted. We will first describe the process of notching. The distance apart having been decided (for *distances*, see future section), and the plan of planting arranged, a line should be laid as a base, after which the work may continue by the eye without artificial aid.

Each man is accompanied by a boy, woman, or girl, whose duty it is to hold the trees and place them in the notch. They should have strong sacking aprons in which to carry the trees, so placed that they may be taken out rapidly as required, without becoming entangled. When this supply is nearly exhausted, they will hand over to the man the last dozen, or thereabouts, and proceed at once to the man in charge of the supplies, as already mentioned, refill their aprons, and return.

The man will bring with him a notching-iron or sharp old spade—the latter is perhaps the best. He will make in the turf, or heath, two deep cuts at right angles to each other, thus :—



And at the point x, cut another, say 5 or 6 inches

from the former point of intersection *o*, and by pressing down the handle of the spade the turf will open at *o*; the boy or girl with the trees will immediately place the roots carefully in the opening, and draw the tree towards the centre at *o*. The man will withdraw the spade, when the turf will reclose; and by pressing the whole firmly with the foot the planting is complete, and he will pass on to the next. A man, aided by a boy or girl, will plant in this way from 700 to 1000 trees in a day.

When planting on the side of a slope the planter should stand with his back to the hill; his cut will then be vertical, and the tree will not only be upright, but will obtain, by interception, a better supply of moisture from the descent of water down the slope.

Each tree should be carefully trodden in, and the slit in the turf thoroughly closed; if this is not done, the tree is hung in the hole, and the roots, instead of being incased in mould, are left suspended in space. The man, not the boy, should be held responsible for properly treading in. The process just described is applicable only to the conifers; if deciduous trees are planted in these districts they must be pit-planted, or the seed must be sown. On stony ground, or where the soil is very thin, it may be difficult to notch; under these circumstances the planting-hoe must be resorted to. In this case the man will carry his own trees, and work his hoe with one hand, whilst he places the tree with the other.

The methods described are best adapted to this class of land, and are also the cheapest. The trees, too, do better, and being small and very young they

do not feel the change to the same extent that older trees would do. They speedily recover, and, as a rule, the losses are few. When planting deeper soils, and when there is much herbage, as stated, pit-planting must be adopted, and we will now describe the process. Whether the plantation is to consist of conifers only, or to be mixed with hard woods, is of little consequence so far as digging the holes is concerned. It will be necessary to determine whether all the holes should be dug before planting commences, or whether the two operations should proceed together. If the land is light or fairly friable it may be well to dig all the holes before planting; but if the soil is clay, or has been recently drained, we recommend digging not more than half a day in advance. If this is not done the soil taken out dries hard, and it is impossible to find mould for covering the roots without digging afresh, which adds to the cost and delays the work. Again, if all the holes are previously dug, all the hands must be engaged later in planting, and this necessitates employing men who are unfit for the work, which has been already referred to. We therefore prefer carrying on the two operations together.

The distance between the plants having been determined, say 3, 4, or 5 feet, a line is set out wherever it is considered best to commence. There are several ways of setting out the work, and they will depend greatly upon the shape and area, uniformity of soil, and so forth. Once, however, the base line has been laid down, there will be no difficulty afterwards. A line of light cord, say 100 yards long, should be

marked out with red cloth at the required distances ; and two good men should be chosen to mark the holes in advance of the men. Each marker should have a stick of the right length—*i.e.*, to correspond with the distance apart—and when one length is finished, they should set out the next by these sticks, and re-lay the line so that the red marks correspond with the centre of the holes made, or, if alternate planting is adopted, with every other line. Various methods of laying-out, and various distances are recommended by forest nursery-men, as will be seen on reference to their catalogues. For even distribution the equilateral triangle must be resorted to ; but in practice 4 feet square planting will be found best in the long run.

The men will follow in two sets : the first will, with spades or forks, open the holes, and the second set will follow and complete the work ; or, which is sometimes better, the first set may open and complete the holes, and the second, with forks, follow and loosen the bottom. In this case the former set should be double the latter. Each man should lay the turf on one side of the hole, and the soil on the other ; if mixed, there will be delay when planting.

The holes should be of a size to meet the necessities of the trees—*i.e.*, if they are one-year seedlings two-year transplanted, they may be eight inches square and nine inches deep. This is usually large enough for ordinary plantation purposes. If the soil is turf, the holes should be as square and uniform as possible ; if loose, this is sometimes impossible.

Care should be taken in laying out plantations to arrange, previously to digging the holes, all outside or road side plantings, as the holes required will not probably run with the main lines.

Some landowners object greatly to uniformity, and will not have lines at all. In this case random-planting must be resorted to. We greatly object, however, to this, as the work entailed when thinning is very great, much in excess of thinning uniform plantations. Dragging out the trees where there are no regular lines is heavy and discouraging. If, however, this plan is resorted to, we recommend cutting lines right through at certain distances before proceeding with the thinning ; but of this hereafter.

When digging on hill-sides, cut vertically down and throw the soil on the lower side ; and when planting hold the tree on the low side and back in with top soil. A man can dig under ordinary circumstances 150 holes a day, so if the wage is 2s. a day the cost will range from say 1s. 6d. to 2s. per hundred. We prefer, however, in almost all forest operations to work by the day. Well inspected day labour, as a rule, is more successful than hastily and imperfectly performed task-work.

It will be well, before passing on to the actual planting, to describe the method of preparing for the planting of ornamental trees. These are usually larger than those planted on more extensive areas, and have been specially trained in the nursery for the purpose. Their roots are more developed, and therefore require larger holes ; and the object being to obtain individual symmetry and beauty, greater

care must be exercised. Care should be taken to so prepare each hole that the tree receives the least possible check. As a rule, if a tree intended for ornament, especially a conifer, remains dormant for an undue period, its future beauty is marred. It is possible, if skill is exercised, to prevent this; and as the object in view is so apparent, the forester should spare no pains to secure a regular and uniform growth.

If we examine trees planted for ornament, we too often find that they fail to develop into ornamental trees; and this is almost invariably due to either an unwise selection or to the want of careful planting.

Compare the ordinary specimen, seen in gardens and pleasure grounds, with those with their beauty and grandeur fully developed, and no one will, we are sure, grudge the extra care and expense required to attain to an equal perfection. We always recommend when the object is to secure ornamental trees, whether individually or collectively, a previous course of preparation.

If the soil is a tenacious clay with an obdurate subsoil, the trees should be planted in the spring, and the previous autumn the land should be trenched in the following manner:—Open a trench on one side to the correct depth and break up the bottom; wheel the soil so taken out to the opposite side. Then throw the top soil of the next trench into the bottom of the trench first opened, and the second or under soil on to the top of that, and so proceed until the whole is trenched. This may be performed for 1s. to 1s. 6d. per square rod. In the spring when the trees are planted the roots will come into contact at once

with the turf or upper soil so buried. Between the trees for the first year potatoes may be beneficially grown, the dressing and cultivation will materially benefit the plantation, and assist somewhat towards the initial expenses. During the trenching it will be well to work in with the soil a well-made compost.

If individual trees are to be planted it will be unnecessary to trench more than the hole, say with a diameter of three or four feet. Let this be conducted in the following manner:—Dig out the hole completely to a depth of 2 feet 6 inches or 3 feet, and break the bottom. Throw the turf and topsoil into the bottom and spread the remainder on the surrounding land. Fill in the hole with a prepared compost of soil, leaf-mould, lime, &c.; allow this to remain until the planting season, and plant in a manner hereafter to be described.

We have now explained the various methods of preparation for planting, and must proceed to describe the process of planting. The future success will depend greatly upon the care and skill exercised in this respect; and yet, too often, we find that large areas are planted without even ordinary attention to the most simple rules.

There is a right and a wrong way of doing everything, and this is very apparent in the process of planting. Too often trees are carelessly planted, more with the view of completing the task than that of the future welfare of the plantation. If the foregoing preparation has been carried out with skill and care, and the planting be carelessly conducted, failure, or a partial success only, will result. To save expense,

boys to hold the trees are often not employed, and the men are expected to hold and plant at the same time. This in itself renders the work imperfect, as it cannot, under these conditions, be properly performed.

We recommend then, at the outset, that when pit-planting boys be employed to hold the trees. The forester having determined the distances of his hard woods and nurses, the kinds and distribution of his trees, and set off his areas or districts, will (the trees being on the spot, as already described) lay off his line or lines, and proceed at once with the planting. If he decides upon first planting his hard woods, he will proceed as follows:—A trustworthy man, who will henceforth be employed in laying out the trees, will place them in the holes as arranged. The planters will follow, and the boys will hold the trees in the holes to the same depth as they came from the nursery. If the hole is too deep (as it should be), a layer of cut turf or mould should be put in until the correct depth is secured. The boy, holding the tree in the centre of the hole and arranging the root-fibres, will, as the mould is put in, lift the tree up and down slightly, so that it may penetrate among the fibres; and the planter for this purpose should select the finest mould he can find. *He will then put in the whole of the soil, and not until the hole is full will he tread in the tree.*

This, perhaps, in planting, is the most important instruction that can be given.

The too common practice is to ram in the soil with the heel as the work proceeds, and often crush a lump (unbroken) on to the delicate root-fibres instead of first breaking it up with the spade. The fine roots

are thus crushed and wounded, and, instead of at once commencing to perform their functions, the spongioles have to recover their lost powers of absorption. Trees, too, are often planted too deep, so that the lateral branches of the conifers become buried ; and, in short, the whole system of the plant becomes deranged, and valuable time is lost in the recovery and readjustment.

When planting conifers, especially on exposed sites, it is well to hold them in the lee corner of the holes, as by this means they get an extra support from the firm and unbroken soil ; on clays, if planted in the centre, they are apt to work and form a cup, which in a wet season fills with water, and tends to rot the base of the tree. When planting purchased trees, which may have been exposed for some days, it is advisable to place the fibres in water or damp mould for a day or two previous to planting.

On large areas for commercial purposes little more is needed. The trees being small should not need staking, even in exposed sites ; but later in the season, say a month or two after planting, the whole should be again carefully inspected and trodden in, as the soil will contract and leave the trees loose.

It should be borne in mind that the life of the tree depends upon the vitality of the root-fibres, and everything should be done that skill can devise to keep them healthy and active. The chief thing is to bring every fibre into contact with the mould so that the water, which contains the plant food in solution, may be brought into contact with it as it percolates through the soil. If hung in space, water will not reach it without the soil is water-logged, which we have

already referred to as fatal to tree life. When planting larger trees, and for ornament, similar, but still greater care must be exercised with each individual plant. The holes, as already prepared, should be opened sufficiently only for the reception of the tree, because the soil, as we have seen, has been already arranged by trenching. The tree must be set carefully in the hole to the proper depth, and the roots set out in their natural order (not entangled or crushed); the finest compost be placed over the whole, and, instead of lifting the tree as before stated, water should be used to consolidate the mould. If this is resorted to, the fibres will at once settle down to their work, and speedily recover their suspended functions. When completed, each tree should be at once secured by properly arranged stakes.

CHAPTER IX.

DISTANCES AND DISTRIBUTION OF TREES IN PLANTATIONS.

THE forester in all his work must keep in view the future, and a more remote future than the ordinary husbandman. In deciding upon the distance between his trees and the selection to suit soil and site, he will display his skill and knowledge more than in many other branches of forestry. If his object is, as it should be, to grow the greatest amount of good timber in the least possible time, he must carefully exercise this knowledge in the initiatory step, and not by fatuity allow the hopes of an early return to warp his judgment. To secure an early return requires close planting, which has a tendency to draw up the trees, and to destroy the natural proportion between the height and girth, which, in well-developed conifers, should be one foot to one inch—*i.e.*, an inch in girth should represent one foot in height.

Close planting, too, necessitates early thinning, and early thinning discourages development of timber, especially when dealing with conifers. Some trees require more room than others—for example, oaks, though they need protection in their early stages,

require more space than other hard woods, because it is important that they should attain a large girth with a medium height; on the other hand, where height is required, fairly close proximity must be maintained for many years.

With conifers, the distance apart in early growth is a matter of the gravest consequence. As already stated, if too close, the trees become weak and dependent upon each other for support; if too wide apart, they become laterally clothed with strong branches, which is prejudicial to the development of timber of fine quality. A medium distance, therefore, is requisite, and the forester must endeavour to select one that will secure both height and girth in fair proportion. The lateral branches must die off, and not be cut (in fact, pruning of any kind is an evil resulting from the neglect of well-known rules, and should in really good forestry be unnecessary); and to secure this, the trees must be sufficiently close. If too close, however, the branches will die off before they have performed their functions; if too wide, it will be necessary to cut them off, which, as before stated, results in injury to the future timber.

If large timber is desired, 5 feet is not too wide; this yields sufficient protection, and allows the lateral branches to cling long enough to assist in the development of wood. From 15 to 20 years may elapse after planting before any thinning will be required, and this we consider preferable to the common practice of thinning at a much earlier period. It will be found after a lapse of this period that the lateral branches may be broken off sufficiently to enable the men to

work freely in the plantation without being obliged to use the knife at all ; it will be found, too, that the trees have attained a proportional growth, and a clean and robust character.

We are, however, trespassing upon future sections, but it seemed necessary here to draw attention to the necessity of carefully weighing this subject before proceeding to plant. Even where there is a demand for the product of early thinning we prefer, to some extent, ignoring it, rather than sacrificing the future prosperity of the plantation to obtain it. We write this advisedly, as, after years of close observation, we are convinced that the future prosperity of the planting will be best secured by keeping the mind fixed upon producing timber, and setting aside in the meantime all minor considerations.

Where the demand for small wood is considerable, as, for instance, hop-poles in a hop district, it can be met by special cultivation. By planting larch or Scotch pine 2 to 3 feet apart a good crop of poles may be obtained in ten years ; and the whole may be cut at once or in close succession, and then replanted ; and in all probability each successive planting will be more prosperous than the one preceding it. Then, again, it will be necessary to consider the site, whether it is exposed or sheltered. If exposed, some prefer close planting, especially on the side exposed to the prevailing wind, but we venture here, also, to take a different view. More protection will be obtained by the encouragement of branches and foliage than by proximity of stems ; and all know who have had experience that belts of conifers, with wide and well-

developed branches, are a greater protection than bare stems, however closely they may be packed.

Take for an example a belt of Austrian pines (*Pinus Austriaca*), planted, say, 5 or 6 feet apart, what better protection can there be? Again, take a belt of Scotch pine or larch, planted $2\frac{1}{2}$ feet apart or even 3 feet, and what security do they afford after the lapse of a few years? Shelter, as before stated, is so important that too much care and foresight cannot be exercised. In pleasure grounds, too, how many schemes are frustrated by the ignorance displayed in the early stages? Go where we will we see trees that should have been beautiful, and would have been, but for the process of crushing which they have had to undergo, and to the buffeting they have received from want of shelter. These disappointments may be overcome by judicious treatment, and especially in the wise choice of distance. Lateral development is all-important when planting for ornament, and this is best secured by protection; but if the protection afforded is too close or too distant the result will be disappointment. In the first case the laterals will be lost, in the second, the tree will be unshapely.

With regard to hard woods, distance is also of great importance, and must be determined by the class of timber required. If long straight timber is desired, there must be close proximity in the early stages, and thinning must be judiciously carried out for many years. This discourages lateral growth; but, at the same time, encourages, under proper management, a sufficiency of foliage. If, however, girth is required with a proportionate height, a greater distance must

be allowed from the first, and each tree should have ample room. We do not, however, imply from this isolation and exposure.

We must in future sections on thinning and pruning draw attention again to these important considerations, because both these operations, as we have before implied, are dependent upon the choice of distance.

To come to some conclusion, however, which may serve as a guide to the young forester, we may take, when planting conifers alone for timber purposes, a distance of not less than 4 feet and not more than 5 feet. When planting for hop-poles, $2\frac{1}{2}$ to 3 feet; and for pit-props 3 to $3\frac{1}{2}$ feet. If our object is the rearing of hard woods, the distance may range from 12 to 20 feet; in which case we should make up with conifers 4 feet apart. We should ourselves, if planting oaks, take 12 feet in medium soils, and 16 feet in the best clay loams. In the case of beech (if artificially reared), we should prefer from 12 to 15 feet; if, as is often the case, beech is naturally reproduced, the distance will be governed by circumstances. In other cases the distances will range, as suggested, from 12 to 16 feet, in accordance with the object in view.

We have to deal now with the distribution of trees. This also is an important link in the long chain which we are endeavouring successfully to forge. The choice of trees in the first instance will depend upon the soil and the local demand. What tree, or what trees, are best adapted to the soil to be dealt with? What timber is there most demand for in the immediate locality? These are questions which will naturally force themselves on the mind of the forester before he

commences to plant. He knows that to plant oak on light or thin soils will result in failure; he knows, too, that to plant ash on poor meagre soils will also result in disappointment; to plant trees loving a moist soil and a sheltered position on exposed and dry soils cannot but bring discredit upon his work. It is therefore clear that he must thoroughly acquaint himself with the character of the soil he has to deal with, and the contour, altitude, and aspect of his site. He must endeavour to distribute the trees so that each variety may obtain what it naturally requires, and not try to force an unnatural regularity for the sake of uniformity. For uniformity in Nature does not exist.

Again, it is necessary in the development of timber to secure a uniform and level growth. Throughout the future the forester should endeavour to obtain an *unbroken leafy canopy*, and this he cannot obtain if the trees are irregular in growth. True forestry greatly consists of this uniform and regular growth, this gradual and even development of timber, this mutual dependence on each other for support. By it is secured the greatest amount of humidity, and the least amount of draught and exposure. Compare it with a plantation of uneven growth, where trees are of mixed character, and of unequal size and development. Here we find a beech occupying great space, to the destruction of more valuable timber; an ash, drawn up to an unnatural height, and totally dependent for support upon its fellows; an oak, so deformed as to be absolutely useless, except for firewood; dead trees, which have died from drip, and from want of air and light; trees with meagre tops like palms, and

stems like whips ; larch, fir, or other conifers covered with lichen and useless. It is a sight to break the heart of a forester, and yet how often is it seen ! This need not be where forestry is understood and appreciated, but there is no cure for this state of things where it exists. No forester, however clever, can rectify the result of past mismanagement ; he cannot bring order out of chaos. Nothing is more hopeless than to be called upon to deal with neglected woods and plantations. This state of things has been produced by unwise distribution and selection, by ignorant thinning, and by an absolute indifference to recognised rules and elementary physiology.

Prevention alone must be looked to, and the forester should endeavour to prevent a recurrence of such a chaotic state of things by carefully studying what we have endeavoured to picture. He should satisfy himself that by studying Nature, and endeavouring to follow on her lines, he may secure that which is absolutely essential to success ; and by ignoring her teaching, and carrying out his own preconceived opinions, he may court failure and future discomfiture.

Another feature not to be lost sight of in the distribution of trees, is that of planting together those of equal development and power. When taking trees from the nursery the nurseryman should always sort the plants, placing those of robust growth, both with regard to stem and root fibre, together, and keeping separate those of feeble or imperfect growth. The planter by this method will plant in accordance with this selection, and so do his best to secure uniformity.

If this is not done, and the trees are planted as they come, the strong and robust overpower the weak, and there is from the beginning irregularity, which, as before stated, leads to disappointment. Plantations well managed should present in their early stages an even top, like a field of corn.

Indirectly distance affects the initial expenditure, both with regard to the number of trees required and the extra labour incurred in planting them; but no true forester will permit this to influence his judgment. Nevertheless, it is by no means a mean factor when other circumstances are unimportant. For instance, if a distance of 3 feet is decided upon instead of 4 feet, 2,000 more trees per acre will be required, and, of course, 2,000 more holes. Therefore, if there is no demand for small wood, and the intention is to grow timber, there is a manifest waste.

We have endeavoured in this section to draw attention to the necessity of giving full consideration to the subject of distance and distribution before commencing large planting operations. When a large expenditure is absolutely necessary to secure the most trifling results, it is clear that too much care cannot be exercised to bring about a maximum of success.

It is, of course, clearly understood that our remarks apply to plantations only, and not to established woods. In the latter we have to deal with natural reproduction, and we must adapt our arrangement to local circumstances, only endeavouring to induce Nature to fulfil artificial demands.

CHAPTER X.

TREES AND GROUND GAME.

AFTER planting, the work of the forester is not complete ; constant attention must be given, as will be hereafter described. Between the planting and first thinning there are many dangers and causes of failure, which must all be met and combated. Perhaps the most serious of these is caused by the presence of ground game.

It is a fact beyond dispute that ground game and young trees cannot live together. If landlords decide upon improving their estates by planting and thereby incur a heavy expenditure, it is not unreasonable to suppose that they have at the same time decided to reduce or exterminate their hares and rabbits. If they have not, they have, of course, decided upon wasting their money. If they desire to do so, they cannot possibly choose a more satisfactory method of achieving it. Nothing is more disheartening than to plant with great pains and to have all destroyed by these pests.

We lately visited an estate, not 300 miles from London, the owner of which had shortly before his death developed a passion for coursing, and had

allowed his hares to increase enormously. Not only were all the young plantations entirely destroyed, but the large ash were completely barked as high as the hares could reach. The estate presented a forlorn and pitiable appearance. Here the injury had become a perpetuity, and will affect future and successive generations. To an agricultural crop the injury is a passing and temporary one and may be overcome.

This, of course, is an extreme case, but nine times out of ten injury is done, and carelessly permitted to continue, which not only renders the result of the expenditure but a partial success, but often retards even this for many years.

Constant replanting, which is often carried out, results in an uneven growth, and a large percentage of trees never reach maturity, but are killed by drip and want of light. Some proprietors aver that trees bitten off will recover and make a new start with a new leader, or that trees barked will eventually revive, but there can be no greater delusion. They may undoubtedly live, but they will never thrive. In a well-protected plantation, and where the work has been well executed, about 15 per cent. will require replanting the first season after planting, and perhaps from 5 to 10 per cent. the second year. But where ground game has been allowed to live upon them, from 50 to 70 per cent. will need replanting, and often the whole. Some profess to guard their plantations by wire netting, but this we have in every instance found to result in failure. To wire all round extensive plantations is a matter of great expense, and to render it secure requires the constant services of a trustworthy

man. All this adds greatly to the initial cost. Again, when plantations are wired, the keeper's sense of duty becomes dulled. He considers that the responsibility has been taken out of his hands, and he consequently allows both hares and rabbits to increase at will. We have always found that ground game increases with the increased use of wire.

The keeper's interest and the forester's are antagonistic. The one is anxious to show good sport (and although a good sportsman is satisfied with an ample supply of feather, the young and inexperienced novice requires an ample supply of ground game to whet his appetite, which it pays the keeper to foster), the other is anxious to obtain healthy timber as fast as nature will permit unhindered by the injurious bite of these rodents. However, as we have stated, the two cannot exist together, so landowners must take this matter into consideration when they count the cost of planting.

Another plan often adopted (done, too, generally after the mischief) is to tar the stem; this, in our opinion, is most injurious to young trees, rendering, as it does, the bark hard and inelastic, and inducing a hide-bound condition detrimental to tree-life. The patent mixtures sold for the purpose of protection from bite of rabbit we have found useful if newly applied at least once a year. The caustic effect of tar is not apparent.

Of the two, hares, when in excess, are more injurious than rabbits; their depredations are more widespread, and to young larch especially they are most destructive. They are not satisfied with a nibble here and

there, but bite off the stem, about half-way up, as clean as if cut with a knife. Rabbits, although very injurious, confine their destruction to their haunts, so that it is possible to deal with them.

From a money point of view it is impossible to support the undue preservation of hares and rabbits. The money obtained by their sale is insignificant compared with the injury they commit in plantations. On the other hand, the complete extirpation of hares and rabbits is neither required nor desired, in fact such a possibility must be greatly deplored; but young plantations must be protected, otherwise failure is a foregone conclusion, and the cost incurred is actual and wilful waste.

CHAPTER XI.

ATTENTION AFTER PLANTING.

AFTER planting, young plantations require constant supervision. Often when the work has been completed they are left entirely to take care of themselves, and when visited much disappointment ensues. A gardener, when he plants out his flowers or shrubs, gives them constant attention, and does all in his power to bring about success; but a tree is too often treated as a strong and robust plant, which will take root and thrive as a matter of course. If the planting has been carefully carried out—in accordance with the suggestions we have made—and a man is employed for a few months to tend the plantations, there need be little fear of evil results; but if the trees have been carelessly planted and afterwards neglected, it will be found necessary to replant largely the following season. Taking this into consideration, it is worth the forester's while to employ men to watch the plantations for some months after planting.

On land that has been recently drained, and where the natural herbage is rank and luxuriant, one man will be needed to each fifteen acres. We have found this area as large as one can easily manage. When, however, the herbage is short and the land fairly dry,

one man may manage thirty acres. His work will consist of treading in the trees, which, especially in the former case, will always become loose by contraction of the soil, and cutting the surrounding herbage, be it grass, fern, or scrub. Here and there an outside ornamental tree will need staking, drains will need keeping open, and so on.

The best instrument for cutting the herbage is a short-bladed scythe. A hook is often used ; but, we think, trees are in more danger with this than the former. Care, under all circumstances, is needed, as much injury may result. If the trees are allowed to grow in the midst of this undergrowth, a large number will damp off ; so that the work is really necessary, and the expense should not be considered. We have seen much injury follow from neglect of this simple action on the part of the forester. Let the forester satisfy himself on this point by visiting a plantation where the undergrowth is rank and luxuriant, and where the scythe has not been used, and he will find many of the trees dead and covered with mildew. Under such circumstances as we have described, it will not be found sufficient to cut when full growth has taken place, but it must be cut early and kept cut throughout the season. Many trees, too, as we have stated, would be saved if they were newly earthed and trodden from time to time. If all this is carefully carried out, the necessity for replanting will be reduced to a minimum, and uniformity, as far as possible, will be secured, and at a moderate cost. On heavy land the cost may be put at 7s., and on light land 3s. 6d. an acre. This is so trifling, that,

when the advantages which accrue are considered, no forester is justified in neglecting so important a part of his work. When the trees have become established, which, in well-managed plantations, will take place two years after planting, little attention will be needed until the first thinning becomes necessary. Hereafter there will be a financial return with each operation, a return which may possibly recoup the outlay from the commencement; and the plantations will have become an important factor in the economy of the estate.

The advantages to be gained by planting are considered by many so remote and visionary that our area under timber does not largely increase; if, however, the operation were more systematically, judiciously, and economically carried out, the result would stimulate and encourage the owners of waste land to plant, and so add largely to their resources. There are few finer investments open to landowners than the planting of larch and other trees suitable to their soil, and if taken advantage of many financial difficulties might be overcome. In Ireland especially there is room for most extensive planting. There is no finer soil or climate in the world for timber, and yet the country has become almost disafforested. If the bare hill-sides and the extensive wastes could be re clothed with wood, prosperity would again dawn, and employment would be afforded to thousands who now for the lack of it are living in poverty or quitting the country.

We hear of all kinds of schemes, many of them wild, to promote the well-being of the land, and yet this one absolutely feasible method of reclamation is allowed to pass almost unheeded. We believe that

much rural distress would have been avoided had arboriculture received fair consideration, and planting been steadily carried out. From the want of knowledge, from the failures brought about by wilful ignorance and neglect of common natural laws, capital invested in planting has been wasted, and the work thereby been suspended. It is only by spreading the knowledge of forestry that this desirable end can be achieved, and when this is secured we believe land-owners will willingly make use of the knowledge so acquired.

CHAPTER XII.

THINNING OF PLANTATIONS.

WE have endeavoured in the foregoing chapters to build up, as it were, a plantation, and have followed carefully the various operations which are from time to time required. There must naturally be an interval of rest between the final replanting and first thinning, during which period Nature is at work and, in her silent way, bringing to maturity what man has commenced. Her work will be more or less rapid and successful as man has carefully and wisely performed his. If the principles of true forestry have been ignored and the work of preparation and planting been carelessly carried out, the first thinning may be required too early or possibly be too long deferred; but if the principles laid down have been followed, the work of thinning may be commenced from 12 to 20 years after planting. This wide space may seem remarkable and halting to the uninitiated, but it simply applies to the distance chosen, the quality of the soil, the aspect, kinds of trees, and so forth.

There is no fixed period for thinning; the forester must exercise his discretion, and upon this discretion will depend very greatly the future success of the plantation. If too early, there will be waste of

material; if too late, a tardy development of timber, and future weakness. Too much stress cannot be laid upon the necessity of wise and prudent thinning. All who have practically followed the fortunes of a plantation will have noticed the rapid development of timber after each successive thinning. Where thinning, too, has been neglected, they will have noticed the weak and feeble growth, the lichen-covered stems, the dead and dying trees, and the unhealthy appearance of the whole. Why is this? Simply because there has been a lack of air and light and insufficiency of foliage to elaborate the sap, and the want of room for the ramification of the root-fibres. Trees, when growing, need air and light and ample room below, otherwise they crush out one another, and the strongest and fittest only survive. Diseases of various kinds prey upon the enfeebled trees, and the result is failure and disappointment. Again, if left too long, they become dependent upon each other for support; and when this support is removed they feel, like the brute creation, the cold and draughts which follow, growth becomes sluggish, the sap circulates slowly, the elaboration is imperfect, the cells become thickened, and the tree, by epicormic branches, makes an effort to relieve itself from the superabundant sap, and finally succumbs. We have seen large areas of both deciduous trees and conifers suffering from this careless management; and it is rendered the more lamentable by the impossibility of fully repairing the mischief.

Where from the earliest period careful thinning has been carried out, very different results are manifest,

Each tree stands firm and independent of its fellow, the lateral branches are retained until they have performed their functions, they do not wind-whip each other, but give support without dependence; the growth is rapid and uniform, and the trees being of equal height, obtain their full share of light and heat. Ill-grown, weak, deformed, or diseased trees have been removed, and there is at once the appearance of prosperous development, which to the landowner is nothing more nor less than an accumulation of capital or a silent influx of revenue.

The great and true principle of thinning (and we look upon the process as one of the most important in forestry) is to encourage the growth of those trees which are left, and not to secure a financial present return. This, though important, is quite a secondary consideration, and should at all times be ignored. Of course, if the thinnings can be sold or made profitable use of, so much the better.

If, as is too often the case, the trees have been planted too closely together, an early thinning becomes absolutely essential; and the thinnings, except larch, will be of little value, which is a proof of the waste in the first expenditure. Larch, as we have before pointed out, may be sold for hop-poles in some districts; but this is almost the only exception. In fact, too close planting is so unwise from every point of view that its continual adoption points to ignorance of the most dangerous type. Dangerous, because it adds to the initial cost, and prevents to a large extent the increase of expenditure of capital in this most important branch of land improvement

and development. We have already drawn attention to the fact that proximity of plants affects directly the initial cost—*e.g.*, if trees are planted 3 feet apart, 4,840 plants are required per acre; whereas if 4 feet or $4\frac{1}{2}$ feet is the chosen distance, 2,722 and 2,151 plants respectively will be required only. If we take these as one year seedlings, two years transplanted, usually sold for 15s. to 20s. per 1000, there is at once a saving of, say, 40s. per acre, exclusive of the cost of planting. If nothing is gained, therefore, by close planting (and we maintain much is lost), this is a case of sheer waste and extravagance.

When we consider by-and-by the cost of planting we must again draw attention to this point; in the meantime it is only necessary to impress upon the forester the necessity of early and gradual thinning, and then to proceed to describe the actual process.

When the period arrives for thinning, the forester will make the necessary arrangements for carrying it out. If the area is large he must commence early, even if by so doing he sacrifices to some extent the thinnings—*i.e.*, without his staff is also large. He should proceed year by year, and section by section, so that the whole work is kept under control. We say section by section, because he has, of course, arranged the plantations in squares of uniform dimension. If planted in rows, there will be little difficulty in deciding what trees to remove and what to leave; but if random planting has been resorted to, greater care must be exercised. Of course, in every case the best and most robust trees must be left, and the weakest and ill-formed removed. Small trees, too, which have

been left behind in the race, should be removed, as they can never recover, and mar by their presence the appearance and uniformity of the whole.

All should be felled one way, so as not to become entangled; and if the work is commenced on the outside, and the trees thrown against the standing timber, they can be drawn out and stripped as the work proceeds, either by manual or horse labour. When stripped, they should be sorted and laid in piles by the roadside so that each lot can be readily removed. The branches of fir are of little use without bricks are burnt upon the estate, when it may pay to tie them in bundles; this, however, will cost 2s. 6d. per hundred. If there is no demand, the best course is to burn the whole in the plantation, taking care, of course, not to scorch any ornamental or outside trees.

The first thinnings will be of little value without they are larch, when, if there is a demand, they may be sold for hop poles at prices according to lengths. They should be cut into 12, 14, and 16 feet lengths, and sorted accordingly, and the price in the plantation may run from 12s. to 20s. per hundred. Small Scotch pine possess really no value, but when large enough, say three to four inches in diameter at the smallest end, bot larch and Scotch may be sold for pit-wood. It should be remarked here that the value of thinnings will depend almost entirely upon the proximity of the plantations to roads. When roads are good and near, a maximum value may be anticipated; but when situated in remote and inaccessible districts, a minimum. This rule, of course, applies in every case, and equally to agricultural and arboreal products. There

will, of course, be no thinnings of hard woods at this early period.

The operation of thinning will be much advanced by keeping the lower branches broken off from time to time as they die. If this is not done during growth, it should always be done before commencing the actual work of thinning, as the men are then able to work freely, and the forester can see what he is doing when marking. With regard to marking, it is almost impossible in the first stage to carry it out. The woodman in charge must exercise his discretion as the work proceeds; later, however, when the trees have assumed greater proportions, the forester should carefully mark each tree which he wishes removed. The cost of thinning may be stated as follows:—When 4 inches in diameter, $\frac{1}{2}$ d. each tree; when from 8 inches to 9 inches, $1\frac{1}{2}$ d. each. At such task-work as this good men will earn 4s. a day. This sum includes cutting, stripping, and carrying out.

It will be necessary to continue this process of thinning from time to time until the plantation has reached the age of 50 or 60 years. By such time, whether the trees are conifers or hard woods, the ground will be capable of bearing them and carrying them forward to maturity. What number of trees an acre of ground will eventually carry depends upon circumstances, but from 40 to 80 may perhaps fairly represent the number of hard woods, and 200 to 300 pines and firs.

If thinning has been wisely and judiciously carried out from the earliest stages, the trees will at this period be rapidly laying on timber; and from this

time the forester must watch for the period when full maturity is reached, as there can be no question that when this point is reached the whole should be felled. The rule is a universal one, that the proprietor in possession when timber arrives at maturity is entitled to the crop; the harvest period has been reached, and he who holds his hand is not fulfilling the laws of good forestry. The exception applies, of course, to ornamental trees; these, though they have reached their full growth, are still "things of beauty," and must remain. Dryden realised this when he wrote of the oak:—

"The monarch oak, the patriarch of the trees,
Shoots, rises up, and spreads by slow degrees;
Three centuries he grows, and three he stays
Supreme in state, and in three more decays."

It may be asked, When is maturity reached? How are we to know when trees are no longer profitably developing?

There are signs which it is difficult to describe, and yet are visible to the experienced eye. The shoots thrown out each year indicate by their weakness or vigour the state of the tree. If long and vigorous, there is no doubt whatever that wood is being formed; if short and weak, the wood laid on is too slight to be appreciable, and the tree may be looked upon practically as dormant. When shoots show themselves on the limbs and trunk; when branches die; when the leading branches show signs of decay; when moss and lichen take possession, and so on;—these all indicate that the period of ripeness has passed.

If we visit woods in any part of the country we see this, and with regret, and attribute it either to ignorance or to the love of the scenic rather than the commercial aspect of forestry on the part of the landowner.

We could carry the reader to large areas both in England and Ireland where this waste has taken place, and is still going on. The scenic aspect of forestry is too much a matter of fact to be treated with ridicule, but we venture to assert that it is best secured by following closely the rules of good forestry.

CHAPTER XIII.

PRUNING OF FOREST TREES.

PRUNING may be considered as a necessary evil arising from defective forestry. It is an operation to be avoided wherever possible, and in plantations which have been well managed it is never necessary after the first few years. In the nursery stage some amount of training is of course required, such as the cutting off of a double leader, the cutting back of too robust laterals, clearing the stem, and so forth. After this, if proper distances are selected, Nature will perform the task.

The rule with regard to larch is well known, and the exceptions to the rule are few—it is that no knife or sharp instrument of any kind should touch them. The laterals will die off from close contact when their work is done, and may be broken off from time to time by a blunt instrument. If cut off when still green the tree will bleed, and disease, especially canker, will be developed.

Circumstances may arise when it may be necessary to cut off a limb, and when this is the case care should be taken not to wound the stem; at the same time the limb should be separated close to the stem, if it is not the portion left will die; and as the trees grow

rapidly this dead portion soon becomes embedded in the new growth, and when sawn into planks forms a blemish of a serious character.

When thinning plantations of Scotch pine and spruce fir it is sometimes impossible to avoid the cutting off of green limbs, as these trees do not cast their laterals as early as larch. If not cut off, the woodmen cannot move about and perform their task. In this case, however, if care is taken to cut close without wounding the stem, little or no injury will follow, because these trees do not suffer from bleeding like larch. In this matter of cutting off the lower branches of Scotch pine and spruce our experience is, that if cut off close to the trunk by a sharp upward cut of the axe no harm will follow, as in a few years the wound will heal by occlusion.

With these remarks we may dismiss the pruning of conifers, but the pruning of deciduous trees is a matter of much greater importance and must be further considered.

Pruning means nothing more nor less than diminishing the number of leaves and branches, and as these are necessary to the full development of timber, the question arises—Why cut them off?

No forester should suffer a limb to be severed without he can give, if asked, a good reason for doing so. Random pruning is of all others a mark of ignorance and bad forestry.

Let us follow the various stages of growth, and consider pruning under each. When removed from the nursery the plants should be shaped, *i.e.*, the best leader, if there are more than one, should be selected,

the rest cut off; lateral branches near the base should be cut off close to the stem, but overgrown branches which tend or are likely to destroy the balance of the tree should be shortened. Later side branches should be cut off so that a clean stem may be formed to the extent of one-third or one-half the height of the tree.

Trees which have been planted and have become hide-bound, or which show signs of decay, should be cut clean away to four inches from the ground; at the same time, however, a small stake should be driven in to mark the stool, so that the young shoots which will soon appear should not be destroyed when cutting the herbage. This process should be carried out in April or early in May, and by the following winter the best shoot may be selected for the future tree. Some foresters invariably adopt this plan in all plantations of oaks. Poplars, or other fast-growing trees planted for shelter, may also be cut back when planted, or soon after, as this tends to develop branches and renders the shelter more effective.

Passing on to a later stage, it may be found necessary to prune outside or isolated trees, so as to secure a well-balanced head, or it may be necessary to cut off or shorten branches which have been broken or twisted by wind; these, however, are exceptional cases, for in the main plantations, or in woods which have been carefully tended, no occasion for the knife or saw is likely to be found. In neglected woods, where trees have attained considerable dimensions, much may be noticed which might have been rectified; but it is too late to rectify errors of the past, and all pruning under these circumstances will be worse

than useless. Dying trees, nevertheless, may be re-invigorated by a timely cutting away of dead-wood. Where *Stag-horn* (so often seen—notably, in Kensington Gardens) presents itself, the trees may be retained as ornaments for many years by cutting off the top. Their ornamental qualities are diminished, of course, but they still remain a desirable feature in parks or pleasure-grounds.

When large trees are transplanted—as they may be by timely preparation—their tops should be cut back and branches shortened; this process will tend to balance the root-fibre and branches until the tree becomes established.

It will thus be seen that—although the rule is an acknowledged one that pruning should not be resorted to—there are several exceptions, and the forester must exercise his discretion when these present themselves. There is no absolute rule, but common sense will go a long way towards a correct solution.

Let us now consider the subject from the practical point of view; first as to season, second as to method. The best season for pruning hard woods is undoubtedly the summer, when the trees are in full foliage. This may at first be resented by many as incorrect, but it is correct, nevertheless—June, July, and August are the best months. The trees feel the operation less when in full vigour; the cut surface more rapidly hardens, and the formation of wood, which at this season is very active, grows over and prevents the escape of sap. There is a minimum of discharge, the sap being taken up, elaborated, and returned with unceasing regularity.

When the branch is only shortened—*i.e.* cut back to a smaller branch—no ill effect at all need be looked for, for new branches will be developed at the cut surface, and the life of the tree be prolonged rather than shortened.

Small branches, which may be cut with a pruning knife only, may be cut close to the stem, but when a pruning chisel or saw are required, greater care should be exercised. The cut should be upward; as, if downward, the tree is often injured by the branch partially breaking off. The cut surface should be chiseled smooth, and if large, say 3 or 4 inches or more across, should be painted or tarred to throw off the water. If a large surface is exposed decay will soon set in, and, if not checked, will permanently injure the tree. After a while the wound will be lost to sight by the growth of wood, and one is apt to congratulate oneself on the success of the operation—but this is often delusive. If care has not been taken, a decayed cavity of greater or less dimension will be found when the tree is sawn into planks. In our practice we have often found these healed surfaces very deceptive.

A dead *horn*, too, so often seen adhering to the trunks of old oaks, elms, or other trees, and partially embedded, is but the outward manifestation of much hidden mischief.

Under all circumstances, a ragged cut is to be avoided, also a horizontal which permits of the gradual absorption of the rain which falls upon it. All should be vertical, so that the least possible surface is exposed.

We may sum up the foregoing remarks briefly as follows :—

Render by good forestry pruning unnecessary, as far as possible.

When necessary, prune with judgment, not forgetting that the removal of branches and leaves reduces the vital power of the tree.

Prune in summer, as the circulation of sap is then in full vigour, and wounds are more readily healed.

Small branches may be cut with a sharp knife ; larger branches with a pruning chisel, with an upward blow from a wooden mallet ; still larger branches with a saw, the rough surface being afterwards smoothed and painted.

When necessary to deal with large limbs, shorten back rather than cut off close, and close to a side branch.

Never allow two leaders on any young tree, but where they exist in large trees leave them alone.

Maintain as far as possible the balance of the tree.

Do not prune conifers at all, except under circumstances already referred to.

Poplars, willows, &c., required for shelter or for yearly cutting, may be cut back and converted into pollards.

Trees suffering from disease may be cut back more or less severely, and life may thus be prolonged.

Before transplanting large trees the leader may be shortened, and the laterals reduced.

CHAPTER XIV

REALISATION.

WE have now arrived at that period when the forester gathers in his harvest. He, like the farmer, has sown, planted, tended, and trained his crop, and when maturity is reached gathers it in to his garner. Patience, however, is a virtue which the forester must possess in greater abundance than the farmer, for many years must elapse between the sowing of the seed in the nursery and the reaping of the matured tree. Generations pass away, foresters succeed foresters, those who planted are forgotten, and when the axe is laid to the foot of the tree it, too, is forgotten, and the work is complete.

It must not be supposed for one moment that this series of chapters (treating of the creation and after management of a plantation) extends only over the brief period comprised in the life of an average landowner; on the contrary, it deals with a period more or less extended in accordance with the nature of the timber and the nature of the soil in which it is grown. It may be thirty, or it may be one hundred years or more.

But, nevertheless, if each successive landowner follows honestly the rules of good forestry, each one

may realise his full share during his limited occupation. This fact alone should tend to a fuller development of forestry, but it is too often lost sight of; and the love of gain, or necessity, obscures the vision, otherwise clear and honest enough. For each tree felled by impecunious owners a young tree is not planted, and only too often a young heir is not preserved, therefore the yearly growth of remaining timber alone can balance that which is taken; and this we know to be insufficient.

There can be no doubt that the quantity of home timber, by this constant realisation, has been sadly and seriously diminished; and it is only by an extension of the knowledge of forestry and the conservation of existing woods and plantations that the loss can be replaced.

What should we say of the farmer who reaped his wheat and sowed no more? Yet, for generations landowners have reaped and have not planted! Look at our hillsides which at one time were clothed with woods, where rivulets have dried up, and where sudden floods prevail through the removal of timber. This is the result of realisation without replenishment.

Realisation, when full maturity is reached, is, as we have before stated, an act of good forestry. There is no period of actual rest in the growth of timber. When a tree has reached the zenith of its vigour it will begin to decay. It is waste, then, on the part of the forester to stay his hand. It is not necessary, however, always to wait for this period, for commercial maturity may be reached before natural maturity, and probably it will pay the owner best to

take advantage of this period. Again, realisation does not necessarily imply complete dismissal of whole woods or forests, it means possibly progressive thinnings—it applies to the earliest thinnings, to a money return in any form ; but, nevertheless, we apply the term here to the selling of full-grown timber which has reached a saleable maturity, and propose to treat the subject, first, as to *methods of realisation*, and secondly, as to *measurement and valuation*.

We shall endeavour to describe the methods usually employed in the realisation of timber, and then, for the benefit of young beginners, describe fully the methods of valuation of both standing and felled timber, with the rules of measurement applicable. Our remarks will apply only to round timber—to the timber as it is felled and taken from the wood. We are dealing with forestry from an estate point of view, and not from the point of view of the timber merchant. We shall not, therefore, pursue the subject into the mysteries of conversion, for this, though allied to forestry, is wide of our mark, and would carry us into a business which needs the experience of a life. To make the most out of a round piece of timber requires skill unknown to the forester ; and many unsuccessful timber merchants probably trace their want of success to this very failing.

The forester should know, of course, for the purpose of valuation, what each tree is fitted for ; but his work is complete when he has felled, valued, and sold it.

We took occasion in the early part of this book to comment upon the lack of knowledge of forestry in

land agents, but on the subject of realisation they are undoubtedly the very best judges. By long and varied practice they can, and do, measure and value with the greatest accuracy, and if their general knowledge of forestry equalled their knowledge in this respect, our woods and plantations would not now be in the languishing state they are. This very skill has been attained by constant realisation, the result of which, as we have already stated, is so apparent. Let landowners realise that to continue this depletion without replenishment will lead to a timber famine, and set to work with a will to plant their waste and unoccupied land for the benefit of themselves and those who follow them.

CHAPTER XV.

METHODS OF SALE.

THERE are two methods of sale—viz., by *public auction* and *private sale*. Again, there are two methods of preparing timber for sale—viz., by *marking and selling standing* and when *felled*.

The object of the forester will be to obtain the highest possible value for his timber ; and he will exercise his own judgment as to whether he will effect this best by auction or private sale. When the quantity for sale is large, there can be no doubt that auction is the best, as purchasers are brought together from various districts, and local rings are rendered almost impossible. In auction sales, too, especially if the class of timber is varied, there are sure to be a number of lots suitable for small buyers, for men who are doing, perhaps, small jobs ; and these men are willing, as a rule, to pay fairly for the accommodation thus afforded. These odd lots, if merged with timber of a large and more valuable size, are seldom calculated in private sales, but, allowed, as a rule, to serve the purpose of an indirect discount. By this process a considerable sum is lost to the seller, as the presence of these odds and ends does not really improve the prices of the more valuable timber.

By auction, too, if the auctioneer has been well chosen—*i.e.*, if he is a man who knows and who is known to the timber trade—a brisk competition is obtained, and varieties of timber, for which, perhaps, there is no local demand, sell freely to men from a distance, who require such.

Different districts represent different trades, and different trades require various kinds of timber, and thus a healthy spirit will pervade the sale.

There are, of course, expenses attaching to sales by auction which are avoided in private sales ; but, on the other hand, competition is not rife—in fact, is often entirely absent ; and this, when the quantity to be sold is large, will far outweigh the contingent expenses. These expenses, however, to some extent are normal, and attach to small and large sales equally, so that they are little felt when dealing with large figures, but become heavy charges on small sales. This being the case, public auction cannot be recommended when the transactions are small. The question naturally arises—what is the limit? Elsewhere we have named £200 as the minimum, and see no reason to alter this assertion. Under this amount the percentage becomes onerous, and is not balanced by increased prices gained by competition.

Private sales, or *sales by tender*, which is another form of private sale, should be resorted to for sales under this amount, as the least possible expense will attach. At the same time, whilst recommending sales by auction, we do not for one moment condemn private sales even for large quantities of timber. There is much to recommend in private sales ; op-

portunities often present themselves to gain high prices for certain timber, owing to an exceptional demand which does not affect trade generally. Timber may lie or stand in remote districts, which would not attract distant purchasers, and for which publicity would not improve the demand. Terms may be made with local men, without incurring the inevitable expenses already referred to.

In a private sale, however, one quality in the forester is absolutely essential, and that is, a thorough knowledge of the timber trade and a knowledge of valuing. If he does not possess this knowledge, he will be more or less at the mercy of the purchaser, who in all probability will understand his business well.

If sale by tender is resorted to, the same knowledge is equally essential, for, before accepting a tender, he must himself know the value. This, however, applies to all the methods named ; the value (not necessarily so accurately assessed) must be given the auctioneer as his reserved or upset price, or the forester will be working in the dark.

Lotting timber, whether felled or standing, is a matter of much importance, if the full value is to be obtained. The auctioneer possibly may be a better judge of this, as from long experience he has become acquainted with the requirements of the trade ; but the forester, too, must know, and know well, how to best arrange his lots, as to sizes and varieties. As a rule we are of opinion (especially when the sale is a very mixed one) that small lots sell best, as it gives small purchasers a chance, as we have already explained. When, on the other hand, the sale consists

of large, or, at least, uniform timber, the same necessity for small lots does not exist.

The forester, too, will have to decide whether he will sell his timber standing or felled. Perhaps of the two, to sell standing is the most general, especially on small estates where no forest staff is kept. The money obtained is thus clear or only subject to sale expenses.

Where a staff is kept it may answer as well to fell first. If this is done we strongly recommend drawing the lots to a convenient place of sale, as no process will pay better. We do not mean a long distance, but to a roadside or some convenient spot for removal.

Where, too, as on many estates, large quantities of timber for various purposes are required, it enables the forester to select for himself before selling, and enables him also to weed out inferior classes which would not assist the sale.

This is a matter, however, to which it is only necessary to draw attention ; the question must be decided upon its merits.

The forester having decided upon the quantity of timber which he has for sale, must ask himself some or all of the following questions :—

How shall I sell, by auction, private sale, or by tender ?

Shall I sell it standing or felled ?

What regulations will be necessary to ensure careful removal and prompt payment ?

How shall I arrive at the correct quantity and value ?

These questions we will now proceed to consider in detail.

Public Auction having been decided upon, it will be necessary first of all to select an auctioneer. The choice should fall upon one who is known to the timber trade, and who thoroughly understands this branch of his business. Having chosen, it will be well to act in concert with him in the preparation of details. The first step will be to set out and mark the lots, whether the sale consists of standing or felled timber. If the former, the lots should consist of a certain number of trees in juxtaposition, and as far as possible of a similar kind. These should—having been previously marked by the forester—be marked in some way which will render them visible to the eye from all positions; a ring of white paint is perhaps the best.

Then on one side the number of the lot should be clearly painted in large figures, and to divide the lots it is a good plan to mark the following one on the opposite side, and so on alternately. In the latter case, the various trees having been drawn together, as described in the last chapter, the lots may be marked with paint on the butts, or a board with a painted number be fastened to a stake close by. The lots in this case should be regularly laid, with the butts pointing one way, and towards the road.

This work of lotting may be performed by the forester or auctioneer; if the former has had experience, it will save expense if he undertakes it; if he has not, he had better leave it to the auctioneer.

This being done, both the auctioneer and forester should enter the particulars carefully in their books. These should consist of the number of trees in each

lot, the kinds of timber, a space for the name of the purchaser, the forester's estimated value, and a column for the sum obtained. This will furnish full details for present and future use.

In the meantime and for (say) three weeks the auctioneer will advertise the sale in the best timber journals, not forgetting to be explicit as to quantity, varieties, dimensions, and so forth. This will enable merchants to judge if the sale is worth their consideration. If these details are withheld, and for the sake of expense the advertisements are curtailed, it will either lead to a large number of letters of inquiry or deter merchants from attending. During this period intending purchasers will view the lots, and every assistance should be rendered them to make their work easy.

The next matter to engage the attention of both auctioneer and forester will be the conditions of sale. In large and important sales these are of consequence. It is quite unnecessary here to give *seriatim* the rules and conditions of an ordinary sale. They are somewhat stereotyped, but, nevertheless, the forester must see that arrangements are made for careful cutting and removal, that standing trees are not injured by the falling timber—and this is best met by providing that for all trees so injured double the market value should be paid—that the roads specified should alone be used; and other such like provisions. The auctioneer will, on his part, see that arrangements are made as to bidding, payments, and so forth. It should be borne in mind that a deposit must be made by each purchaser at the time of sale

•

—the amount of such deposit being a matter of arrangement. Good and approved bills should be exacted for the balance ; but the best plan is, perhaps, to induce cash payments by the offer of a liberal discount.

One condition should never be forgotten, and that is, that the lots should all be removed within a specified time ; and if they are not, the right of the purchaser to their possession shall cease. We have often seen lots left lying about for a long while after sale, giving an untidy and unbusinesslike appearance to the woods. At the conclusion of the sale, each purchaser should be required to sign an agreement signifying his assent to the conditions of sale, and his willingness to abide by them. Finally, the auctioneer will render his statement of account, with the balance due, together with the bills for the remainder. The costs, as we have already stated, will be somewhat heavy,—a percentage in accordance with the amount of the sale as commission, lotting, printing, travelling expenses, refreshments, and so forth.

Notwithstanding these charges, auction confers advantages offered by no other method, and in our opinion should be adopted when the quantity for sale is large, without there is some really good reason to the contrary.

The forester should bear in mind that the success of the sale depends largely upon his own efforts, and not for one moment consider that the employment of an auctioneer relieves him of his just liability. One word of advice to both the auctioneer and forester before concluding the subject of sale by

auction, and that is, to dress out each tree to the full length. It is a mistake to saw into lengths, as, by so doing, the object of the purchaser may be defeated.

Private Sale is nothing more nor less than private bargain. A certain amount of timber is for sale and the fact soon becomes known, and those desirous of buying make their desire known to the agent or forester; or the agent or forester will seek for a purchaser whom he thinks will require the class of timber he has for sale. The first step will be to mark the timber in the wood or woods where it is standing or lying in the way already described, except that it will not be necessary to lot it. The next will be to measure and value it; and in this case a more careful survey must be made, as there is not likely to be competition to secure the highest possible figure.

Here then the knowledge and skill of the agent or forester comes into play, for without it he is likely to make a sorry bargain. It is impossible to lay down rules or to attempt in any way to regulate private sales, because they are always, as the name implies, open to private arrangements; and private arrangements are necessarily full of vagaries. They are open, too, to bye-arrangements between the buyer and the medium, not always advantageous to the owner. Nevertheless, many private sales are good and sound, especially when the parties engaged are skilful, and their acts *bonâ fide*. The remarks on private sales apply equally to felled and standing timber, only if the latter plan is adopted greater care must be taken in arriving at the quantity and value. As a rule, we believe the measurement of standing

timber tends to a low estimate; but, nevertheless, when properly understood and carefully executed, we believe a really sound valuation may be made which will favour neither the buyer nor the seller. Although this system of selling standing timber is often adopted, we do not for one moment specially advocate it; but we fully recognise the fact that it is often very convenient. Very old oaks, for instance, sold standing, will, we believe, favour the seller as a rule, as they are often very faulty indeed, the defects being most difficult and often impossible to detect when standing. In extensive dealing, nevertheless, with these old trees we certainly prefer, in our practice, felling before selling.

There is, as a rule, less precision in carrying out private sales, which in itself detracts somewhat from the method.

Another form of private sale is *Sale by Tender*. This is a kind of middle course, and by no means a bad one under certain circumstances. The agent or forester having made himself fully acquainted with the timber, the quantity and value, the locality, and so on, will proceed to advertise it in the trade journals for sale by tender; but will take care to make it clear that he does not bind himself to accept the highest or any tender. This advertisement, which should be explicit enough to elicit replies, should state that full particulars will be forwarded on application, and that the lots can be viewed by applying to certain individuals specified.

It is needless to write more fully on such a simple process as this; all that is required is to mark and lot

the timber, measure and value it, draw up conditions, and advertise for tenders. The probability is, if the timber is useful, that the result will be satisfactory, and the expense attending the sale will be very moderate. It will be a good plan when the sale by this method is an extensive one to furnish applicants with printed forms of tender.

These then are the various methods of selling timber. We do not attempt to dictate, or even to give a decided opinion upon one or the other, but recommend those responsible to weigh the matter well ; and then to adopt the plan which will in their opinion secure the highest possible value. This, after all, is the acme of forestry—to first grow the greatest possible amount of timber in the least possible time, and then to sell it at the highest possible price. We shall now explain and describe in detail the various methods of measurement and valuation.

CHAPTER XVI.

MEASUREMENT OF TIMBER.

THERE is, of course, a theoretical method of measuring timber, but the mathematician would fail to satisfy the parties interested unless he added to his knowledge of mixed mathematics the practical knowledge gained only in the woods. The mathematician would by his process accurately determine the solid contents of the trees, but what is required is the saleable contents ; and we shall endeavour to show that there is a considerable difference between the two. We propose confining our remarks to the measurement of round timber, for, as we have before stated, the conversion of timber belongs to another line of business. True, we could, under the head of forestry, easily and correctly merge the two ; but we fail to see the necessity or expediency of so doing.

If the timber is sold it passes into the hands of the timber merchant or contractor, who converts it to suit his purposes ; if it passes by transfer into the hands of the clerk of the works, he also converts it ; the land agent's or forester's duty is complete when he has obtained from one source or the other the value of the round or hewn tree.

The question will naturally arise—*What is timber?* The lawyers tell us that oak, ash, and elm are alone timber, other classes are timber-like trees; but from the forester's point of view all trees are timber which have a quarter girth of six inches under the bark. This custom has become almost universal; and go where we will we seldom find it disputed.

In some districts beech is timber, especially in those counties where it grows largely and is in demand, such as in Bucks, Hampshire, Gloucestershire, and so on. Birch, again, is in great demand in the Northern counties, and counts as timber; in others it is not always so. Again, it is considered by some that a tree is not timber until it has reached a content of nine or ten solid feet; under this they are treated as saplings. But these are the exceptions, the rule is as stated.

The object of the forester, then, is to obtain the *saleable* content of the tree. This quantity lies between the die square and the full contents. The die square measurement represents the largest piece of scantling that can be obtained from a piece of round timber, the full contents is that obtained by taking the full circumference. The saleable contents is obtained by taking the quarter girth, or one-fourth of the circumference.

In measuring standing timber the girth is taken by the measuring strap as high as can be readily reached, and an allowance made for fall; which means that a deduction is made from the circumference thus obtained so as to approach as closely as possible to the true girth in the middle. This is usually taken at six inches from the full measure; but although this is usually

taken as sufficient, it is not so in most cases, as we have more than once proved. Then, again, an allowance must be made for the bark, and this in oak, ash, and elm is usually taken at one inch from each foot of quarter girth. Some prefer a sliding scale ranging from $\frac{1}{2}$ to $1\frac{1}{2}$ inch, but 1 inch may in practice be taken as satisfactory. The height in most cases may be taken by a jointed rod, 20 feet in length; or in the case of very high trees one or two may be felled and measured, which will enable the forester to judge of the rest. It is possible, of course, to take the height by the sextant, but this we pass by, as being beyond the power of the ordinary forester or agent. In measuring felled timber the method is to take the length of the entire tree, or, if the length is divided, according to size and shape of each portion, and measuring back to obtain the exact half; here the girth is taken with a string, the string is then folded into four, and laid along the rule, which will give the quarter girth in inches. Here it will be noticed no allowance for fall is required, as the girth in the middle has been taken.

In the case of a larch plantation, we have found it best to assume that all the trees are 20 feet in height, then by taking the girth breast-high and making no allowance for fall, the saleable contents will be approximately found.

Now it will be seen that this method of quarter girth divides the waste between the buyer and the seller. If the die square be taken, a large quantity of saleable waste will be obtained, and which would be lost to the seller; on the other hand, if the full con-

tents be taken the buyer would purchase the waste at a price far above the value. The quarter girth meets this, as already described.

Having obtained these data, the rule for ascertaining the cubical contents from them will be:—*The square of the girth in inches multiplied by the length in feet and divided by 144.*

By the sliding scale it will be:—*As the length upon C is to 12 upon D, so is the girth on D to the contents on C.*

Tables, too, are published, but we strongly recommend all beginners to avoid them and to keep closely to their own calculations until they have become experienced.

If they do not take this step they will never rise above the ordinary level, which should be contrary to the creed of all aspiring agents.

Having given the rules for timber measurement, it will now be necessary to apply them. For this purpose we will proceed to carry out a valuation for the sale of standing timber, may be for sale by auction or for transfer on sale of land—the process in either case will be similar. Some measure a tree here and there, and compute the rest; some experienced men do not measure at all, but set the cubical contents and value by the eye alone; others measure carefully each tree. The latter plan is the most satisfactory, and we strongly recommend all, especially beginners, to take this extra trouble. They will be well repaid for their labours by the knowledge they will possess of the accuracy of their work. We do not, of course, imply that every tree in the wood should be measured, as

there will be many instances, especially where the woods have been carefully thinned, where trees will be of similar size and growth ; we allude to the practice of measuring off areas, or counting the trees and roughly estimating the lots.

The quantity is invariably estimated in cubic feet, and sales are usually effected also by the foot ; but in certain districts sales are effected by the ton, and then it is necessary to ascertain how many cubic feet of rough timber are required to make the weight. The weight of timber may be roughly estimated at from 60 to 90 lbs. per cubic foot, but the forester should satisfy himself on this point in accordance with the class and kind of timber he has for sale. This he may do by referring to published tables or by weighing a piece for himself. The latter plan is the best.

The measurer should supply himself with a measuring strap, a rod, a small blazing axe or scribe, and a book and pencil. The strap must be well-seasoned, so that it will not stretch, and marked so that each inch shall read $\frac{1}{4}$; thus— $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1 inch, &c., up to 8 feet or more, as may be desired. By this means the quarter girth will be seen at a glance. At the end of the strap is attached a weight of lead, so that it may be thrown round by the operator, and caught by the left hand. This is done by standing close to the trunk, and only requires practice. As already described, from this quantity a deduction is made for fall and bark, and the true quarter girth entered in the book in the column assigned to it. The length is then taken by the rod. This is held against the tree by an assistant—his full reach being previously ascertained—and

any remainder judged by the eye of the measurer. This also is entered in the book.

The book should be ruled as follows:—The first column for numbers, the second for kind of tree, and then successively for length, quarter girth, quantity, value per foot, total value, and remarks.

Some enter each tree, of whatever kind, in rotation; others keep separate pages for each kind. It is also usual, and to be commended, to keep a separate account of trees of 27 cubic feet and upwards, as these possess a higher value.

Trees under timber measurement are entered as saplings, or “tellers,” and are usually valued to 1s.; below this they are usually allowed to pass. The value of these “tellers” will range from 1s. to 3s. each, according to girth. It is usual in contracts of sale to specify the standard below which no payment will be exacted.

It may be useful here to state that these young trees are the future timber and do not pass as underwood.

Young trees allowed to grow from stools are still underwood until they attain timber size; therefore special provision must be made if they are to pass as saplings.

The total quantities may be worked out after the work is completed, or by experienced men during the valuation. We have known auctioneers enter the quantity in the book as fast as the figures are called out by their assistants, but this is arrived at only by long practice. It may be useful, however, to the beginner if we draw his attention to the following facts:—

- 6-inch quarter girth will give contents equal to one-fourth the entire length in feet.
- 7-inch, one-third.
- 8½-inch, one-half.
- 10-inch, two-thirds.
- 12-inch, equal.
- 17-inch, twice.
- 21-inch, three times.
- 27-inch, five times ; and so forth.

If he can impress these on his memory he will soon get into the way of rapid computation.

Tables are used and can be kept in the book, so that reference is easy ; but before selecting a table, it should be ascertained whether the results given agree with the rule laid down.

If the sliding rule is used more time will be required, and for large quantities we do not recommend it. We do strongly advise, however, the beginner to make himself by practice acquainted with its use, as it is often most useful. As the work proceeds, the trees must be marked, so that they should not be measured the second time, as may easily be done in a large wood. This mark should be on one side only, so that by looking back they may be seen. If marked at random, much running about is needed to satisfy any doubt.

In a large and thick wood, some care will be necessary to avoid confusion. We have found it useful to mark off sections by aid of white rods ; but valuers must adopt their own plan to suit local circumstances. One thing, however, is absolutely essential—

that is systematic regularity. Only those who have had experience know how easy it is to become confused in a thick wood.

In measuring ornamental timber, we are of opinion that it should be treated as ordinary timber, and measured and valued in the usual way. Some, we believe, take it at one-half the value; but we see no reason for this practice, for although it may not be felled by tenants for life, it adds materially to the beauty and capital value of the estate.

If any exception is made in favour of ornamental timber when measuring for transfer of land, it will be necessary to define what is and what is not ornamental.

Ornamental timber is not necessarily that which is left for ornament by a present or past tenant for life, but that which has been planted or left for the purpose by some one having the absolute power of disposition. It is not necessary here, however, to go into the legal technicalities attaching to timber. Having obtained the cubical contents of the trees for sale, whether for the one purpose or the other, the value must be attached according to circumstances. The full value, as if felled, will be taken, as the lop and top will fairly cover the cost of felling. When valuing standing oaks, the bark must be added to the value of the timber. Some make no deduction for bark, and take the extra quantity of timber so obtained as an equivalent; others take, after deducting for bark, so much bark to so many tons of timber. This will range from 1 ton of bark to 3, 4, or 5 tons of timber, according to circumstances. These circumstances are governed by

the situation of the trees, whether in woods, or isolated, exposed or sheltered, and number and size of limbs, and so forth.

At the present time, when bark possesses so low a value, it is questionable whether it pays to strip it. Oak timber, felled in winter, is more durable, and, therefore, more valuable than when felled in spring, and the extra price obtainable will, in our opinion, more than compensate for the bark. For Navy and Government purposes this is imperative. It is well to draw the attention of the student to the fact that when oak is in scantling it is impossible for anyone to tell whether it was felled in winter or spring.

When trees are felled by the forest staff, and then sold, the method of measurement will be as described—a string (whip-cord is the best) will be used in place of the strap, and the length be taken by a two-foot rule or tape. Sometimes it is difficult to run the string round the tree; so the measurer should be provided with a needle for pushing under the log; the string can then be threaded, and the string pulled under.

We will next proceed to describe the methods of valuing larch plantations.

CHAPTER XVII.

MEASUREMENT AND VALUATION OF LARCH PLANTATIONS.

THE measurement and valuation of larch plantations differs somewhat from the ordinary valuation of timber. When larch or other fir have attained timber size the quantity and value may be determined in the usual way—*i.e.*, by ascertaining the cubical contents, and placing upon it the market value. This value may range from 6d. to 1s. a foot according to size, quality, and kind.

Often, however, plantations as a whole are sold, either for cutting, or for transfer on sale of land. These areas are often of various ages, some newly planted, others approaching maturity, others ripe for cutting. Some have not reached timber size, and yet possess a considerable present value to the timber merchant, or prospective value to the landowner. It is not usual to take into account prospective values when valuing timber, and yet this item cannot altogether be lost sight of in determining the value of land, nevertheless we pass it by here.

Plantations of Scotch fir possess little value until they have attained timber dimensions, and are seldom

sold except when the land upon which they stand is sold. The values are usually then determined by the cost of planting. It is different with larch; these soon reach a commercial value, long before they reach maturity, and are greedily sought after from the first thinnings until finally cleared. No tree, perhaps, grown is so universally useful, or more eagerly inquired for.

The first thinning will take place in ten or fifteen years, according to soil, site, and distance apart; and, as we have before stated, in hop districts they will sell from 12s. to 20s. per hundred.

The next thinning may take place three years later, and the produce be again sold for the same purpose. After this, if the trees grow freely, they will be fit for scaffold poles, and sell as such. Five pounds a hundred is perhaps a fair estimate for this class of larch. From this period until timber size is reached they are usually valued by the hundred, and will reach £15, £20, and £25, according to size; after this they are probably timber, and will be valued by the cubic foot.

Before they reach the first thinning—*i.e.*, when they are quite young—it may be necessary to value them on the sale or purchase of land, and the best course to pursue is to take the cost of planting and add to this the rent, rates, interest on capital, and so forth, for the period which has elapsed since planting. From this, however, should be deducted failures, which may have arisen through neglect or bad judgment.

On the sale or purchase of land probably nothing is more satisfactory to all parties than the transfer of

really healthy larch plantations. The seller, who planted, receives his money plus a fair interest, and the buyer purchases at a reasonable rate something of certain prospective value. Valuers are satisfied because the value is readily determined.

When, however, these plantations have been unwisely planted, or after planting been neglected, the seller is in the same position as any other person who has unwisely invested his capital.

With regard to the method of valuing and selling standing larch, it is very similar to the process already described. If the whole plantation is to be sold for felling there will be no need to mark, but it should be carefully lotted by the forester or auctioneer into suitable lots, and the lots should be carefully defined, so that they do not intermingle.

If a thinning only is for sale, the forester must himself carefully mark those which should be removed before lotting. For information upon this point we must refer him to the chapter on "Thinning."

As we have before stated, it is not necessary for the forester to take into account the conversion of timber, only so far, at least, as to enable him to set a correct value upon his fall. In larch, perhaps, this knowledge is more necessary than in other classes of timber, as the uses to which it is applied are so numerous as to give it a high value, upon the principle of supply and demand. In accordance with size it is sought after for hop-poles, scaffold and telegraph poles, pit-props, sleepers, flooring-boards, piles, boat-building, wheelwright-work, fencing, and so on.

This long list is quite sufficient to show that it possesses a value beyond any other home-grown timber. It also proves, we think, conclusively that when planting for commercial and investment purposes there is no tree which approaches it where the soil and site are suitable.

In northern districts it has been customary to peel larch, the bark possessing tanning properties; but, probably owing to the low price of oak bark, this is not so common as it was. When this is done the value must be added to the timber, and an allowance made for bark where necessary.

We do not recommend peeling when the poles are to lie long in the wood or elsewhere, as they season better with it on; but when for immediate delivery peeling largely reduces the cost of carriage, and is therefore advisable.

When larch, spruce, or Scotch pine are sold by the ton, the forester may take 70 to 80 lbs. per cubic foot as a fair estimate, which will give him about 30 cubic feet to the ton. This weight will, of course, vary in accordance with circumstances, and applies only to newly-felled and rough timber.

We do not for this purpose enter with accuracy into the subject of weight, as our object is only to enable the forester to place upon his timber a sufficiently accurate estimate for the purpose of auction or private sale.

CHAPTER XVIII.

FIRE LINES.

IN our moist clime little attention is paid as a rule to destruction of plantations by fire encroachment, and yet past dry seasons have not been unattended by loss—loss which would have been avoided had fire-lines been in existence.

It may be asked by some—What are fire-lines? Fire-lines are lines of deciduous trees, or bare spaces passing through plantations, and dividing the area, like water-tight bulk-heads formed for the purpose of checking the encroachment of water in ships.

In our opinion, when planting large areas bordering on waste land covered with heather or gorse these lines should never be omitted—they are unnecessary only where the plantations are surrounded by arable or pasture land. It is seldom that fires occur inside a plantation or directly, although such is possible where dead branches or *débris* are burned upon the spot. Fires usually arise through encroachment from conflagrations on the surrounding wastes, and if once fir plantations catch, nothing can prevent great loss and possibly entire destruction.

There are three classes of fire-lines :—

- (a) Bare spaces left when planting, or cut down in existing plantations.
- (b) The exclusion of conifers.
- (c) The planting (alone) of certain deciduous trees less inflammable than others.

In the first case there is unnecessary waste of space, and also the extra labour periodically of cutting away the growth of heather or gorse which will grow freely where there are no trees, and which, if left, will feed the fire as well as the fir trees, and prove a danger instead of a preventive. This plan, therefore, we do not recommend.

The second plan may be resorted to with success. The deciduous trees may be planted the same as in the rest of the area, but the nursing conifers excluded—or, which is still better, the third plan may be adopted, viz., that of selecting certain deciduous trees suitable to the soil and site, but less inflammable than others. These are as follows :—Maples, sycamore, alder, hornbeam, walnut, ash, plane, poplars, and birch. The direction and width of the lines is somewhat difficult to define, and must be left to the discretion of the forester or agent. They should run as far as possible across the line of prevailing wind ; but, when the area is narrow, they should take the direction of the shortest length.

This plan will serve to check the advance of a conflagration more completely than if the lines are taken along the greatest extent.

A further preventive will be found in good management—when fir plantations are carefully thinned, and

the lower branches broken off from time to time, there will be less food for the flames, and the fire will be more readily stayed.

To some these remarks may be considered as emanating from the brain of an alarmist, but we have seen great injury done which might have been avoided by such reasonable foresight.

We strongly recommend all land agents who have the control of large areas of fir-plantations on or near waste land, to take the hint and create fire-lines, although it is unlikely that hot summers will occur year by year in this variable climate.

We have so far dwelt upon the prevention of fires, and in this instance prevention is better than cure ; but fires will occur, and differences of opinion will also occur as to the best methods of extinguishment ; and it seems somewhat presumptuous to offer advice. We nevertheless recommend the lighting of lines of fires to leeward and encouraging the advance to windward. This can only be done, however, successfully where plenty of men are available to check the spread to leeward.

CHAPTER XIX.

COST OF PLANTING.

WE propose first of all treating this important subject from the primary point of view, *i.e.*, the initial cost, leaving for future consideration the yearly payments for rates, taxes, tithe-rent charge, interest on capital, fencing, maintenance, and so forth. To show conclusively that planting will pay, we must very closely examine all matters relating to expenditure, bearing in mind that interest and compound interest on capital expended forms a most important factor in the profit and loss account. Nevertheless, especially in times of agricultural depression, the initial outlay is the item most likely to weigh with the intending planter. By initial cost we mean the actual sum required for the creation of the plantation. This represents actual and immediate expenditure of capital, that which follows more immediately affects revenue. The investment must be viewed in the light of the purchase of a reversionary interest, and this, as we all know, is by no means a favourite method of investing capital. The return, however, is by no means visionary, and, looked at as a reversion pure and simple, is not remote.

Planting, however, is such a visible estate improvement, so tangible, so absorbing to the true lover of

rural life, that if the money can be readily spared little inducement is necessary to promote a wide increase of woodland area. The great question is, How can it be carried out when money is not forthcoming? Money may be borrowed for the purpose, but this creates a further burden, and those who own or manage land know too well that the land is already overburdened, in fact will bear no more. The Settled Land Act, 1882, makes provision by allowing capital trust money to be used for the purpose of planting.— See section 21, sub-section (III.), and section 25, sub-section (IX.). A further question—and by no means a depressing one—is this. Will not wise and judicious planting serve to pay off and clear away much of the existing debt in a comparatively short space of time? If this can be proved, we think even a further burden in the form of a rent-charge will not deter many from planting largely.

If, again, this can be proved and brought home clearly to landowners, we believe a great advance will have been made, and that our area of woodland will soon largely increase.

The difficulty lies in proving this, but we by no means shrink from such a task. Undoubtedly there are soils that it will not pay to plant. Trees of some kind will no doubt grow, but trees alone must be grown which, in years to come, will be saleable—*i.e.*, when we look upon this matter purely from a commercial point of view. These soils, however, we believe to be few and far between. Most soils can be made to carry trees, suitable for home consumption, to a profitable maturity, even if they are incapable of

producing really fine timber—take larch as a passing example.

We know from our own experience that larch plantations, planted thirty and forty years ago, are now producing large quantities of valuable timber, the whole of which may be looked upon as profit ; for the whole expenditure has long since been recovered. This result, too, has been achieved on land which at the present time would be returning nothing whatever in the form of rent if in a state of cultivation. Further, we may point out, as a practical proof of this, that land actually adjoining has been recently capitalised at a nominal rent. These larch have recently produced boards 14 inches wide.

It seems necessary, first of all, to ascertain the first cost of planting an acre of land under various conditions, and then to add to this the accumulation of rent, rates, taxes, and maintenance. The cost must, of course, vary in accordance with the nature of the soil and the class of trees to be planted, the cost of labour in the district, and other such matters. There can be no fixed amount which will apply accurately to all districts.

Take drainage for instance. This is only required under certain conditions as already described, and even then varies as the soil is more or less heavy. It is impossible to fix the amount required for this operation, but a practical agent can readily ascertain the cost applicable to each piece to be planted. Suffice it to say that the operation adds materially to the initial cost, and may render the whole a doubtful act of improvement. Fencing again is a necessary

outlay which cannot be avoided, and the cost of which cannot be expressed at a fixed sum per acre. The expenditure will vary per acre with the size of the plantation. The larger the area the less the cost per acre, *e.g.*, to fence a plot of one acre must cost in proportion much more than a hundred acres. It must suffice then to place a sum per yard or per rod upon the various classes of fencing, and leave the result to the case in question. Fencing of some kind is of course absolutely essential, and men of foresight will adopt live fences, which will eventually become permanent if properly looked after. These fences, however, must be themselves protected, so that the original expenditure will be somewhat heavy.

It is almost impossible to erect the simplest wire fence under 6d. per yard, and if the stumps and strainers have to be bought the cost may be at least 1s.

The class of fence adopted will of course depend upon local circumstances. In some, turf fences may be the best; in others, stone walls, sunk fences, post and rails, wire with wooden uprights, palings, and so forth. For our present purpose the cost may be said to vary from 6d. to 1s. 3d. per yard.

Live fences may consist of common thorn, beech, hornbeam, privet, or holly, the cost of which will vary also; the price of the plants will be somewhat as follows:—Thorns from 7s. 6d. to 20s.; beech, 15s. to 25s.; hornbeam, 15s. to 20s.; privet, 10s. to 15s. per 1,000; holly, 15s. to 30s. per 100.

The number of plants per yard will vary in accordance with the age and size, but will run from three to seven, if planted in single lines.

These few *data* will be sufficient to show how impossible it is to fix any price per acre for planting operations.

Let us first consider the cost of notch planting. This is the cheapest method, and applies to moor or heath land. For our purpose we will take 2,700 plants per acre, *i.e.*, at 4 feet apart.

1,200 pines at 7s. 6d. per 1,000	...	...	£0	9	0
1,500 larch „ 10s. „ „	...	...	0	15	0
Planting ... ..	...	...	0	9	0
			£1 13 0		

N.B.—If planted 3 feet apart the cost will, of course, be greater.

Let us now take a case of pit-planting (4 feet apart) applicable to a mixed plantation:—

200 hardwood trees at 20s. per 1000	...	...	£0	4	0
1,500 larch „ 20s. „ „	...	...	1	10	0
1,000 pines, silver, and spruce firs, &c. „ 15s. „ „	...	...	0	15	0
* Digging 2,700 holes, planting and treading in „ 2s 6d. „ 100	...	...	3	7	6
			£5 16 6		

The total amount therefore of £5 16s. 6d. may be taken as the extreme. The price of pit-planting for ordinary plantation purposes will range from £4 to £6

* We have taken 2s. 6d. per 100 for digging, planting, and treading in, but in many cases where the trees are small or not heavily rooted, and when the soil is friable, two-thirds of this sum may be sufficient.

per acre, exclusive of fencing and drainage. This sum, too, may be still further reduced by growing the trees in a home nursery. We shall now consider the items of yearly expenditure, together with the interest and compound interest which must accumulate owing to the periods which must elapse between each thinning. Nevertheless this calculation is somewhat imaginary, and is often in practice lost sight of. We do not for one moment hesitate to accept it as a patent fact, but only express our opinion as to its being more chimerical than real.

If then we take £6—the extreme cost—as the initial outlay, and, for the sake of calculation, consider the plantation so far as the conifers are concerned as likely to stand, with intermediate thinnings, for 40 years; then we shall find that it will accumulate, at 3 per cent., to, say, £20. If, too, we take 7s. as the annual expenditure per acre for rent, rates, tithes, and so on, it will accumulate, at the same rate of interest to £26 7s. 9d., or in all to £46 7s. 9d. The thinnings, it will be seen by the table of produce, will in the same period reach the sum of £120 9s. 3d. The facts as shown, if accepted as facts, must be somewhat startling.

COST OF PRODUCTION PER ACRE.

Interest on £6, at 3 per cent., will accumulate in 40 years to	...	...	...	£20	0	0
Rent, rates, tithes, taxes, &c., at 7s. will accumulate in 40 years, at 3 per cent., to				26	7	9
				<hr/>		
				£46	7	9
				<hr/>		

VALUE OF PRODUCE PER ACRE.

The thinnings at the end of 20 years, say 2,000 trees (larch and Scotch fir poles), should be worth £30, which will accumu- late in 20 years, at 3 per cent., to	... £54 3 7
The thinnings at the end of 30 years, say another 300 trees, should be worth £27, which will accumulate in 10 years, at 3 per cent., to	... .. 36 5 8
The value of the final cutting of 200 larch and Scotch firs, should be £30	... .. 30 0 0
	£120 9 3

To this amount, viz. £120 9s. 3d., must be added the value of the 200 deciduous trees left standing; and, on the other hand, the cost of fencing and (possibly) draining must be added to the £46 7s. 9d., the cost of production.

These figures we cannot attempt to estimate. We have, however, we think, clearly shown that wise and judicious planting will pay on lands too poor for cultivation in these days of low prices.

Estimates such as the above must be general, and open to criticism; it is quite impossible to deal with exact figures which will meet all classes of soils and local conditions.

A further gain, impossible to capitalise, is the improvement to the soil by the accumulation of leaf mould, the value of which any true forester knows how to appreciate. If the remaining deciduous trees are well managed, the prospective value must be very great. Some may consider that we have thinned too severely, and left too few standing at such an early

period as 40 years ; perhaps so ; if this is the case, the money calculation we have made will not be much affected, as what is lost on the one hand will be gained on the other.

We shall content ourselves with this one example, as if we quadrupled it there would still be room for further. Each must adapt the calculation to his own locality and soil ; *ab uno disce omnes*.

To the above calculations must be added the losses and failures of the first few years, from deaths and imperfect development of many trees, the fluctuations of the markets, the cost of re-planting, and so forth. These risks attach, however, to all things mundane, and are by no means peculiar to forestry.

INDEX.

- A**IR, 72
Alder, 113
Ash, 113
Auction, 90, 93
Austrian pine, 25
- B**ARK, allowance for, 101
Batters, 37
Beech, 25, 113
Bog, drainage of, 35
Book, measurer's, 104
Boys, 52
- C**ALCAREOUS soils, 19
Clays, 18
Contract, 13
Corsican pine, 25
Cost of auction, 95
initial, 62
of planting, 118
- D**AMPING off, 68
Distances, 47, 55, 74
Distribution, 55, 59
Drainage, 27
correct fall, 34
cost of forest, 38
depth of, 34
direction of main, 34
minors, 36
distance between, 35
length of drains, 34
point of discharge in, 33
slope of sides, 37
sub-mains, 36
what does it do? 27
Drain pipes, 28
stone pipes, 28
- E**FFECTS of drainage, 27
planting, 9
- F**ALL in drainage, 34
Fire-lines, 112
Forest, definition of, 22
Forester, 11
certificate of, 15
choice of, 11
grades of, 13
- G**EOLGY, 16
structural, 16
surface, 17
Girths and lengths, 105
Ground game, 63
- H**ARDWOODS, 58
distances of, 58
Holes, cost of, 49
methods of digging, 48
on hillsides, 49
size of, 48
Hop poles, 57, 109
Hornbeam, 113
- I**NVESTMENT, 69
examples of, 120
- L**ARCH, bark, 111
measurement of, 101
pruning of, 79
Laying out for planting, 22
Leaf canopy, 60
Lengths and girths, 105
Levelling, 33
Loams, 18
Lotting of timber, 91-93

- M**APLE, 25, 113
 Marking of timber, 89
 Marls, 19
 Maturity of trees, 77
 Measurement, 87, 99
 of larch, 101
 of ornamental trees, 106
 rules of, 102
- N**ATURE, study of, 61
 Netting, 64
 Notch-planting, 44
 Nursery, 12, 43
- O**AK, cutting back of, 81
 felling in winter, 107
 Objects of planting, 5, 7
 Ornamental trees, 50
 definition of, 106
 planting, 49
- P**ERIOD of thinning, 71
 Pinaster, pinus, 25
 Pit-planting, 47
 Plane, 113
 Plantation, definition of, 22
 form of, 24
 Planting, 26
 attention after, 68
 care in, 41
 conifers, 53
 cost of, 115
 distances in, 47
 large trees, 54
 for ornament, 26
 for shelter, 26
 purchased trees, 53
 right and wrong methods, 52
 Poplar, 113
 Private sale, 91, 96
 Pruning, 79
 maxims, 84
 methods of, 83
- Q**UARTER girth measure-
 ment, 101
- R**EALISATION, 85
 Roads, 25
 Rule to find rods in drainage, 38
 Rule of measurement, 102
- S**ALE, methods of, 89
 Saleable contents, 100
 Scenic effect, 78
 Seasons, planting, 41
 Selection of trees, 31
 Selling of timber, 89
 Settled Land Act, 116
 Shelter, 57
 Site, 20
 Sliding scale, 102, 105
 Soils, 16, 18, 28
 Springs, 36
 Stag-horn top, 82
 Strap for taking girth, 103
 Sycamore, 25, 113
- T**ARRING of trees, 65
 Tellers, 104
 Tender, sales by, 90, 97
 Thinning, 55, 71
 period of, 71
 true principle of, 73
 Timber, commercial, 9, 23
 definition of, 100
 Trees, distribution of, 55
 Trenching, 50
- V**ALUATION of timber, 87,
 108
 Value of land, 8, 9
 thinnings, 75, 109, 121
 Views, 25
 Vistas, 25
- W**ALNUT, and fire-lines, 113
 Weight of timber, 103, 111
 Woodlands, neglect of, 12
 Woods, definition of, 22

WORKS ON AGRICULTURE & FARMING

PUBLISHED BY

CROSBY LOCKWOOD & SON,
7 STATIONERS' HALL COURT, LONDON, E.C.

THE COMPLETE GRAZIER AND FARMER'S AND CATTLE BREEDER'S ASSISTANT: A Compendium of Husbandry. Originally written by WILLIAM YOUATT. Thirteenth Edition, entirely Re-written, considerably Enlarged, and brought up to the Present Requirements of Agricultural Practice, by WILLIAM FREAM, LL.D., Steven Lecturer in the University of Edinburgh, Author of "The Elements of Agriculture," &c. Royal 8vo, 1,100 pp., with 450 Illustrations. Price £1. 11s. 6d., strongly and handsomely bound.

EXTRACT FROM PUBLISHERS' ADVERTISEMENT.

"A treatise that made its original appearance in the first decade of the century, and that enters upon its thirteenth edition before the century has run its course, has undoubtedly established its position as a work of permanent value. . . . The phenomenal progress of the last dozen years in the Practice and Science of Farming has rendered it necessary, however, that the volume should be re-written, . . . and for this undertaking the Publishers were fortunate enough to secure the services of Dr FREAM, whose high attainments in all matters pertaining to agriculture have been so emphatically recognised by the highest professional and official authorities. In carrying out his editorial duties, Dr FREAM has been favoured with valuable contributions by Prof. J. WORTLEY AXE, Mr E. BROWN, Dr BERNARD DYER, Mr W. J. MALDEN, Mr R. H. REW, Prof. SHELDON, Mr J. SINCLAIR, Mr SANDERS SPENCER, and others.

"As regards the illustrations of the work, no pains have been spared to make them as representative and characteristic as possible, so as to be practically useful to the Farmer and Grazier."

SUMMARY OF CONTENTS.

BOOK I. ON THE VARIETIES, BREEDING, REARING, FATTENING, AND MANAGEMENT OF CATTLE.
BOOK II. ON THE ECONOMY AND MANAGEMENT OF THE DAIRY.
BOOK III. ON THE BREEDING, REARING, AND MANAGEMENT OF HORSES.
BOOK IV. ON THE BREEDING, REARING, AND FATTENING OF SHEEP.
BOOK V. ON THE BREEDING, REARING, AND FATTENING OF SWINE.
BOOK VI. ON THE DISEASES OF LIVE STOCK.

BOOK VII. ON THE BREEDING, REARING, AND MANAGEMENT OF POULTRY.
BOOK VIII. ON FARM OFFICES AND IMPLEMENTS OF HUSBANDRY.
BOOK IX. ON THE CULTURE AND MANAGEMENT OF GRASS LANDS.
BOOK X. ON THE CULTIVATION AND APPLICATION OF GRASSES, PULSE, AND ROOTS.
BOOK XI. ON MANURES AND THEIR APPLICATION TO GRASS LAND AND CROPS.
BOOK XII. MONTHLY CALENDARS OF FARMWORK.

* OPINIONS OF THE PRESS ON THE NEW EDITION.

"Dr Fream is to be congratulated on the successful attempt he has made to give us a work which will at once become the standard classic of the farm practice of the country. We believe that it will be found that it has no compeer among the many works at present in existence. . . . The illustrations are admirable, while the frontispiece, which represents the well-known bull, New Year's Gift, bred by the Queen, is a work of art."—*The Times*.

"The most comprehensive guide to modern farm practice that exists in the English language to-day. . . . The book is one that ought to be on every farm and in the library of every landowner."—*Mark Lane Express*.

"In point of exhaustiveness and accuracy the work will certainly hold a pre-eminent and unique position among books dealing with scientific agricultural practice. It is, in fact, an agricultural library of itself."—*North British Agriculturist*.

"The best and brightest guide to the practice of husbandry: one that has no superior—no equal we might truly say—among the agricultural literature now before the public. . . . In every section in which we have tested it, the work has been found thoroughly up to date."—*Bell's Weekly Messenger*.

FARM LIVE STOCK OF GREAT BRITAIN.

By ROBERT WALLACE, F.L.S., F.R.S.E., &c., Professor of Agriculture and Rural Economy in the University of Edinburgh. Third Edition, thoroughly Revised and considerably Enlarged. With over 120 Phototypes of Prize Stock. Demy 8vo, 384 pp., with 79 Plates and Maps. Price 12s. 6d., cloth.

"A really complete work on the history, breeds, and management of the farm stock of Great Britain, and one which is likely to find its way to the shelves of every country gentleman's library."—*The Times*.

"The book is very attractive, and we can scarcely imagine the existence of a farmer who would not like to have a copy."—*Mark Lane Express*.

"A work which will long be regarded as a standard authority whenever a concise history and description of the breeds of live stock in the British Isles is required."—*Bell's Weekly Messenger*.

BRITISH DAIRYING: A Handy Volume on the Work of the Dairy-Farm. For the Use of Technical Instruction Classes, Students in Agricultural Colleges, and the Working Dairy-Farmer. By Prof. J. P. SHELDON. With Illustrations. Second Edition, Revised. Crown 8vo, 2s. 6d., cloth. [Just Published.]

"Probably the best half-crown manual on dairy work that has yet been produced."—*North British Agriculturist*.

"It is the soundest little work we have yet seen on the subject."—*The Times*.

MILK, CHEESE, AND BUTTER: A Practical Handbook on their Properties and the Processes of their Production. Including a Chapter on Cream and the Methods of its Separation from Milk. By JOHN OLIVER, late Principal of the Western Dairy Institute, Berkeley. With Coloured Plates and 200 Illustrations. Crown 8vo, 7s. 6d., cloth.

"An exhaustive and masterly production. It may be cordially recommended to all students and practitioners of dairy science."—*N. B. Agriculturist*.

"We recommend this very comprehensive and carefully written book to dairy farmers and students of dairying. It is a distinct acquisition to the library of the agriculturist."—*Agricultural Gazette*.

NOTE-BOOK OF AGRICULTURAL FACTS AND FIGURES FOR FARMERS AND FARM STUDENTS. By PRIMROSE MCCONNELL, B.Sc. Fifth Edition. Royal 32mo, roan, gilt edges, with band, 4s.

"Literally teems with information, and we can cordially recommend it to all connected with agriculture."—*North British Agriculturist*.

FARM ENGINEERING, THE COMPLETE TEXT-BOOK OF. Comprising Draining and Embanking; Irrigation and Water Supply; Farm Roads, Fences, and Gates; Farm Buildings; Barn Implements and Machines; Field Implements and Machines; Agricultural Surveying, &c. By Professor JOHN SCOTT. In one vol., 1,150 pp., half-bound, with over 600 Illustrations, 12s.

"Written with great care, as well as with knowledge and ability. The author has done his work well; we have found him a very trustworthy guide wherever we have tested his statements. The volume will be of great value to agricultural students."—*Mark Lane Express*.

THE FIELDS OF GREAT BRITAIN: A Text-Book of Agriculture. Adapted to the Syllabus of the Science and Art Department. For Elementary and Advanced Students. By HUGH CLEMENTS (Board of Trade). Second Edition, Revised, with Additions. 18mo, 2s. 6d., cloth.

"It is a long time since we have seen a book which has pleased us more, or which contains such a vast and useful fund of knowledge."—*Educational Times*.

SYSTEMATIC SMALL FARMING; or, The Lessons of my Farm. Being an Introduction to Modern Farm Practice for Small Farmers. By R. SCOTT BURN, Author of "Outlines of Modern Farming," &c. Crown 8vo, 6s., cloth.

"This is the completest book of its class we have seen, and one which every amateur farmer will read with pleasure, and accept as a guide."—*Field*.

OUTLINES OF MODERN FARMING: By R. SCOTT BURN. Soils, Manures, and Crops—Farming and Farming Economy—Cattle, Sheep, and Horses—Management of Dairy, Pigs, and Poultry—Utilization of Town-Sewage, Irrigation, &c. Sixth Edition. In one vol., 1,250 pp., half-bound, profusely Illustrated, 12s.

TABLES AND MEMORANDA FOR FARMERS, GRAZIERS, Agricultural Students, Surveyors, Land Agents, Auctioneers, &c. With a New System of Farm Book-keeping. By SIDNEY FRANCIS. Third Edition, Revised. 272 pp., waistcoat-pocket size, limp leather, 1s. 6d.

"Weighing less than 1 oz., and occupying no more space than a match box, it contains a mass of facts and calculations which has never before, in such handy form, been obtainable. Every operation on the farm is dealt with. The work may be taken as thoroughly accurate, the whole of the tables having been revised by Dr Fream."—*Bell's Weekly Messenger*.

FERTILISERS AND FEEDING STUFFS: Their Properties and Uses. A Handbook for the Practical Farmer. By BERNARD DYER, D.Sc. (Lond.). With Text of the Fertilisers and Feeding Stuffs Act of 1893, &c. Second Edition, Revised. Crown 8vo, 1s., cloth.

[Just Published.

BEEES FOR PLEASURE AND PROFIT: Guide to the Manipulation of Bees, the Production of Honey, and the General Management of the Apiary. By G. GORDON SAMSON. With numerous Illustrations. Crown 8vo, 1s., cloth.

BOOK-KEEPING FOR FARMERS AND ESTATE OWNERS. A Practical Treatise, presenting, in Three Plans, a System adapted for all classes of Farms. By JOHNSON M. WOODMAN, Chartered Accountant. Second Edition, Revised. Crown 8vo, 3s. 6d., cloth boards; or, 2s. 6d., cloth limp.

"The volume is a capital study of a most important subject."—*Agricultural Gazette*.

"Farmers and land agents will find the book more than repay its cost and study."—*Building News*.

WOODMAN'S YEARLY FARM ACCOUNT BOOK. Giving Weekly Labour Account and Diary, and showing the Income and Expenditure under each Department of Crops, Live Stock, Dairy, &c. &c. With Valuation, Profit and Loss Account, and Balance-Sheet at the end of the Year. By JOHNSON M. WOODMAN, Chartered Accountant. Second Edition. Folio, half bound, 7s. 6d. net.

"Contains every requisite form for keeping farm accounts readily and accurately."—*Agriculture*.

MARKET AND KITCHEN GARDENING. By C. W. SHAW, late Editor of "Gardening Illustrated." 3s. 6d., cloth.

"The most valuable compendium of kitchen and market-garden work published."—*Farmer*.

NO MORE LAWYERS' BILLS!

Crown 8vo, price 6s. 8d. (saved at every Consultation!!),
strongly bound in cloth.

EVERY MAN'S OWN LAWYER: A HANDY BOOK

OF THE

PRINCIPLES OF LAW AND EQUITY

BY A BARRISTER.

Thirty-fourth Edition, carefully Revised, including the Legislation of 1896.

SUMMARY OF CONTENTS.

I. ADMINISTRATION OF THE LAW.	IX. HOUSES AND LANDS.
II. CRIMINAL LAW.	X. MARRIAGE, HUSBAND AND WIFE, AND CHILDREN.
III. PERSONAL RIGHTS AND RE- MEDIES.	XI. WILLS, EXECUTORS AND AD- MINISTRATORS, AND TRUS- TEES.
IV. GAME LAWS AND SPORTING.	XII. PUBLIC HEALTH AND GOOD ORDER.
V. MERCANTILE AND COMMER- CIAL LAW.	XIII. PARLIAMENTARY ELECTIONS.
VI. COPYRIGHT, PATENTS, AND TRADE MARKS.	XIV. LOCAL GOVERNMENT.
VII. LIBEL AND SLANDER.	XV. CHURCH AND CLERGY.
VIII. MASTERS, SERVANTS, AND WORKMEN.	XVI. TAXES, EXCISE LICENCES, AND DEATH DUTIES.

FORMS OF WILLS, AGREEMENTS, NOTICES, &c.

TO WHICH IS ADDED

A Concise Dictionary of Legal Terms.

OPINIONS OF THE PRESS.

“No Englishman ought to be without this book.”—*Engineer*.

“It is a complete code of English law written in plain language, which all can understand. Should be in the hands of every business man, and all who wish to abolish lawyers' bills.”—*Weekly Times*.

“Thoroughly intelligible to non-professional readers.”—*Bell's Life*.

“This excellent handbook. . . Admirably done, admirably arranged, and admirably cheap.”—*Leeds Mercury*.

“A concise, cheap, and complete epitome of the law. So plainly written that he who runs may read, and he who reads may understand.”—*Figaro*.

CROSBY LOCKWOOD & SON, 7 Stationers' Hall Court, London, E.C.
And may be had of all Booksellers.

CROSBY LOCKWOOD & SON'S

Catalogue of

Scientific, Technical and Industrial Books.

	PAGE		PAGE
MECHANICAL ENGINEERING	1	DECORATIVE ARTS	30
CIVIL ENGINEERING	9	NATURAL SCIENCE	32
MARINE ENGINEERING, &c.	17	CHEMICAL MANUFACTURES	34
MINING & METALLURGY	19	INDUSTRIAL ARTS	36
ELECTRICITY	23	COMMERCE, TABLES, &c.	41
ARCHITECTURE & BUILDING	25	AGRICULTURE & GARDENING	43
CARPENTRY & TIMBER	28	AUCTIONEERING, VALUING, &c.	46
LAW & MISCELLANEOUS			47

MECHANICAL ENGINEERING, &c.

THE MECHANICAL ENGINEER'S POCKET-BOOK.

Comprising Tables, Formulæ, Rules, and Data: A Handy Book of Reference for Daily Use in Engineering Practice. By D. KINNEAR CLARK, M. Inst. C.E., Third Edition, Revised. Small 8vo, 700 pp., bound in flexible Leather Cover, rounded corners. **6/0**

SUMMARY OF CONTENTS:—MATHEMATICAL TABLES.—MEASUREMENT OF SURFACES AND SOLIDS.—ENGLISH AND FOREIGN WEIGHTS AND MEASURES.—MONEYS.—SPECIFIC GRAVITY, WEIGHT, AND VOLUME.—MANUFACTURED METALS.—STEEL PIPES.—BOLTS AND NUTS.—SUNDRY ARTICLES IN WROUGHT AND CAST IRON, COPPER, BRASS, LEAD, TIN, ZINC.—STRENGTH OF TIMBER.—STRENGTH OF CAST IRON.—STRENGTH OF WROUGHT IRON.—STRENGTH OF STEEL.—TENSILE STRENGTH OF COPPER, LEAD, &c.—RESISTANCE OF STONES AND OTHER BUILDING MATERIALS.—RIVETED JOINTS IN BOILER PLATES.—BOILER SHELLS.—WIRE ROPES AND HEMP ROPES.—CHAINS AND CHAIN CABLES.—FRAMING.—HARDNESS OF METALS, ALLOYS, AND STONES.—LABOUR OF ANIMALS.—MECHANICAL PRINCIPLES.—GRAVITY AND FALL OF BODIES.—ACCELERATING AND RETARDING FORCES.—MILL GEARING, SHAFTING, &c.—TRANSMISSION OF MOTIVE POWER.—HEAT.—COMBUSTION: FUELS.—WARMING, VENTILATION, COOKING STOVES.—STEAM.—STEAM ENGINES AND BOILERS.—RAILWAYS.—TRAMWAYS.—STEAM SHIPS.—PUMPING STEAM ENGINES AND PUMPS.—COAL GAS, GAS ENGINES, &c.—AIR IN MOTION.—COMPRESSED AIR.—HOT AIR ENGINES.—WATER POWER.—SPEED OF CUTTING TOOLS.—COLOURS.—ELECTRICAL ENGINEERING.

"Mr. Clark manifests what is an innate perception of what is likely to be useful in a pocket-book, and he is really unrivalled in the art of condensation. It is very difficult to hit upon any mechanical engineering subject concerning which this work supplies no information, and the excellent index at the end adds to its utility. In one word, it is an exceedingly handy and efficient tool, possessed of which the engineer will be saved many a wearisome calculation, or yet more wearisome hunt through various text-books and treatises, and, as such, we can heartily recommend it to our readers."—*The Engineer*.


"It would be found difficult to compress more matter within a similar compass, or produce a book of 650 pages which should be more compact or convenient for pocket reference. . . Will be appreciated by mechanical engineers of all classes."—*Practical Engineer*.

MR. HUTTON'S PRACTICAL HANDBOOKS.

THE WORKS' MANAGER'S HANDBOOK.

Comprising Modern Rules, Tables, and Data. For Engineers, Millwrights, and Boiler Makers; Tool Makers, Machinists, and Metal Workers; Iron and Brass Founders, &c. By W. S. HUTTON, Civil and Mechanical Engineer, Author of "The Practical Engineer's Handbook." Fifth Edition, carefully Revised, with Additions. In One handsome Volume, medium 8vo, strongly bound

15/0

 *The Author having compiled Rules and Data for his own use in a great variety of modern engineering work, and having found his notes extremely useful, decided to publish them—revised to date—believing that a practical work, suited to the DAILY REQUIREMENTS OF MODERN ENGINEERS, would be favourably received.*

"Of this edition we may repeat the appreciative remarks we made upon the first and third. Since the appearance of the latter very considerable modifications have been made, although the total number of pages remains almost the same. It is a very useful collection of rules, tables, and workshop and drawing office data."—*The Engineer*, May 10, 1895.

"The author treats every subject from the point of view of one who has collected workshop notes for application in workshop practice, rather than from the theoretical or literary aspect. The volume contains a great deal of that kind of information which is gained only by practical experience, and is seldom written in books."—*The Engineer*, June 5, 1885.

"The volume is an exceedingly useful one, brimful with engineer's notes, memoranda, and rules, and well worthy of being on every mechanical engineer's bookshelf."—*Mechanical World*.


"The information is precisely that likely to be required in practice. . . . The work forms a desirable addition to the library not only of the works' manager, but of any one connected with general engineering."—*Mining Journal*.

"Brimful of useful information, stated in a concise form, Mr. Hutton's books have met a pressing want among engineers. The book must prove extremely useful to every practical man possessing a copy."—*Practical Engineer*.

THE PRACTICAL ENGINEER'S HANDBOOK.

Comprising a Treatise on Modern Engines and Boilers, Marine, Locomotive, and Stationary. And containing a large collection of Rules and Practical Data relating to Recent Practice in Designing and Constructing all kinds of Engines, Boilers, and other Engineering work. The whole constituting a comprehensive Key to the Board of Trade and other Examinations for Certificates of Competency in Modern Mechanical Engineering. By WALTER S. HUTTON, Civil and Mechanical Engineer, Author of "The Works' Manager's Handbook for Engineers," &c. With upwards of 370 Illustrations. Fifth Edition, Revised with Additions. Medium 8vo, nearly 500 pp., strongly bound.

[Just Published. 18/0

 *This Work is designed as a companion to the Author's "WORKS' MANAGER'S HANDBOOK." It possesses many new and original features, and contains, like its predecessor, a quantity of matter not originally intended for publication, but collected by the Author for his own use in the construction of a great variety of MODERN ENGINEERING WORK.*

The information is given in a condensed and concise form, and is illustrated by upwards of 370 Woodcuts; and comprises a quantity of tabulated matter of great value to all engaged in designing, constructing, or estimating for ENGINES, BOILERS, and OTHER ENGINEERING WORK.

"We have kept it at hand for several weeks, referring to it as occasion arose, and we have not on a single occasion consulted its pages without finding the information of which we were in quest."—*Athenæum*.

"A thoroughly good practical handbook, which no engineer can go through without learning something that will be of service to him."—*Marine Engineer*.

"An excellent book of reference for engineers, and a valuable text-book for students of engineering."—*Scotsman*.

"This valuable manual embodies the results and experience of the leading authorities on mechanical engineering."—*Building News*.

"The author has collected together a surprising quantity of rules and practical data, and has shown much judgment in the selections he has made. . . . There is no doubt that this book is one of the most useful of its kind published, and will be a very popular compendium."—*Engineer*.

"A mass of information set down in simple language, and in such a form that it can be easily referred to at any time. The matter is uniformly good and well chosen, and is greatly elucidated by the illustrations. The book will find its way on to most engineers' shelves, where it will rank as one of the most useful books of reference."—*Practical Engineer*.

"Full of useful information, and should be found on the office shelf of all practical engineers."—*English Mechanic*.

MR. HUTTON'S PRACTICAL HANDBOOKS—continued.

STEAM BOILER CONSTRUCTION.

A Practical Handbook for Engineers, Boiler-Makers, and Steam Users. Containing a large Collection of Rules and Data relating to Recent Practice in the Design, Construction, and Working of all Kinds of Stationary, Locomotive, and Marine Steam-Boilers. By WALTER S. HUTTON, Civil and Mechanical Engineer, Author of "The Works' Manager's Handbook," "The Practical Engineer's Handbook," &c. With upwards of 300 Illustrations. Second Edition, medium 8vo, cloth **18/0**

THIS WORK is issued in continuation of the Series of Handbooks written by the Author, viz. :—"THE WORKS MANAGER'S HANDBOOK" and "THE PRACTICAL ENGINEER'S HANDBOOK," which are so highly appreciated by engineers for the practical nature of their information; and is consequently written in the same style as those works.

The Author believes that the concentration, in a convenient form for easy reference, of such a large amount of thoroughly practical information on Steam-Boilers, will be of considerable service to those for whom it is intended, and he trusts the book may be deemed worthy of as favourable a reception as has been accorded to its predecessors.

"Every detail, both in boiler design and management, is clearly laid before the reader. The volume shows that boiler construction has been reduced to the condition of one of the most exact sciences; and such a book is of the utmost value to the *fin de siècle* Engineer and Works Manager."—*Marine Engineer*.

"There has long been room for a modern handbook on steam boilers; there is not that room now, because Mr. Hutton has filled it. It is a thoroughly practical book for those who are occupied in the construction, design, selection, or use of boilers."—*Engineer*.

"The book is of so important and comprehensive a character that it must find its way into the libraries of every one interested in boiler using or boiler manufacture if they wish to be thoroughly informed. We strongly recommend the book for the intrinsic value of its contents."—*Machinery Market*.

"The value of this book can hardly be over-estimated. The author's rules, formulæ, &c., are all very fresh, and it is impossible to turn to the work and not find what you want. No practical engineer should be without it."—*Colliery Guardian*.

PRACTICAL MECHANICS' WORKSHOP COMPANION.

Comprising a great variety of the most useful Rules and Formulæ in Mechanical Science, with numerous Tables of Practical Data and Calculated Results for Facilitating Mechanical Operations. By WILLIAM TEMPLETON, Author of "The Engineer's Practical Assistant," &c., &c. Seventeenth Edition, Revised, Modernised, and considerably Enlarged by WALTER S. HUTTON, C.E., Author of "The Works' Manager's Handbook," "The Practical Engineer's Handbook," &c. Fcap. 8vo, nearly 500 pp., with 8 Plates and upwards of 250 Illustrative Diagrams, strongly bound for workshop or pocket wear and tear. **6/0**

"In its modernised form Hutton's 'Templeton' should have a wide sale, for it contains much valuable information which the mechanic will often find of use, and not a few tables and notes which he might look for in vain in other works. This modernised edition will be appreciated by all who have learned to value the original editions of 'Templeton.'"—*English Mechanic*.

"It has met with great success in the engineering workshop, as we can testify; and there are a great many men who, in a great measure, owe their rise in life to this little book."—*Building News*.

"This familiar text-book—well known to all mechanics and engineers—is of essential service to the every-day requirements of engineers, millwrights, and the various trades connected with engineering and building. The new modernised edition is worth its weight in gold."—*Building News*. (Second Notice.)

"This well-known and largely-used book contains information, brought up to date, of the sort so useful to the foreman and draughtsman. So much fresh information has been introduced as to constitute it practically a new book. It will be largely used in the office and workshop."—*Mechanical World*.

"The publishers wisely entrusted the task of revision of this popular, valuable, and useful book to Mr. Hutton, than whom a more competent man they could not have found."—*Iron*.

ENGINEER'S AND MILLWRIGHT'S ASSISTANT.

A Collection of Useful Tables, Rules, and Data. By WILLIAM TEMPLETON. Seventh Edition, with Additions. 18mo, cloth **2/6**

"Occupies a foremost place among books of this kind. A more suitable present to an apprentice to any of the mechanical trades could not possibly be made."—*Building News*.

"A deservedly popular work. It should be in the 'drawer' of every mechanic."—*English Mechanic*.

THE MECHANICAL ENGINEER'S REFERENCE BOOK.

For Machine and Boiler Construction. In Two Parts. Part I. GENERAL ENGINEERING DATA. Part II. BOILER CONSTRUCTION. With 51 Plates and numerous Illustrations. By NELSON FOLEY, M.I.N.A. Second Edition, Revised throughout and much Enlarged. Folio, half-bound, net **£3 3s**

SUMMARY OF CONTENTS.

PART I.

MEASURES.—CIRCUMFERENCES AND AREAS, &c., SQUARES, CUBES, FOURTH POWERS.—SQUARE AND CUBE ROOTS.—SURFACE OF TUBES.—RECIPROCALLS.—LOGARITHMS.—MENSURATION.—SPECIFIC GRAVITIES AND WEIGHTS.—WORK AND POWER.—HEAT.—COMBUSTION.—EXPANSION AND CONTRACTION.—EXPANSION OF GASES.—STEAM.—STATIC FORCES.—GRAVITATION AND ATTRACTION.—MOTION AND COMPUTATION OF RESULTING FORCES.—ACCUMULATED WORK.—CENTRE AND RADIUS OF GYRATION.—MOMENT OF INERTIA.—CENTRE OF OSCILLATION.—ELECTRICITY.—STRENGTH OF MATERIALS.—ELASTICITY.—TEST SHEETS OF METALS.—FRICTION.—TRANSMISSION OF POWER.—FLOW OF LIQUIDS.—FLOW OF GASES.—AIR PUMPS, SURFACE CONDENSERS, &c.—SPEED OF STEAMSHIPS.—PROPELLERS.—CUTTING TOOLS.—FLANGES.—COPPER SHEETS AND TUBES.—SCREWS, NUTS, BOLT HEADS, &c.—VARIOUS RECIPES AND MISCELLANEOUS MATTER.—WITH DIAGRAMS FOR VALVE-GEAR, BELTING AND ROPES, DISCHARGE AND SUCTION PIPES, SCREW PROPELLERS, AND COPPER PIPES.

PART II.

TREATING OF POWER OF BOILERS.—USEFUL RATIOS.—NOTES ON CONSTRUCTION.—CYLINDRICAL BOILER SHELLS.—CIRCULAR FURNACES.—FLAT PLATES.—STAYS.—GIRDERS.—SCREWS.—HYDRAULIC TESTS.—RIVETING.—BOILER SETTING, CHIMNEYS, AND MOUNTINGS.—FUELS, &c.—EXAMPLES OF BOILERS AND SPEEDS OF STEAMSHIPS.—NOMINAL AND NORMAL HORSE POWER.—WITH DIAGRAMS FOR ALL BOILER CALCULATIONS AND DRAWINGS OF MANY VARIETIES OF BOILERS.

"The book is one which every mechanical engineer may, with advantage to himself, add to his library."—*Industries*.

"Mr. Foley is well fitted to compile such a work. . . . The diagrams are a great feature of the work. . . . Regarding the whole work, it may be very fairly stated that Mr. Foley has produced a volume which will undoubtedly fulfil the desire of the author and become indispensable to all mechanical engineers."—*Marine Engineer*.

"We have carefully examined this work, and pronounce it a most excellent reference book for the use of marine engineers."—*Journal of American Society of Naval Engineers*.

"A veritable monument of industry on the part of Mr. Foley, who has succeeded in producing what is simply invaluable to the engineering profession."—*Steamship*.

COAL AND SPEED TABLES.

A Pocket Book for Engineers and Steam Users. By NELSON FOLEY, Author of "The Mechanical Engineer's Reference Book." Pocket-size, cloth **3/6**

"These tables are designed to meet the requirements of every-day use; they are of sufficient scope for most practical purposes, and may be commended to engineers and users of steam."—*Iron*.

"This pocket-book well merits the attention of the practical engineer. Mr. Foley has compiled a very useful set of tables, the information contained in which is frequently required by engineers, coal consumers, and users of steam."—*Iron and Coal Trades Review*.

TEXT-BOOK ON THE STEAM ENGINE.

With a Supplement on GAS ENGINES, and PART II. on HEAT ENGINES. By T. M. GOODEVE, M.A., Barrister-at-Law, Professor of Mechanics at the Royal College of Science, London; Author of "The Principles of Mechanics," "The Elements of Mechanism," &c. Fourteenth Edition. Crown 8vo, cloth **6/0**

"Professor Goodeve has given us a treatise on the steam engine which will bear comparison with anything written by Huxley or Maxwell, and we can award it no higher praise."—*Engineer*.

"Mr. Goodeve's text-book is a work of which every young engineer should possess himself."—*Mining Journal*.

ON GAS ENGINES.

With Appendix describing a Recent Engine with Tube Igniter. By T. M. GOODEVE, M.A. Crown 8vo, cloth **2/6**

"Like all Mr. Goodeve's writings, the present is no exception in point of general excellence. It is a valuable little volume."—*Mechanical World*.

A TREATISE ON STEAM BOILERS.

Their Strength, Construction, and Economical Working. By R. WILSON, C.E. Fifth Edition. 12mo, cloth **6/0**

"The best treatise that has ever been published on steam boilers."—*Engineer*.

"The author shows himself perfect master of his subject, and we heartily recommend all employing steam power to possess themselves of the work."—*Ryland's Iron Trade Circular*.

A HANDBOOK ON THE STEAM ENGINE.

With especial Reference to Small and Medium-sized Engines. For the Use of Engine Makers, Mechanical Draughtsmen, Engineering Students, and users of Steam Power. By HERMAN HAEDER, C.E. Translated from the German with considerable additions and alterations, by H. H. P. POWLES, A.M.I.C.E., M.I.M.E. Second Edition, Revised. With nearly 1,100 Illustrations. Crown 8vo, cloth **9/0**

"A perfect encyclopædia of the steam engine and its details, and one which must take a permanent place in English drawing-offices and workshops."—*A Foreman Pattern-maker*.

"This is an excellent book, and should be in the hands of all who are interested in the construction and design of medium-sized stationary engines. . . . A careful study of its contents and the arrangement of the sections leads to the conclusion that there is probably no other book like it in this country. The volume aims at showing the results of practical experience, and it certainly may claim a complete achievement of this idea."—*Nature*.

"There can be no question as to its value. We cordially commend it to all concerned in the design and construction of the steam engine."—*Mechanical World*.

BOILER AND FACTORY CHIMNEYS.

Their Draught-Power and Stability. With a chapter on *Lightning Conductors*. By ROBERT WILSON, A.I.C.E., Author of "A Treatise on Steam Boilers," &c. Crown 8vo, cloth **3/6**

"A valuable contribution to the literature of scientific building."—*The Builder*.

BOILER MAKER'S READY RECKONER & ASSISTANT.

With Examples of Practical Geometry and Templating, for the Use of Platers, Smiths, and Riveters. By JOHN COURTNEY, Edited by D. K. CLARK, M.I.C.E. Third Edition, 480 pp., with 140 Illustrations. Fcap. 8vo **7/0**

"No workman or apprentice should be without this book."—*Iron Trade Circular*.

REFRIGERATING & ICE-MAKING MACHINERY.

A Descriptive Treatise for the Use of Persons Employing Refrigerating and Ice-Making Installations, and others. By A. J. WALLIS-TAVLER, A.-M. Inst. C.E. With Illustrations. Crown 8vo, cloth. [Just Published. **7/6**

"Practical, explicit, and profusely illustrated."—*Glasgow Herald*.

"We recommend the book, which gives the cost of various systems and illustrations showing details of parts of machinery and general arrangements of complete installations."—*Builder*.

"May be recommended as a useful description of the machinery, the processes, and of the facts, figures, and tabulated physics of refrigerating. It is one of the best compilations on the subject."—*Engineer*.

HYDRAULIC MACHINERY.

A Practical Handbook on the Machinery Employed in the Concentration and Transmission of Power. By G. CROYDON MARKS, A.M.I.C.E., A.M.I.M.E. New Edition, Enlarged. Crown 8vo. [In the Press.

THE LOCOMOTIVE ENGINE AND ITS DEVELOPMENT.

A Popular Treatise on the Gradual Improvements made in Railway Engines between 1803 and 1896. By CLEMENT E. STRETTON, C.E. Fifth Edition, Enlarged. With 120 Illustrations. Crown 8vo, cloth. [Just Published. **3/6**

"Students of railway history and all who are interested in the evolution of the modern locomotive will find much to attract and entertain in this volume."—*The Times*.

"The author of this work is well known to the railway world, and no one, probably, has a better knowledge of the history and development of the locomotive. The volume before us should be of value to all connected with the railway system of this country."—*Nature*.

ENGINEERING ESTIMATES, COSTS, AND ACCOUNTS.

A Guide to Commercial Engineering. With numerous examples of Estimates and Costs of Millwright Work, Miscellaneous Productions, Steam Engines and Steam Boilers; and a Section on the Preparation of Costs Accounts. By A GENERAL MANAGER. Second Edition. 8vo, cloth. [Just Published. **12/0**

"This is an excellent and very useful book, covering subject-matter in constant requisition in every factory and workshop. . . . The book is invaluable, not only to the young engineer, but also to the estimate department of every works."—*Builder*.

"We accord the work unqualified praise. The information is given in a plain, straightforward manner, and bears throughout evidence of the intimate practical acquaintance of the author with every phase of commercial engineering."—*Mechanical World*.

PLATING AND BOILER MAKING.

A Practical Handbook for Workshop Operations. By JOSEPH G. HORNER, A.M.I.M.E. ("Foreman Pattern Maker"), Author of "Pattern Making," &c. 380 pp. with 338 Illustrations. Crown 8vo, cloth. [Just Published. 7/6

"The latest production from the pen of this writer is characterised by that evidence of close acquaintance with workshop methods which will render the book exceedingly acceptable to the practical hand. We have no hesitation in commending the work as a serviceable and practical handbook on a subject which has not hitherto received much attention from those qualified to deal with it in a satisfactory manner."—*Mechanical World*.

PATTERN MAKING.

A Practical Treatise, embracing the Main Types of Engineering Construction, and including Gearing, both Hand and Machine-made, Engine Work, Sheaves and Pulleys, Pipes and Columns, Screws, Machine Parts, Pumps and Cocks, the Moulding of Patterns in Loam and Greensand, &c., together with the methods of estimating the weight of Castings; to which is added an Appendix of Tables for Workshop Reference. By JOSEPH G. HORNER, A.M.I.M.E. ("Foreman Pattern Maker"). Second Edition, thoroughly Revised and much Enlarged. With 450 Illustrations. Crown 8vo, cloth 7/6

"A well-written technical guide, evidently written by a man who understands and has practised what he has written about. . . . We cordially recommend it to engineering students, young journeymen, and others desirous of being initiated into the mysteries of pattern-making."—*Builder*.

"More than 400 illustrations help to explain the text, which is, however, always clear and explicit, thus rendering the work an excellent *vade mecum* for the apprentice who desires to become master of his trade."—*English Mechanic*.

MECHANICAL ENGINEERING TERMS

(Lockwood's Dictionary of). Embracing those current in the Drawing Office, Pattern Shop, Foundry, Fitting, Turning, Smiths', and Boiler Shops, &c., &c. Comprising upwards of 6,000 Definitions. Edited by JOSEPH G. HORNER, A.M.I.M.E. ("Foreman Pattern Maker"), Author of "Pattern Making," &c. Second Edition, Revised, with Additions. Crown 8vo, cloth 7/6

"Just the sort of handy dictionary required by the various trades engaged in mechanical engineering. The practical engineering pupil will find the book of great value in his studies, and every foreman engineer and mechanic should have a copy."—*Building News*.

"Not merely a dictionary, but, to a certain extent, also a most valuable guide. It strikes us as a happy idea to combine with a definition of the phrase useful information on the subject of which it treats."—*Machinery Market*.

TOOTHED GEARING.

A Practical Handbook for Offices and Workshops. By JOSEPH HORNER, A.M.I.M.E. ("Foreman Pattern Maker"), Author of "Pattern Making," &c. With 184 Illustrations. Crown 8vo, cloth 6/0

"We must give the book our unqualified praise for its thoroughness of treatment, and we can heartily recommend it to all interested as the most practical book on the subject yet written."—*Mechanical World*.

FIRES, FIRE-ENGINES, & FIRE BRIGADES.

With a History of Fire-Engines, their Construction, Use, and Management; Remarks on Fire-proof Buildings, and the Preservation of Life from Fire; Statistics of the Fire Appliances in English Towns; Foreign Fire Systems; Hints on Fire-Brigades, &c., &c. By CHARLES F. T. YOUNG, C.E. With Illustrations, 544 pp. Demy 8vo, cloth £1 4s.

"To such of our readers as are interested in the subject of fires and fire apparatus, we can most heartily commend this book. It is really the only English work we now have upon the subject."—*Engineering*.

MOTOR CARS FOR COMMON ROADS.

By A. J. WALLIS-TAYLER, Assoc. Memb. Inst. C.E., Author of "Modern Cycles," &c. Including Early and Recent Examples of Steam Road Carriages, Internal Combustion or Explosive Engine Carriages, Electric Motor Carriages, Miscellaneous Motor Cars, Auto-Car Bill, Rules and Regulations, &c. With numerous Illustrations. Crown 8vo, cloth. [Just Published. 4/6

STONE=WORKING MACHINERY.

A Manual dealing with the Rapid and Economical Conversion of Stone. With Hints on the Arrangement and Management of Stone Works. By M. POWIS BALE, M.I.M.E. Second Edition, enlarged. With Illustrations. Crown 8vo, cloth. [Just Published. 9/0

"The book should be in the hands of every mason or student of stonework."—*Colliery Guardian*.

"A capital handbook for all who manipulate stone for building or ornamental purposes."—*Machinery Market*.

PUMPS AND PUMPING.

A Handbook for Pump Users. Being Notes on Selection, Construction, and Management. By M. POWIS BALE, M.I.M.E. Third Edition, Revised. Crown 8vo, cloth. [Just Published. 2/6

"The matter is set forth as concisely as possible. In fact, condensation rather than diffuseness has been the author's aim throughout; yet he does not seem to have omitted anything likely to be of use."—*Journal of Gas Lighting*.

"Thoroughly practical and simply and clearly written."—*Glasgow Herald*

MILLING MACHINES AND PROCESSES.

A Practical Treatise on Shaping Metals by Rotary Cutters. Including Information on Making and Grinding the Cutters. By PAUL N. HASLACK, Author of "Lathe-Work." 352 pp. With upwards of 300 Engravings. Large crown 8vo, cloth 12/6

"A new departure in engineering literature. . . . We can recommend this work to all interested in milling machines; it is what it professes to be—a practical treatise."—*Engineer*.

"A capital and reliable book which will no doubt be of considerable service both to those who are already acquainted with the process as well as to those who contemplate its adoption."—*Industries*.

LATHE=WORK.

A Practical Treatise on the Tools, Appliances, and Processes employed in the Art of Turning. By PAUL N. HASLACK. Fifth Edition. Crown 8vo, cloth 5/0

"Written by a man who knows not only how work ought to be done, but who also knows how to do it, and how to convey his knowledge to others. To all turners this book would be valuable."—*Engineering*.

"We can safely recommend the work to young engineers. To the amateur it will simply be invaluable. To the student it will convey a great deal of useful information."—*Engineer*.

SCREW=THREADS,

And Methods of Producing Them. With numerous Tables and complete Directions for using Screw-Cutting Lathes. By PAUL N. HASLACK, Author of "Lathe-Work," &c. With Seventy-four Illustrations. Fourth Edition, Re-written and Enlarged. Waistcoat-pocket size 1/6

"Full of useful information, hints and practical criticism. Taps, dies, and screwing tools generally are illustrated and their actions described."—*Mechanical World*.

"It is a complete compendium of all the details of the screw-cutting lathe; in fact a *multum-in-parvo* on all the subjects it treats upon."—*Carpenter and Builder*.

TABLES AND MEMORANDA FOR ENGINEERS, MECHANICS, ARCHITECTS, BUILDERS, &c.

Selected and Arranged by FRANCIS SMITH. Sixth Edition, Revised, including ELECTRICAL TABLES, FORMULÆ, and MEMORANDA. Waistcoat-pocket size, limp leather. [Just Published. 1/6

"It would, perhaps, be as difficult to make a small pocket-book selection of notes and formulæ to suit ALL engineers as it would be to make a universal medicine; but Mr. Smith's waistcoat-pocket collection may be looked upon as a successful attempt."—*Engineer*.

"The best example we have ever seen of 270 pages of useful matter packed into the dimensions of a card-case."—*Building News*. "A veritable pocket treasury of knowledge."—*Iron*.

POCKET GLOSSARY OF TECHNICAL TERMS.

English-French, French-English; with Tables suitable for the Architectural, Engineering, Manufacturing, and Nautical Professions. By JOHN JAMES FLETCHER, Engineer and Surveyor. Second Edition, Revised and Enlarged, 200 pp. Waistcoat-pocket size, limp leather 1/6

"It is a very great advantage for readers and correspondents in France and England to have so large a number of the words relating to engineering and manufacturers collected in a lilliputian volume. The little book will be useful both to students and travellers."—*Architect*.

"The glossary of terms is very complete, and many of the Tables are new and well arranged. We cordially commend the book."—*Mechanical World*.

THE ENGINEER'S YEAR BOOK FOR 1897.

Comprising Formulæ, Rules, Tables, Data and Memoranda in Civil, Mechanical Electrical, Marine and Mine Engineering. By H. R. KEMPE, A.M. Inst. C.E., M.I.E.E., Technical Officer of the Engineer-in-Chief's Office, General Post Office, London, Author of "A Handbook of Electrical Testing," "The Electrical Engineer's Pocket-Book," &c. With about 850 Illustrations, specially Engraved for the work. Crown 8vo, 670 pp., leather. [Just Published. 8/0

"Represents an enormous quantity of work, and forms a desirable book of reference."—*The Engineer*.

"The volume is distinctly in advance of most similar publications in this country."—*Engineering*.

"This valuable and well-designed book of reference meets the demands of all descriptions of engineers."—*Saturday Review*.

"Teems with up-to-date information in every branch of engineering and construction."—*Building News*.

"The needs of the engineering profession could hardly be supplied in a more admirable, complete and convenient form. To say that it more than sustains all comparisons is praise of the highest sort, and that may justly be said of it."—*Mining Journal*.

"There is certainly room for the newcomer, which supplies explanations and directions, as well as formulæ and tables. It deserves to become one of the most successful of the technical annuals."—*Architect*.

"Brings together with great skill all the technical information which an engineer has to use day by day. It is in every way admirably equipped, and is sure to prove successful."—*Scotsman*.

"The up-to-dateness of Mr. Kempe's compilation is a quality that will not be lost on the busy people for whom the work is intended."—*Glasgow Herald*.

THE PORTABLE ENGINE.

A Practical Manual on its Construction and Management. For the use of Owners and Users of Steam Engines generally. By WILLIAM DYSON WANSBROUGH. Crown 8vo, cloth 3/6

"This is a work of value to those who use steam machinery. . . . Should be read by every one who has a steam engine, on a farm or elsewhere."—*Mark Lane Express*.

"We cordially commend this work to buyers and owners of steam engines, and to those who have to do with their construction or use."—*Timber Trades Journal*.

"Such a general knowledge of the steam-engine as Mr. Wansbrough furnishes to the reader should be acquired by all intelligent owners and others who use the steam engine."—*Building News*.

"An excellent text-book of this useful form of engine. The 'Hints to Purchasers' contain a good deal of common-sense and practical wisdom."—*English Mechanic*.

IRON AND STEEL.

A Work for the Forge, Foundry, Factory, and Office. Containing ready, useful, and trustworthy Information for Ironmasters and their Stock-takers; Managers of Bar, Rail, Plate, and Sheet Rolling Mills; Iron and Metal Founders; Iron Ship and Bridge Builders; Mechanical, Mining, and Consulting Engineers; Architects, Contractors, Builders, &c. By CHARLES HOARE, Author of "The Slide Rule," &c. Ninth Edition. 32mo, leather 6/0

"For comprehensiveness the book has not its equal."—*Iron*.

"One of the best of the pocket books."—*English Mechanic*.

CONDENSED MECHANICS.

A Selection of Formulæ, Rules, Tables, and Data for the Use of Engineering Students, Science Classes, &c. In accordance with the Requirements of the Science and Art Department. By W. G. CRAWFORD HUGHES, A.M.I.C.E. Crown 8vo, cloth 2/6

"The book is well fitted for those who are either confronted with practical problems in their work, or are preparing for examination and wish to refresh their knowledge by going through their formulæ again."—*Marine Engineer*.

"It is well arranged, and meets the wants of those for whom it is intended."—*Railway News*

THE SAFE USE OF STEAM.

Containing Rules for Unprofessional Steam Users. By an ENGINEER. Seventh Edition. Sewed. 6d.

"If steam-users would but learn this little book by heart, boiler explosions would become sensations by their rarity."—*English Mechanic*.

HEATING BY HOT WATER.

With Information and Suggestions on the best Methods of Heating Public, Private and Horticultural Buildings. By WALTER JONES. Second Edition. With 96 Illustrations, crown 8vo, cloth Net 2/6

"We confidently recommend all interested in heating by hot water to secure a copy of this valuable little treatise."—*The Plumber and Decorator*.

CIVIL ENGINEERING, SURVEYING, &c.

LIGHT RAILWAYS FOR THE UNITED KINGDOM, INDIA, AND THE COLONIES.

A Practical Handbook setting forth the Principles on which Light Railways should be Constructed, Worked, and Financed; and detailing the Cost of Construction, Equipment, Revenue and Working Expenses of Local Railways already established in the above-mentioned countries, and in Belgium, France, Switzerland, &c. By J. C. MACKAY, F.G.S., A.M. Inst. C.E. Illustrated with Plates and Diagrams. Medium 8vo, cloth. [Just Published. 15/0

"Mr. Mackay's volume is clearly and concisely written, admirably arranged, and freely illustrated. The book is exactly what has been long wanted. We recommend it to all interested in the subject. It is sure to have a wide sale."—*Railway News*.

"Those who desire to have within reach general information concerning almost all the light railway systems in the world will do well to buy Mr. Mackay's book."—*Engineer*.

"This work appears very opportunely, when the extension of the system on a large scale to England is at last being mooted. In its pages we find all the information that the heart of man can desire on the subject. . . . every detail in its story, founded on the experience of other countries and applied to the possibilities of England, is put before us."—*Spectator*.

PRACTICAL TUNNELLING.

Explaining in detail Setting-out the Works, Shaft-sinking, and Heading-driving, Ranging the Lines and Levelling underground, Sub-Excavating, Timbering and the Construction of the Brickwork of Tunnels, with the amount of Labour required for, and the Cost of, the various portions of the work. By FREDERICK W. SIMMS, M. Inst. C.E. Fourth Edition, Revised and Further Extended, including the most recent (1895) Examples of Sub-aqueous and other Tunnels, by D. KINNEAR CLARK, M. Inst. C.E. Imperial 8vo, with 34 Folding Plates and other Illustrations. Cloth. [Just Published. £2 2s.

"The present (1896) edition has been brought right up to date, and is thus rendered a work to which civil engineers generally should have ready access, and to which engineers who have construction work can hardly afford to be without, but which to the younger members of the profession is invaluable, as from its pages they can learn the state to which the science of tunnelling has attained."—*Railway News*.

"The estimation in which Mr. Simms's book on tunnelling has been held for many years cannot be more truly expressed than in the words of the late Prof. Rankine: 'The best source of information on the subject of tunnels is Mr. F. W. Simms's work on Practical Tunnelling.'"—*Architect*.

THE WATER SUPPLY OF TOWNS AND THE CONSTRUCTION OF WATER-WORKS.

A Practical Treatise for the Use of Engineers and Students of Engineering. By W. K. BURTON, A.M. Inst. C.E., Professor of Sanitary Engineering in the Imperial University, Tokyo, Japan, and Consulting Engineer to the Tokyo Water-works. With an Appendix on THE EFFECTS OF EARTHQUAKES ON WATER-WORKS, by Professor JOHN MILNE, F.R.S. With numerous Plates and Illustrations. Super-royal 8vo, buckram 25/0

I. INTRODUCTORY.—II. DIFFERENT QUALITIES OF WATER.—III. QUANTITY OF WATER TO BE PROVIDED.—IV. ON ASCERTAINING WHETHER A PROPOSED SOURCE OF SUPPLY IS SUFFICIENT.—V. ON ESTIMATING THE STORAGE CAPACITY REQUIRED TO BE PROVIDED.—VI. CLASSIFICATION OF WATER-WORKS.—VII. IMPOUNDING RESERVOIRS.—VIII. EARTHWORK DAMS.—IX. MASONRY DAMS.—X. THE PURIFICATION OF WATER.—XI. SETTLING RESERVOIRS.—XII. SAND FILTRATION.—XIII. PURIFICATION OF WATER BY ACTION OF IRON, SOFTENING OF WATER BY ACTION OF LIME, NATURAL FILTRATION.—XIV. SERVICE OR CLEAN WATER RESERVOIRS—WATER TOWERS—STAND PIPES.—XV. THE CONNECTION OF SETTLING RESERVOIRS, FILTER BEDS AND SERVICE RESERVOIRS.—XVI. PUMPING MACHINERY.—XVII. FLOW OF WATER IN CONDUITS—PIPES AND OPEN CHANNELS.—XVIII. DISTRIBUTION SYSTEMS.—XIX. SPECIAL PROVISIONS FOR THE EXTINCTION OF FIRE.—XX. PIPES FOR WATER-WORKS.—XXI. PREVENTION OF WASTE OF WATER.—XXII. VARIOUS APPLICATIONS USED IN CONNECTION WITH WATER-WORKS.

APPENDIX. By PROF. JOHN MILNE, F.R.S.—CONSIDERATIONS CONCERNING THE PROBABLE EFFECTS OF EARTHQUAKES ON WATER-WORKS, AND THE SPECIAL PRECAUTIONS TO BE TAKEN IN EARTHQUAKE COUNTRIES.

"The chapter upon filtration of water is very complete, and the details of construction well illustrated. . . . The work should be specially valuable to civil engineers engaged in work in Japan, but the interest is by no means confined to that locality."—*Engineer*.

"We congratulate the author upon the practical commonsense shown in the preparation of this work. . . . The plates and diagrams have evidently been prepared with great care, and cannot fail to be of great assistance to the student."—*Builder*.

"The whole art of water-works construction is dealt with in a clear and comprehensive fashion in this handsome volume. . . . Mr. Burton's practical treatise shows in all its sections the fruit of independent study and individual experience. It is largely based upon his own practice in the branch of engineering of which it treats."—*Saturday Review*.

THE WATER SUPPLY OF CITIES AND TOWNS.

By WILLIAM HUMBER, A. M. Inst. C.E., and M. Inst. M.E., Author of "Cast and Wrought Iron Bridge Construction," &c., &c. Illustrated with 50 Double Plates, 1 Single Plate, Coloured Frontispiece, and upwards of 250 Woodcuts, and containing 400 pp. of Text. Imp. 4to, elegantly and substantially half-bound in morocco **£6 6s.**

LIST OF CONTENTS.

I. HISTORICAL SKETCH OF SOME OF THE MEANS THAT HAVE BEEN ADOPTED FOR THE SUPPLY OF WATER TO CITIES AND TOWNS.—II. WATER AND THE FOREIGN MATTER USUALLY ASSOCIATED WITH IT.—III. RAINFALL AND EVAPORATION.—IV. SPRINGS AND THE WATER-BEARING FORMATIONS OF VARIOUS DISTRICTS.—V. MEASUREMENT AND ESTIMATION OF THE FLOW OF WATER.—VI. ON THE SELECTION OF THE SOURCE OF SUPPLY.—VII. WELLS.—VIII. RESERVOIRS.—IX. THE PURIFICATION OF WATER.—X. PUMPS.—XI. PUMPING MACHINERY.—XII. CONDUITS.—XIII. DISTRIBUTION OF WATER.—XIV. METERS, SERVICE PIPES, AND HOUSE FITTINGS.—XV. THE LAW OF ECONOMY OF WATER-WORKS.—XVI. CONSTANT AND INTERMITTENT SUPPLY.—XVII. DESCRIPTION OF PLATES.—APPENDICES, GIVING TABLES OF RATES OF SUPPLY, VELOCITIES, &c., &c., TOGETHER WITH SPECIFICATIONS OF SEVERAL WORKS ILLUSTRATED, AMONG WHICH WILL BE FOUND: ABERDEEN, BIDEFORD, CANTERBURY, DUNDEE, HALIFAX, LAMBETH, ROTHERHAM, DUBLIN, AND OTHERS.

"The most systematic and valuable work upon water supply hitherto produced in English, or in any other language. . . . Mr. Humber's work is characterised almost throughout by an exhaustiveness much more distinctive of French and German than of English technical treatises."—*Engineer.*

RURAL WATER SUPPLY.

A Practical Handbook on the Supply of Water and Construction of Water-works for small Country Districts. By ALLAN GREENWELL, A.M.I.C.E., and W. T. CURRY, A.M.I.C.E., F.G.S. With Illustrations. Crown 8vo, cloth. **[Just Published. 5/0]**

"We conscientiously recommend it as a very useful book for those concerned in obtaining water for small districts, giving a great deal of practical information in a small compass."—*Builder.*
"The volume contains valuable information upon all matters connected with water supply. . . . It is full of details on points which are continually before water-works engineers."—*Nature.*

HYDRAULIC TABLES, CO-EFFICIENTS, & FORMULÆ.

For Finding the Discharge of Water from Orifices, Notches, Weirs, Pipes, and Rivers. With New Formulæ, Tables, and General Information on Rain-fall, Catchment-Basins, Drainage, Sewerage, Water Supply for Towns and Mill Power. By JOHN NEVILLE, Civil Engineer, M.R.I.A. Third Edition, revised, with additions. Numerous Illustrations. Crown 8vo, cloth **14/0**

"It is, of all English books on the subject, the one nearest to completeness. . . . From the good arrangement of the matter, the clear explanations and abundance of formulæ, the carefully calculated tables, and, above all, the thorough acquaintance with both theory and construction, which is displayed from first to last, the book will be found to be an acquisition."—*Architect.*

HYDRAULIC MANUAL.

Consisting of Working Tables and Explanatory Text. Intended as a Guide in Hydraulic Calculations and Field Operations. By LOWIS D'A. JACKSON, Author of "Aid to Survey Practice," "Modern Metrology," &c. Fourth Edition, Enlarged. Large crown 8vo, cloth **16/0**

"The author has had a wide experience in hydraulic engineering and has been a careful observer of the facts which have come under his notice, and from the great mass of material at his command he has constructed a manual which may be accepted as a trustworthy guide to this branch of the engineer's profession."—*Engineering.*

"The most useful feature of this work is its freedom from what is superannuated, and its thorough adoption of recent experiments; the text is in fact in great part a short account of the great modern experiments."—*Nature.*

WATER ENGINEERING.

A Practical Treatise on the Measurement, Storage, Conveyance, and Utilisation of Water for the Supply of Towns, for Mill Power, and for other Purposes. By C. SLAGG, A. M. Inst. C.E. Second Edition. Crown 8vo, cloth **7/6**

As a small practical treatise on the water supply of towns, and on some applications of water-power, the work is in many respects excellent."—*Engineering.*

"The author has collated the results deduced from the experiments of the most eminent authorities, and has presented them in a compact and practical form, accompanied by very clear and detailed explanations. . . . The application of water as a motive power is treated very carefully and exhaustively."—*Builder.*

MASONRY DAMS FROM INCEPTION TO COMPLETION.

Including numerous Formulæ, Forms of Specification and Tender, Pocket Diagram of Forces, &c. For the use of Civil and Mining Engineers. By C. F. COURTNEY, M. Inst. C.E. 8vo, cloth. [Just Published. 9/0

RIVER BARS.

The Causes of their Formation, and their Treatment by "Induced Tidal Scour;" with a Description of the Successful Reduction by this Method of the Bar at Dublin. By I. J. MANN, Assist. Eng. to the Dublin Port and Docks Board. Royal 8vo, cloth. 7/6

"We recommend all interested in harbour works—and, indeed, those concerned in the improvements of rivers generally—to read Mr. Mann's interesting work on the treatment of river bars."—*Engineer*.

DRAINAGE OF LANDS, TOWNS AND BUILDINGS.

By G. D. DEMPSEY, C.E. Revised, with large Additions on RECENT PRACTICE IN DRAINAGE ENGINEERING, by D. KINNEAR CLARK, M. Inst. C.E., Author of "Tramways: their Construction and Working." Cr. 8vo, cloth 4/6

"The new matter added to Mr. Dempsey's excellent work is characterised by the comprehensive grasp and accuracy of detail for which the name of Mr. D. K. Clark is a sufficient voucher."—*Athenæum*.

TRAMWAYS: THEIR CONSTRUCTION AND WORKING.

Embracing a Comprehensive History of the System; with an exhaustive Analysis of the Various Modes of Traction, including Horse Power, Steam, Cable Traction, Electric Traction, &c.; a Description of the Varieties of Rolling Stock; and ample Details of Cost and Working Expenses. New Edition, Thoroughly Revised, and Including the Progress recently made in Tramway Construction, &c., &c. By D. KINNEAR CLARK, M. Inst. C.E. With 400 Illustrations. 8vo, 780 pp., buckram. [Just Published. 28/0

"Although described as a new edition, this book is really a new one, a large part of it, which covers historical ground, having been re-written and amplified; while the parts which relate to all that has been done since 1882 appear in this edition only. It is sixteen years since the first edition appeared, and twelve years since the supplementary volume to the first book was published. After a lapse, then, of twelve years, it is obvious that the author has at his disposal a vast quantity of descriptive and statistical information, with which he may, and has, produced a volume of great value to all interested in tramway construction and working. The new volume is one which will rank, among tramway engineers and those interested in tramway working, with his world-famed book on railway machinery."—*The Engineer*, March 8, 1895.

PRACTICAL SURVEYING.

A Text-Book for Students preparing for Examinations or for Survey-work in the Colonies. By GEORGE W. USILL, A.M.I.C.E. With 4 Plates and upwards of 330 Illustrations. Fourth Edition, Revised and Enlarged. Including Tables of Natural Sines, Tangents, Secants, &c. Crown 8vo, cloth 7/6; or, on THIN PAPER, bound in limp leather, gilt edges, rounded corners, for pocket use 12/6

"The best forms of instruments are described as to their construction, uses and modes of employment, and there are innumerable hints on work and equipment such as the author, in his experience as surveyor, draughtsman and teacher, has found necessary, and which the student in his inexperience will find most serviceable."—*Engineer*.

"The latest treatise in the English language on surveying, and we have no hesitation in saying that the student will find it a better guide than any of its predecessors. Deserves to be recognised as the first book which should be put in the hands of a pupil of Civil Engineering."—*Architect*.

AID TO SURVEY PRACTICE.

For Reference in Surveying, Levelling, and Setting-out; and in Route Surveys of Travellers by Land and Sea. With Tables, Illustrations, and Records. By LOWIS D'A. JACKSON, A.M.I.C.E. Second Edition, Enlarged. Large crown 8vo, cloth 12/6

"Mr. Jackson has produced a valuable *vade-mecum* for the surveyor. We can recommend this book as containing an admirable supplement to the teaching of the accomplished surveyor."—*Athenæum*.

"As a text-book we should advise all surveyors to place it in their libraries, and study well the matured instructions afforded in its pages."—*Colliery Guardian*.

"The author brings to his work a fortunate union of theory and practical experience which, aided by a clear and lucid style of writing, renders the book a very useful one."—*Builder*.

ENGINEER'S & MINING SURVEYOR'S FIELD BOOK.

Consisting of a Series of Tables, with Rules, Explanations of Systems, and use of Theodolite for Traverse Surveying and plotting the work with minute accuracy by means of Straight Edge and Set Square only; Levelling with the Theodolite, Casting-out and Reducing Levels to Datum, and Plotting Sections in the ordinary manner; Setting-out Curves with the Theodolite by Tangential Angles and Multiples with Right and Left-hand Readings of the Instrument; Setting-out Curves without Theodolite on the System of Tangential Angles by Sets of Tangents and Offsets; and Earthwork Tables to 80 feet deep, calculated for every 6 inches in depth. By W. DAVIS HASKOLL, C.E. With numerous Woodcuts. Fourth Edition, Enlarged. Crown 8vo, cloth. **12/0**

"The book is very handy; the separate tables of sines and tangents to every minute will make it useful for many other purposes, the genuine traverse tables existing all the same."—*Athenæum*.

"Every person engaged in engineering field operations will estimate the importance of such a work and the amount of valuable time which will be saved by reference to a set of reliable tables prepared with the accuracy and fulness of those given in this volume."—*Railway News*.

LAND AND MARINE SURVEYING.

In Reference to the Preparation of Plans for Roads and Railways; Canals, Rivers, Towns' Water Supplies; Docks and Harbours. With Description and Use of Surveying Instruments. By W. DAVIS HASKOLL, C.E. Second Edition, Revised, with Additions. Large crown 8vo, cloth **9/0**

"This book must prove of great value to the student. We have no hesitation in recommending it, feeling assured that it will more than repay a careful study."—*Mechanical World*.

"A most useful and well-arranged book for the aid of the student. We can strongly recommend it as a carefully-written and valuable text-book. It enjoys a well-deserved repute among surveyors."—*Builder*.

"This volume cannot fail to prove of the utmost practical utility. It may be safely recommended to all students who aspire to become clean and expert surveyors."—*Mining Journal*.

PRINCIPLES AND PRACTICE OF LEVELLING.

Showing its Application to Purposes of Railway and Civil Engineering in the Construction of Roads; with Mr. TELFORD'S Rules for the same. By FREDERICK W. SIMMS, F.G.S., M. Inst. C.E. Seventh Edition, with the addition of LAW'S Practical Examples for Setting-out Railway Curves, and TRAUTWINE'S Field Practice of Laying-out Circular Curves. With 7 Plates and numerous Woodcuts, 8vo, cloth. **8/6**

. TRAUTWINE ON CURVES may be had separate **5/0**

"The text-book on levelling in most of our engineering schools and colleges."—*Engineer*.

"The publishers have rendered a substantial service to the profession, especially to the younger members, by bringing out the present edition of Mr. Simms' useful work."—*Engineering*.

AN OUTLINE OF THE METHOD OF CONDUCTING A TRIGONOMETRICAL SURVEY.

For the Formation of Geographical and Topographical Maps and Plans, Military Reconnaissance, LEVELLING, &c., with Useful Problems, Formulæ, and Tables. By Lieut.-General FROME, R.E. Fourth Edition, Revised and partly Re-written by Major-General Sir CHARLES WARREN, G.C.M.G., R.E. With 19 Plates and 115 Woodcuts, royal 8vo, cloth **16/0**

"No words of praise from us can strengthen the position so well and so steadily maintained by this work. Sir Charles Warren has revised the entire work, and made such additions as were necessary to bring every portion of the contents up to the present date."—*Broad Arrow*.

TABLES OF TANGENTIAL ANGLES AND MULTIPLES FOR SETTING-OUT CURVES.

From 5 to 200 Radius. By A. BEAZELEY, M. Inst. C.E. 4th Edition. Printed on 48 Cards, and sold in a cloth box, waistcoat pocket size. **3/6**

"Each table is printed on a small card, which, being placed on the theodolite, leaves the hands free to manipulate the instrument—no small advantage as regards the rapidity of work."—*Engineer*.

"Very handy: a man may know that all his day's work must fall on two of these cards, which he puts into his own card-case, and leaves the rest behind."—*Athenæum*.

HANDY GENERAL EARTH-WORK TABLES.

Giving the Contents in Cubic Yards of Centre and Slopes of Cuttings and Embankments from 3 inches to 80 feet in Depth or Height, for use with either 66 feet Chain or 100 feet Chain. By J. H. WATSON BUCK, M. Inst. C.E. On a Sheet mounted in cloth case. [*Just Published.*] **3/6**

EARTHWORK TABLES.

Showing the Contents in Cubic Yards of Embankments, Cuttings, &c., of Heights or Depths up to an average of 80 feet. By JOSEPH BROADBENT, C.E., and FRANCIS CAMPIN, C.E. Crown 8vo, cloth **5/0**

"The way in which accuracy is attained, by a simple division of each cross section into three elements, two in which are constant and one variable, is ingenious."—*Athenæum*.

A MANUAL ON EARTHWORK.

By ALEX. J. S. GRAHAM, C.E. With numerous Diagrams. Second Edition. 18mo, cloth **2/6**

THE CONSTRUCTION OF LARGE TUNNEL SHAFTS.

A Practical and Theoretical Essay. By J. H. WATSON BUCK, M. Inst. C.E., Resident Engineer, L. and N. W. R. With Folding Plates, 8vo, cloth **12/0**

"Many of the methods given are of extreme practical value to the mason, and the observations on the form of arch, the rules for ordering the stone, and the construction of the templates, will be found of considerable use. We commend the book to the engineering profession."—*Building News*.

"Will be regarded by civil engineers as of the utmost value, and calculated to save much time and obviate many mistakes."—*Colliery Guardian*.

CAST & WROUGHT IRON BRIDGE CONSTRUCTION

(A Complete and Practical Treatise on), including Iron Foundations. In Three Parts.—Theoretical, Practical, and Descriptive. By WILLIAM HUMBER, A. M. Inst. C.E., and M. Inst. M.E. Third Edition, revised and much improved, with 115 Double Plates (20 of which now first appear in this edition), and numerous Additions to the Text. In 2 vols., imp. 4to, half-bound in morocco **£6 16s. 6d.**

"A very valuable contribution to the standard literature of civil engineering. In addition to elevations, plans, and sections, large scale details are given, which very much enhance the instructive worth of those illustrations."—*Civil Engineer and Architect's Journal*.

"Mr. Humber's stately volumes, lately issued—in which the most important bridges erected during the last five years, under the direction of the late Mr. Brunel, Sir W. Cubitt, Mr. Hawkshaw, Mr. Page, Mr. Fowler, Mr. Hemans, and others among our most eminent engineers, are drawn and specified in great detail."—*Engineer*.

ESSAY ON OBLIQUE BRIDGES

(Practical and Theoretical). With 13 large Plates. By the late GEORGE WATSON BUCK, M.I.C.E. Fourth Edition, revised by his Son, J. H. WATSON BUCK, M.I.C.E.; and with the addition of Description to Diagrams for Facilitating the Construction of Oblique Bridges, by W. H. BARLOW, M.I.C.E. Royal 8vo, cloth **12/0**

"The standard text-book for all engineers regarding skew arches is Mr. Buck's treatise, and it would be impossible to consult a better."—*Engineer*.

"Mr. Buck's treatise is recognised as a standard text-book, and his treatment has divested the subject of many of the intricacies supposed to belong to it. As a guide to the engineer and architect, on a confessedly difficult subject, Mr. Buck's work is unsurpassed."—*Building News*.

THE CONSTRUCTION OF OBLIQUE ARCHES

(A Practical Treatise on). By JOHN HART. Third Edition, with Plates. Imperial 8vo, cloth **8/0**

GRAPHIC AND ANALYTIC STATICS.

In their Practical Application to the Treatment of Stresses in Roofs, Solid Girders, Lattice, Bowstring, and Suspension Bridges, Braced Iron Arches and Piers, and other Frameworks. By R. HUDSON GRAHAM, C.E. Containing Diagrams and Plates to Scale. With numerous Examples, many taken from existing Structures. Specially arranged for Class-work in Colleges and Universities. Second Edition, Revised and Enlarged. 8vo, cloth **16/0**

"Mr. Graham's book will find a place wherever graphic and analytic statics are used or studied."—*Engineer*.

"The work is excellent from a practical point of view, and has evidently been prepared with much care. The directions for working are simple, and are illustrated by an abundance of well-selected examples. It is an excellent text-book for the practical draughtsman."—*Athenæum*.

WEIGHTS OF WROUGHT IRON & STEEL GIRDERS.

A Graphic Table for Facilitating the Computation of the Weights of Wrought Iron and Steel Girders, &c., for Parliamentary and other Estimates. By J. H. WATSON BUCK, M. Inst. C.E. On a Sheet **2/6**

HANDY BOOK FOR THE CALCULATION OF STRAINS

In Girders and Similar Structures and their Strength. Consisting of Formulæ and Corresponding Diagrams, with numerous details for Practical Application, &c. By WILLIAM HUMBER, A. M. Inst. C.E., &c. Fifth Edition. Crown 8vo, with nearly 100 Woodcuts and 3 Plates, cloth **7/6**

"The formulæ are neatly expressed, and the diagrams good."—*Atheænium*.

"We heartily commend this really *handy* book to our engineer and architect readers."—*English Mechanic*.

TRUSSES OF WOOD AND IRON.

Practical Applications of Science in Determining the Stresses, Breaking Weights, Safe Loads, Scantlings, and Details of Construction. With Complete Working Drawings. By WILLIAM GRIFFITHS, Surveyor, Assistant Master, Tranmere School of Science and Art. Oblong 8vo, cloth **4/6**

"This handy little book enters so minutely into every detail connected with the construction of roof trusses that no student need be ignorant of these matters."—*Practical Engineer*.

THE STRAINS ON STRUCTURES OF IRONWORK.

With Practical Remarks on Iron Construction. By F. W. SHEILDS, M.I.C.E. 8vo, cloth **5/0**

A TREATISE ON THE STRENGTH OF MATERIALS.

With Rules for Application in Architecture, the Construction of Suspension Bridges, Railways, &c. By PETER BARLOW, F.R.S. A new Edition, revised by his Sons, P. W. BARLOW, F.R.S., and W. H. BARLOW, F.R.S.; to which are added, Experiments by HODGKINSON, FAIRBAIRN, and KIRKALDY; and Formulæ for calculating Girders, &c. Arranged and Edited by WM. HUMBER, A. M. Inst. C.E. Demy 8vo, 400 pp., with 19 large Plates and numerous Woodcuts, cloth **18/0**

"Valuable alike to the student, tyro, and the experienced practitioner, it will always rank in future as it has hitherto done, as the standard treatise on that particular subject."—*Engineer*.

"As a scientific work of the first class, it deserves a foremost place on the bookshelves of every civil engineer and practical mechanic."—*English Mechanic*.

STRENGTH OF CAST IRON AND OTHER METALS.

By THOMAS TREGGOLD, C.E. Fifth Edition, including HODGKINSON'S Experimental Researches. 8vo, cloth **12/0**

SAFE RAILWAY WORKING.

A Treatise on Railway Accidents, their Cause and Prevention; with a Description of Modern Appliances and Systems. By CLEMENT E. STRETTON, C.E., Vice-President and Consulting Engineer, Amalgamated Society of Railway Servants. With Illustrations and Coloured Plates. Third Edition, Enlarged. Crown 8vo, cloth **3/6**

"A book for the engineer, the directors, the managers; and, in short, all who wish for information on railway matters will find a perfect encyclopædia in 'Safe Railway Working.'"—*Railway Review*.

"We commend the remarks on railway signalling to all railway managers, especially where a uniform code and practice is advocated."—*Herepath's Railway Journal*.

"The author may be congratulated on having collected, in a very convenient form, much valuable information on the principal questions affecting the safe working of railways."—*Railway Engineer*.

EXPANSION OF STRUCTURES BY HEAT.

By JOHN KEILY, C.E., late of the Indian Public Works Department. Crown 8vo, cloth **3/6**

"The aim the author has set before him, viz., to show the effects of heat upon metallic and other structures, is a laudable one, for this is a branch of physics upon which the engineer or architect can find but little reliable and comprehensive data in books."—*Builder*.

A TREATISE ON FIELD FORTIFICATION.

The Attack of Fortresses, Military Mining, and Reconnoitring. By Professor Colonel I. S. MACAULAY. Sixth Edition, crown 8vo, with separate Atlas of 12 Plates, cloth **12/0**

RECORD OF THE PROGRESS OF MODERN ENGINEERING.

Complete in Four Volumes, imperial 4to, half-morocco, price **£12 12s.**

Each volume sold separately, as follows:—

FIRST SERIES, Comprising Civil, Mechanical, Marine, Hydraulic, Railway, Bridge, and other Engineering Works, &c. By WILLIAM HUMBER, A. M. Inst. C.E., &c. Imp. 4to, with 36 Double Plates, drawn to a large scale, Photographic Portrait of John Hawkshaw, C.E., F.R.S., &c., and copious descriptive Letterpress, Specifications, &c. Half-morocco **£3 3s.**

LIST OF THE PLATES AND DIAGRAMS.

VICTORIA STATION AND ROOF, L. B. & S. C. R. (8 PLATES); SOUTHPORT PIER (2 PLATES); VICTORIA STATION AND ROOF, L. C. & D. AND G. W. R. (6 PLATES); ROOF OF CREMORNE MUSIC HALL; BRIDGE OVER G. N. RAILWAY; ROOF OF STATION, DUTCH RHENISH RAIL. (2 PLATES); BRIDGE OVER THE THAMES, WEST LONDON EXTENSION RAILWAY (5 PLATES); ARMOUR PLATES: SUSPENSION BRIDGE, THAMES (4 PLATES); THE ALLEN ENGINE; SUSPENSION BRIDGE, AVON (3 PLATES); UNDERGROUND RAILWAY (3 PLATES).

HUMBER'S PROGRESS OF MODERN ENGINEERING.

SECOND SERIES. Imp. 4to, with 3 Double Plates, Photographic Portrait of Robert Stephenson, C.E., M.P., F.R.S., &c., and copious descriptive Letterpress, Specifications, &c. Half-morocco **£3 3s.**

LIST OF THE PLATES AND DIAGRAMS.

BIRKENHEAD DOCKS, LOW WATER BASIN (15 PLATES); CHARING CROSS STATION ROOF, C. C. RAILWAY (3 PLATES); DIGSWELL VIADUCT, GREAT NORTHERN RAILWAY; ROBBERY WOOD VIADUCT, GREAT NORTHERN RAILWAY; IRON PERMANENT WAY; CLYDACH VIADUCT, MERTHYR, TREDEGAR, AND ABERGAVENNY RAILWAY; EBBW VIADUCT, MERTHYR, TREDEGAR, AND ABERGAVENNY RAILWAY; COLLEGE WOOD VIADUCT, CORNWALL RAILWAY; DUBLIN WINTER PALACE ROOF (3 PLATES); BRIDGE OVER THE THAMES, L. C. & D. RAILWAY (6 PLATES); ALBERT HARBOUR, GREENOCK (4 PLATES).

HUMBER'S PROGRESS OF MODERN ENGINEERING.

THIRD SERIES. Imp. 4to, with 40 Double Plates, Photographic Portrait of J. R. McClean, late Pres. Inst. C.E., and copious descriptive Letterpress, Specifications, &c. Half-morocco **£3 3s.**

LIST OF THE PLATES AND DIAGRAMS.

MAIN DRAINAGE, METROPOLIS.—*North Side.*—MAP SHOWING INTERCEPTION OF SEWERS; MIDDLE LEVEL SEWER (2 PLATES); OUTFALL SEWER, BRIDGE OVER RIVER LEA (3 PLATES); OUTFALL SEWER, BRIDGE OVER MARSH LANE, NORTH WOOLWICH RAILWAY, AND BOW AND BARKING RAILWAY JUNCTION; OUTFALL SEWER, BRIDGE OVER BOW AND BARKING RAILWAY (3 PLATES); OUTFALL SEWER, BRIDGE OVER EAST LONDON WATER-WORKS' FEEDER (2 PLATES); OUTFALL SEWER RESERVOIR (2 PLATES); OUTFALL SEWER, TUMBLING BAY AND OUTLET; OUTFALL SEWER, PENSTOCKS. *South Side.*—OUTFALL SEWER, BERMONDSEY BRANCH (2 PLATES); OUTFALL SEWER, RESERVOIR AND OUTLET (4 PLATES); OUTFALL SEWER, FILTH HOIST; SECTIONS OF SEWERS (NORTH AND SOUTH SIDES).

THAMES EMBANKMENT.—SECTION OF RIVER WALL; STEAMBOAT PIER, WESTMINSTER (2 PLATES); LANDING STAIRS BETWEEN CHARING CROSS AND WATERLOO BRIDGES; YORK GATE (2 PLATES); OVERFLOW AND OUTLET AT SAVOY STREET SEWER (3 PLATES); STEAMBOAT PIER, WATERLOO BRIDGE (3 PLATES); JUNCTION OF SEWERS, PLANS AND SECTIONS; GULIES, PLANS AND SECTIONS; ROLLING STOCK; GRANITE AND IRON FORTS.

HUMBER'S PROGRESS OF MODERN ENGINEERING.

FOURTH SERIES. Imp. 4to, with 36 Double Plates, Photographic Portrait of John Fowler, late Pres. Inst. C.E., and copious descriptive Letterpress, Specifications, &c. Half-morocco **£3 3s.**

LIST OF THE PLATES AND DIAGRAMS.

ABBEY MILLS PUMPING STATION, MAIN DRAINAGE, METROPOLIS (4 PLATES); BARROW DOCKS (5 PLATES); MANQUIS VIADUCT, SANTIAGO AND VALPARAISO RAILWAY, (2 PLATES); ADAM'S LOCOMOTIVE, ST. HELEN'S CANAL RAILWAY (2 PLATES); CANNON STREET STATION ROOF, CHARING CROSS RAILWAY (3 PLATES); ROAD BRIDGE OVER THE RIVER MOKA (2 PLATES); TELEGRAPHIC APPARATUS FOR MESOPOTAMIA; VIADUCT OVER THE RIVER WYE, MIDLAND RAILWAY (3 PLATES); ST. GERMAN'S VIADUCT, CORNWALL RAILWAY (2 PLATES); WROUGHT-IRON CYLINDER FOR DIVING BELL; MILLWALL DOCKS (6 PLATES); MILROY'S PATENT EXCAVATOR; METROPOLITAN DISTRICT RAILWAY (6 PLATES); HARBOURS, PORTS, AND BREAKWATERS (3 PLATES).

THE POPULAR WORKS OF MICHAEL REYNOLDS.

LOCOMOTIVE ENGINE DRIVING.

A Practical Manual for Engineers in Charge of Locomotive Engines. By MICHAEL REYNOLDS, Member of the Society of Engineers, formerly Locomotive Inspector, L. B. & S. C. R. Ninth Edition. Including a Key to THE LOCOMOTIVE ENGINE. With Illustrations and Portrait of Author. Crown 8vo, cloth **4/6**

"Mr. Reynolds has supplied a want, and has supplied it well. We can confidently recommend the book not only to the practical driver, but to everyone who takes an interest in the performance of locomotive engines."—*The Engineer*.

"Mr. Reynolds has opened a new chapter in the literature of the day. This admirable practical treatise, of the practical utility of which we have to speak in terms of warm commendation."—*Athenæum*.

"Evidently the work of one who knows his subject thoroughly."—*Railway Service Gazette*.

"Were the cautions and rules given in the book to become part of the every-day working of our engine-drivers, we might have fewer distressing accidents to deplore."—*Scotsman*.

STATIONARY ENGINE DRIVING.

A Practical Manual for Engineers in Charge of Stationary Engines. By MICHAEL REYNOLDS. Fifth Edition, Enlarged. With Plates and Woodcuts. Crown 8vo, cloth **4/6**

"The author is thoroughly acquainted with his subjects, and his advice on the various points treated is clear and practical. . . . He has produced a manual which is an exceedingly useful one for the class for whom it is specially intended."—*Engineering*.

"Our author leaves no stone unturned. He is determined that his readers shall not only know something about the stationary engine, but all about it."—*Engineer*.

"An engineman who has mastered the contents of Mr. Reynolds's book will require but little actual experience with boilers and engines before he can be trusted to look after them."—*English Mechanic*.

THE MODEL LOCOMOTIVE ENGINEER,

Fireman, and Engine-Boy. Comprising a Historical Notice of the Pioneer Locomotive Engines and their Inventors. By MICHAEL REYNOLDS. Second Edition, with Revised Appendix. With numerous Illustrations, and Portrait of George Stephenson. Crown 8vo, cloth. [Just Published. **4/6**

"From the technical knowledge of the author, it will appeal to the railway man of to-day more forcibly than anything written by Dr. Smiles. . . . The volume contains information of a technical kind, and facts that every driver should be familiar with."—*English Mechanic*.

"We should be glad to see this book in the possession of everyone in the kingdom who has ever laid, or is to lay, hands on a locomotive engine."—*Iron*.

CONTINUOUS RAILWAY BRAKES.

A Practical Treatise on the several Systems in Use in the United Kingdom: their Construction and Performance. With copious Illustrations and numerous Tables. By MICHAEL REYNOLDS. Large crown 8vo, cloth **9/0**

"A popular explanation of the different brakes. It will be of great assistance in forming public opinion, and will be studied with benefit by those who take an interest in the brake."—*English Mechanic*.

"Written with sufficient technical detail to enable the principal and relative connection of the various parts of each particular brake to be readily grasped."—*Mechanical World*.

ENGINE-DRIVING LIFE.

Stirring Adventures and Incidents in the Lives of Locomotive Engine-Drivers. By MICHAEL REYNOLDS. Third Edition. Crown 8vo, cloth **1/6**

"From first to last perfectly fascinating. Wilkie Collins's most thrilling conceptions are thrown into the shade by true incidents, endless in their variety, related in every page."—*North British Mail*.

"Anyone who wishes to get a real insight into railway life cannot do better than read 'Engine-Driving Life' for himself, and if he once takes it up he will find that the author's enthusiasm and real love of the engine-driving profession will carry him on until he has read every page."—*Saturday Review*.

THE ENGINEMAN'S POCKET COMPANION,

And Practical Educator for Enginemen, Boiler Attendants, and Mechanics. By MICHAEL REYNOLDS. With 45 Illustrations and numerous Diagrams. Third Edition, Revised. Royal 18mo, strongly bound for pocket wear **3/6**

"This admirable work is well suited to accomplish its object, being the honest workmanship of a competent engineer."—*Glasgow Herald*.

"A most meritorious work, giving in a succinct and practical form all the information an engine-minder desirous of mastering the scientific principles of his daily calling would require."—*The Miller*.

"A boon to those who are striving to become efficient mechanics."—*Daily Chronicle*.

MARINE ENGINEERING, SHIPBUILDING, NAVIGATION, &c.

THE NAVAL ARCHITECT'S AND SHIPBUILDER'S

POCKET-BOOK of Formulæ, Rules, and Tables, and Marine Engineer's and Surveyor's Handy Book of Reference. By CLEMENT MACKROW, M.I.N.A. Sixth Edition, Revised, 700 pp., with 300 Illustrations. Fcap., leather. **12/6**

SUMMARY OF CONTENTS:—SIGNS AND SYMBOLS, DECIMAL FRACTIONS.—TRIGONOMETRY.—PRACTICAL GEOMETRY.—MENSURATION.—CENTRES AND MOMENTS OF FIGURES.—MOMENTS OF INERTIA AND RADII OF GYRATION.—ALGEBRAICAL EXPRESSIONS FOR SIMPSON'S RULES.—MECHANICAL PRINCIPLES.—CENTRE OF GRAVITY.—LAWS OF MOTION.—DISPLACEMENT, CENTRE OF BUOYANCY.—CENTRE OF GRAVITY OF SHIP'S HULL.—STABILITY CURVES AND METACENTRES.—SEA AND SHALLOW-WATER WAVES.—ROLLING OF SHIPS.—PROPULSION AND RESISTANCE OF VESSELS.—SPEED TRIALS.—SAILING, CENTRE OF EFFORT.—DISTANCES DOWN RIVERS, COAST LINES.—STEERING AND RUDDERS OF VESSELS.—LAUNCHING CALCULATIONS AND VELOCITIES.—WEIGHT OF MATERIAL AND GEAR.—GUN PARTICULARS AND WEIGHT.—STANDARD GAUGES.—RIVETED JOINTS AND RIVETING.—STRENGTH AND TESTS OF MATERIALS.—BINDING AND SHEARING STRESSES, &c.—STRENGTH OF SHAFTING, PILLARS, WHEELS, &c.—HYDRAULIC DATA, &c.—CONIC SECTIONS, CATENARIAN CURVES.—MECHANICAL POWERS, WORK.—BOARD OF TRADE REGULATIONS FOR BOILERS AND ENGINES.—BOARD OF TRADE REGULATIONS FOR SHIPS.—LLOYD'S RULES FOR BOILERS.—LLOYD'S WEIGHT OF CHAINS.—LLOYD'S SCANTLINGS FOR SHIPS.—DATA OF ENGINES AND VESSELS.—SHIPS' FITTINGS AND TESTS.—SEASONING PRESERVING TIMBER.—MEASUREMENT OF TIMBER.—ALLOYS, PAINTS, VARNISHES.—DATA FOR STOWAGE.—ADMIRALTY TRANSPORT REGULATIONS.—RULES FOR HORSE-POWER, SCREW PROPELLERS, &c.—PERCENTAGES FOR BUTT STRAPS, &c.—PARTICULARS OF YACHTS.—MASTING AND RIGGING VESSELS.—DISTANCES OF FOREIGN PORTS.—TONNAGE TABLES.—VOCABULARY OF FRENCH AND ENGLISH TERMS.—ENGLISH WEIGHTS AND MEASURES.—FOREIGN WEIGHTS AND MEASURES.—DECIMAL EQUIVALENTS.—FOREIGN MONEY.—DISCOUNT AND WAGES TABLES.—USEFUL NUMBERS AND READY RECKONERS.—TABLES OF CIRCULAR MEASURES.—TABLES OF AREAS OF AND CIRCUMFERENCES OF CIRCLES.—TABLES OF AREAS OF SEGMENTS OF CIRCLES.—TABLES OF SQUARES AND CUBES AND ROOTS OF NUMBERS.—TABLES OF LOGARITHMS OF NUMBERS.—TABLES OF HYPERBOLIC LOGARITHMS.—TABLES OF NATURAL SINES, TANGENTS, &c.—TABLES OF LOGARITHMIC SINES, TANGENTS, &c.

"In these days of advanced knowledge a work like this is of the greatest value. It contains a vast amount of information. We unhesitatingly say that it is the most valuable compilation for its specific purpose that has ever been printed. No naval architect, engineer, surveyor, or seaman, wood or iron shipbuilder, can afford to be without this work."—*Nautical Magazine*.

"Should be used by all who are engaged in the construction or design of vessels. . . . Will be found to contain the most useful tables and formulæ required by shipbuilders, carefully collected from the best authorities, and put together in a popular and simple form. The book is one of exceptional merit."—*Engineer*.

"The professional shipbuilder has now, in a convenient and accessible form, reliable data for solving many of the numerous problems that present themselves in the course of his work."—*Iron*.

"There is no doubt that a pocket-book of this description must be a necessity in the shipbuilding trade. . . . The volume contains a mass of useful information clearly expressed and presented in a handy form."—*Marine Engineer*.

MARINE ENGINES AND STEAM VESSELS.

A Treatise on. By ROBERT MURRAY, C.E. Eighth Edition, thoroughly Revised, with considerable Additions by the Author and by GEORGE CARLISLE, C.E., Senior Surveyor to the Board of Trade at Liverpool. 12mo, cloth . . . **4/6**

"Well adapted to give the young steamship engineer or marine engine and boiler maker a general introduction into his practical work."—*Mechanical World*.

"We feel sure that this thoroughly revised edition will continue to be as popular in the future as it has been in the past, as, for its size, it contains more useful information than any similar treatise."—*Industries*.

"The information given is both sound and sensible, and well qualified to direct young seagoing hands on the straight road to the extra chief's certificate. . . . Most useful to surveyors, inspectors, draughtsmen, and all young engineers who take an interest in their profession."—*Glasgow Herald*

SEA TERMS, PHRASES, AND WORDS

(Technical Dictionary of) used in the English and French Languages (English-French, French-English). For the Use of Seamen, Engineers, Pilots, Shipbuilders, Shipowners, and Ship-brokers. Compiled by W. PIRRIE, late of the African Steamship Company. Fcap. 8vo, cloth limp. [Just Published. **5/0**

"This volume will be highly appreciated by seamen, engineers, pilots, shipbuilders and shipowners. It will be found wonderfully accurate and complete."—*Scotsman*.

"A very useful dictionary, which has long been wanted by French and English engineers, masters, officers, and others."—*Shipping World*.

ELECTRIC SHIP LIGHTING.

A Handbook on the Practical Fitting and Running of Ships' Electrical Plant, for the Use of Shipowners and Builders, Marine Electricians and Sea-going Engineers in Charge. By J. W. URQUHART, Author of "Electric Light," "Dynamo Construction," &c. With numerous Illustrations. Crown 8vo, cloth **7/6**

MARINE ENGINEERS' POCKET-BOOK.

Consisting of useful Tables and Formulæ. By FRANK PROCTOR, A.I.N.A. Third Edition. Royal 32mo, leather, gilt edges, with strap **4/0**
 "We recommend it to our readers as going far to supply a long-felt want."—*Naval Science*.
 "A most useful companion to all marine engineers."—*United Service Gazette*.

ELEMENTARY ENGINEERING.

A Manual for Young Marine Engineers and Apprentices. In the Form of Questions and Answers on Metals, Alloys, Strength of Materials, Construction and Management of Marine Engines and Boilers, Geometry, &c., &c. With an Appendix of Useful Tables. By JOHN SHERREN BREWER, Government Marine Surveyor, Hong Kong. Third Edition, small crown 8vo, cloth **1/6**
 "Contains much valuable information for the class for whom it is intended, especially in the chapters on the management of boilers and engines."—*Nautical Magazine*.
 "A useful introduction to the more elaborate text-books."—*Scotsman*.
 "To a student who has the requisite desire and resolve to attain a thorough knowledge Mr. Brewer offers decidedly useful help."—*Athenæum*.

PRACTICAL NAVIGATION.

Consisting of THE SAILOR'S SEA-BOOK, by JAMES GREENWOOD and W. H. ROSSER; together with the requisite Mathematical and Nautical Tables for the Working of the Problems, by HENRY LAW. C.E., and Professor J. R. YOUNG. Illustrated. 12mo, strongly half-bound **7/0**

MARINE ENGINEER'S DRAWING-BOOK.

Adapted to the Requirements of the Board of Trade Examinations. By JOHN LOCKIE, C.E. With 22 Plates, Drawn to Scale. Royal 8vo, cloth **3/6**
 "The student who learns from these drawings will have nothing to unlearn."—*Engineer*.
 "The examples chosen are essentially practical, and are such as should prove of service to engineers generally, while admirably fulfilling their specific purpose."—*Mechanical World*.

THE ART AND SCIENCE OF SAILMAKING.

By SAMUEL B. SADLER, Practical Sailmaker, late in the employment of Messrs. Ratsey and Laphorne, of Cowes and Gosport. With Plates and other Illustrations. Small 4to, cloth **12/6**
 "This extremely practical work gives a complete education in all the branches of the manufacture, cutting out, roping, seaming, and goring. It is copiously illustrated, and will form a first-rate text-book and guide."—*Portsmouth Times*.
 "The author of this work has rendered a distinct service to all interested in the art of sailmaking. The subject of which he treats is a congenial one. Mr. Sadler is a practical sailmaker, and has devoted years of careful observation and study to the subject; and the results of the experience thus gained he has set forth in the volume before us."—*Steamship*.

CHAIN CABLES AND CHAINS.

Comprising Sizes and Curves of Links, Studs, &c., Iron for Cables and Chains, Chain Cable and Chain Making, Forming and Welding Links, Strength of Cables and Chains, Certificates for Cables, Marking Cables, Prices of Chain Cables and Chains, Historical Notes, Acts of Parliament, Statutory Tests, Charges for Testing, List of Manufacturers of Cables, &c., &c. By THOMAS W. TRAILL, F.E.R.N., M.Inst.C.E., Engineer-Surveyor-in-Chief, Board of Trade, Inspector of Chain Cable and Anchor Proving Establishments, and General Superintendent Lloyd's Committee on Proving Establishments. With numerous Tables, Illustrations, and Lithographic Drawings. Folio, cloth, bevelled boards. **£2 2s.**
 "It contains a vast amount of valuable information. Nothing seems to be wanting to make it a complete and standard work of reference on the subject."—*Nautical Magazine*.

MINING AND METALLURGY

COLLIERY WORKING AND MANAGEMENT.

Comprising the Duties of a Colliery Manager, the Oversight and Arrangement of Labour and Wages, and the different Systems of Working Coal Seams. By H. F. BULMAN and R. A. S. REDMAYNE. 350 pp., with 28 Plates and other Illustrations, including Underground Photographs. Medium 8vo, cloth. [Just Published. 15/0

"This is, indeed, an admirable Handbook for Colliery Managers, in fact it is an indispensable adjunct to a Colliery Manager's education, as well as being a most useful and interesting work on the subject for all who in any way have to do with coal mining. The underground photographs are an attractive feature of the work, being very lifelike and necessarily true representations of the scenes they depict."—*Colliery Guardian*.

"Mr. Bulman and Mr. Redmayne, who are both experienced Colliery Managers of great literary ability, are to be congratulated on having supplied an authoritative work dealing with a side of the subject of coal mining which has hitherto received but scant treatment. The authors elucidate their text by 119 woodcuts and 28 plates, most of the latter being admirable reproductions of photographs taken underground with the aid of the magnesium flash-light. These illustrations are excellent."—*Nature*.

INFLAMMABLE GAS AND VAPOUR IN THE AIR

(The Detection and Measurement of). By FRANK CLOWES, D.Sc., Lond., F.I.C., Prof. of Chemistry in the University College, Nottingham. With a Chapter on THE DETECTION AND MEASUREMENT OF PETROLEUM VAPOUR by BOVERTON REDWOOD, F.R.S.E., Consulting Adviser to the Corporation of London under the Petroleum Acts. Crown 8vo, cloth. [Just Published. Net. 5/0

"Professor Clowes has given us a volume on a subject of much industrial importance. . . Those interested in these matters may be recommended to study this book, which is easy of comprehension and contains many good things."—*The Engineer*.

"A convenient summary of the work on which Professor Clowes has been engaged for some considerable time. . . . It is hardly necessary to say that any work on these subjects with these names on the title-page must be a valuable one, and one that no mining engineer—certainly no coal miner—can afford to ignore or to leave unread."—*Mining Journal*.

MACHINERY FOR METALLIFEROUS MINES.

A Practical Treatise for Mining Engineers, Metallurgists, and Managers of Mines. By E. HENRY DAVIES, M.E., F.G.S. Crown 8vo, 580 pp., with upwards of 300 Illustrations, cloth. [Just Published. 12/6

"Mr. Davies, in this handsome volume, has done the advanced student and the manager of mines good service. Almost every kind of machinery in actual use is carefully described, and the woodcuts and plates are good."—*Athenaeum*.

"From cover to cover the work exhibits all the same characteristics which excite the confidence and attract the attention of the student as he peruses the first page. The work may safely be recommended. By its publication the literature connected with the industry will be enriched and the reputation of its author enhanced."—*Mining Journal*.

METALLIFEROUS MINERALS AND MINING.

By D. C. DAVIES, F.G.S., Mining Engineer, &c., Author of "A Treatise on Slate and Slate Quarrying." Fifth Edition, thoroughly Revised and much Enlarged by his Son, E. HENRY DAVIES, M.E., F.G.S. With about 150 Illustrations. Crown 8vo, cloth. 12/6

"Neither the practical miner nor the general reader, interested in mines, can have a better book for his companion and his guide."—*Mining Journal*.

"We are doing our readers a service in calling their attention to this valuable work."—*Mining World*.

"As a history of the present state of mining throughout the world this book has a real value, and it supplies an actual want."—*Athenaeum*.

EARTHY AND OTHER MINERALS AND MINING.

By D. C. DAVIES, F.G.S., Author of "Metalliferous Minerals," &c. Third Edition, Revised and Enlarged by his Son, E. HENRY DAVIES, M.E., F.G.S. With about 100 Illustrations. Crown 8vo, cloth. 12/6

"We do not remember to have met with any English work on mining matters that contains the same amount of information packed in equally convenient form."—*Academy*.

"We should be inclined to rank it as among the very best of the handy technical and trades manuals which have recently appeared."—*British Quarterly Review*.

BRITISH MINING.

A Treatise on the History, Discovery, Practical Development, and Future Prospects of Metalliferous Mines in the United Kingdom. By ROBERT HUNT, F.R.S., late Keeper of Mining Records. Upwards of 950 pp., with 230 Illustrations. Second Edition, Revised. Super-royal 8vo, cloth **£2 2s.**

"The book is a treasure-house of statistical information on mining subjects, and we know of no other work embodying so great a mass of matter of this kind. Were this the only merit of Mr. Hunt's volume it would be sufficient to render it indispensable in the library of every one interested in the development of the mining and metallurgical industries of this country."—*Athenæum*.

"A mass of information not elsewhere available, and of the greatest value to those who may be interested in our great mineral industries."—*Engineer*.

MINE DRAINAGE.

A Complete and Practical Treatise on Direct-Acting Underground Steam Pumping Machinery, with a Description of a large number of the best known Engines, their General Utility and the Special Sphere of their Action, the Mode of their Application, and their merits compared with other forms of Pumping Machinery. By STEPHEN MICHELL. 8vo, cloth **15/0**

"Will be highly esteemed by colliery owners and lessees, mining engineers, and students generally who require to be acquainted with the best means of securing the drainage of mines. It is a most valuable work, and stands almost alone in the literature of steam pumping machinery."—*Colliery Guardian*.

"Much valuable information is given, so that the book is thoroughly worthy of an extensive circulation amongst practical men and purchasers of machinery."—*Mining Journal*.

THE PROSPECTOR'S HANDBOOK.

A Guide for the Prospector and Traveller in search of Metal-Bearing or other Valuable Minerals. By J. W. ANDERSON, M.A. (Camb.), F.R.G.S., Author of "Fiji and New Caledonia." Seventh Edition, thoroughly Revised and much Enlarged. Small crown 8vo, cloth, **3/6**; or, leather, pocket-book form, with tuck. [Just Published. **4/6**.

"Will supply a much-felt want, especially among Colonists, in whose way are so often thrown many mineralogical specimens the value of which it is difficult to determine."—*Engineer*.

"How to find commercial minerals, and how to identify them when they are found, are the leading points to which attention is directed. The author has managed to pack as much practical detail into his pages as would supply material for a book three times its size."—*Mining Journal*

NOTES AND FORMULÆ FOR MINING STUDENTS.

By JOHN HERMAN MERIVALE, M.A., Certificated Colliery Manager, Professor of Mining in the Durham College of Science, Newcastle-upon-Tyne. Third Edition, Revised and Enlarged. Small crown 8vo, cloth **2/6**

"The author has done his work in a creditable manner, and has produced a book that will be of service to students and those who are practically engaged in mining operations."—*Engineer*.

THE MINER'S HANDBOOK.

A Handy Book of Reference on the subjects of Mineral Deposits, Mining Operations, Ore Dressing, &c. For the Use of Students and others interested in Mining Matters. By JOHN MILNE, F.R.S., Professor of Mining in the Imperial University of Japan. Revised Edition. Fcap. 8vo, leather **7/6**

"Professor Milne's handbook is sure to be received with favour by all connected with mining, and will be extremely popular among students."—*Athenæum*.

POCKET-BOOK for MINERS and METALLURGISTS.

Comprising Rules, Formulæ, Tables, and Notes for Use in Field and Office Work. By F. DANVERS POWER, F.G.S., M.E. Fcap. 8vo, leather **9/0**

"This excellent book is an admirable example of its kind, and ought to find a large sale amongst English-speaking prospectors and mining engineers."—*Engineering*.

MINERAL SURVEYOR and VALUER'S GUIDE.

Comprising a Treatise on Improved Mining Surveying and the Valuation of Mining Properties, with New Traverse Tables. By WM. LINTERN. Third Edition, Enlarged. 12mo, cloth **3/6**

THE COLLIERY MANAGER'S HANDBOOK.

A Comprehensive Treatise on the Laying-out and Working of Collieries, Designed as a Book of Reference for Colliery Managers, and for the Use of Coal Mining Students preparing for First-class Certificates. By CALEB PAMELY, Mining Engineer and Surveyor; Member of the North of England Institute of Mining and Mechanical Engineers; and Member of the South Wales Institute of Mining Engineers. With nearly 700 Plans, Diagrams, and other Illustrations. Third Edition, Revised and Enlarged, medium 8vo, about 900 pp. Strongly bound **£1 5s.**

SUMMARY OF CONTENTS:—GEOLOGY.—SEARCH FOR COAL.—MINERAL LEASES AND OTHER HOLDINGS.—SHAFT SINKING.—FITTING UP THE SHAFT AND SURFACE ARRANGEMENTS.—STEAM BOILERS AND THEIR FITTINGS.—TIMBERING AND WALLING.—NARROW WORK AND METHODS OF WORKING.—UNDERGROUND CONVEYANCE.—DRAINAGE.—THE GASES MET WITH IN MINES; VENTILATION.—ON THE FRICTION OF AIR IN MINES.—THE PRIESTMAN OIL ENGINE; PETROLEUM AND NATURAL GAS.—SURVEYING AND PLANNING.—SAFETY LAMPS AND FIREDAMP DETECTORS.—SUNDRY AND INCIDENTAL OPERATIONS AND APPLIANCES.—COLLIERY EXPLOSIONS.—MISCELLANEOUS QUESTIONS AND ANSWERS.—*Appendix*: SUMMARY OF REPORT OF H.M. COMMISSIONERS ON ACCIDENTS IN MINES.

"Mr. Pameley has not only given us a comprehensive reference book of a very high order, suitable to the requirements of mining engineers and colliery managers, but has also provided mining students with a class-book that is as interesting as it is instructive."—*Colliery Manager*.

"Mr. Pameley's work is eminently suited to the purpose for which it is intended, being clear, interesting, exhaustive, rich in detail, and up to date, giving descriptions of the latest machines in every department. A mining engineer could scarcely go wrong who followed this work."—*Colliery Guardian*.

"This is the most complete 'all-round' work on coal-mining published in the English language. . . . No library of coal-mining books is complete without it."—*Colliery Engineer* (Scranton, Pa., U.S.A.).

COAL & IRON INDUSTRIES of the UNITED KINGDOM.

Comprising a Description of the Coal Fields, and of the Principal Seams of Coal, with Returns of their Produce and its Distribution, and Analyses of Special Varieties. Also, an Account of the Occurrence of Iron Ores in Veins or Seams; Analyses of each Variety; and a History of the Rise and Progress of Pig Iron Manufacture. By RICHARD MEADE. 8vo, cloth **£1 8s.**

"Of this book we may unreservedly say that it is the best of its class which we have ever met. . . . A book of reference which no one engaged in the iron or coal trades should omit from his library."—*Iron and Coal Trades Review*.

COAL AND COAL MINING.

By the late Sir WARINGTON W. SMYTH, M.A., F.R.S., &c., Chief Inspector of the Mines of the Crown. Seventh Edition, Revised and Enlarged. With numerous Illustrations, 12mo, cloth **3/6**

"As an outline is given of every known coal-field in this and other countries, as well as of the principal methods of working, the book will doubtless interest a very large number of readers."—*Mining Journal*.

ASBESTOS AND ASBESTIC.

Their Properties, Occurrence, and Use. By ROBERT H. JONES, F.S.A., Mineralogist, Hon. Mem. Asbestos Club, Black Lake, Canada. With Ten Colotype Plates and other Illustrations. Demy 8vo, cloth. [Just Published. **16/0**

"An interesting and invaluable work."—*Colliery Guardian*.

SUBTERRANEAN SURVEYING

(Elementary and Practical Treatise on), with and without the Magnetic Needle. By THOMAS FENWICK, Surveyor of Mines, and THOMAS BAKER, C.E. Illustrated. 12mo, cloth **2/6**

GRANITES AND OUR GRANITE INDUSTRIES.

By GEORGE F. HARRIS, F.G.S., Membre de la Société Belge de Géologie, Lecturer on Economic Geology at the Birkbeck Institution, &c. With Illustrations. Crown 8vo, cloth **2/6**

"A clearly and well-written manual for persons engaged or interested in the granite industry."—*Scotsman*.

THE METALLURGY OF GOLD.

A Practical Treatise on the Metallurgical Treatment of Gold-bearing Ores. Including the Processes of Concentration, Chlorination, and Extraction by Cyanide, and the Assaying, Melting, and Refining of Gold. By M. EISSLER, Mining Engineer and Metallurgical Chemist, formerly Assistant Assayer of the U.S. Mint, San Francisco. Fourth Edition, Enlarged. With about 250 Illustrations and numerous Folding Plates and Working Drawings. Large crown 8vo, cloth. **[Just Published. 16/0]**

"This book thoroughly deserves its title of a 'Practical Treatise.' The whole process of gold milling, from the breaking of the quartz to the assay of the bullion, is described in clear and orderly narrative and with much, but not too much, fulness of detail."—*Saturday Review*.

"The work is a storehouse of information and valuable data, and we strongly recommend it to all professional men engaged in the gold-mining industry."—*Mining Journal*.

THE CYANIDE PROCESS OF GOLD EXTRACTION.

Including its Practical Application on the Witwatersrand Gold Fields in South Africa. By M. EISSLER, M.E., Author of "The Metallurgy of Gold," &c. With Diagrams and Working Drawings. 8vo, cloth. **[Just Published. 7/6]**

"This book is just what was needed to acquaint mining men with the actual working of a process which is not only the most popular, but is, as a general rule, the most successful for the extraction of gold from tailings."—*Mining Journal*.

"The work will prove invaluable to all interested in gold mining, whether metallurgists or as investors."—*Chemical News*.

THE METALLURGY OF SILVER.

A Practical Treatise on the Amalgamation, Roasting, and Lixiviation of Silver Ores. Including the Assaying, Melting, and Refining of Silver Bullion. By M. EISSLER, Author of "The Metallurgy of Gold," &c. Third Edition. Crown 8vo, cloth **10/6**

"A practical treatise, and a technical work which we are convinced will supply a long-felt want amongst practical men, and at the same time be of value to students and others indirectly connected with the industries."—*Mining Journal*.

"From first to last the book is thoroughly sound and reliable."—*Colliery Guardian*.

"For chemists, practical miners, assayers, and investors alike we do not know of any work on the subject so handy and yet so comprehensive."—*Glasgow Herald*.

THE METALLURGY OF ARGENTIFEROUS LEAD.

A Practical Treatise on the Smelting of Silver-Lead Ores and the Refining of Lead Bullion. Including Reports on various Smelting Establishments and Descriptions of Modern Smelting Furnaces and Plants in Europe and America. By M. EISSLER, M.E., Author of "The Metallurgy of Gold," &c. Crown 8vo, 400 pp., with 183 Illustrations, cloth **12/6**

"The numerous metallurgical processes, which are fully and extensively treated of, embrace all the stages experienced in the passage of the lead from the various natural states to its issue from the refinery as an article of commerce."—*Practical Engineer*.

"The present volume fully maintains the reputation of the author. Those who wish to obtain a thorough insight into the present state of this industry cannot do better than read this volume, and all mining engineers cannot fail to find many useful hints and suggestions in it."—*Industries*.

METALLURGY OF IRON.

By H. BAUERMAN, F.G.S., A.R.S.M. Sixth Edition, Revised and Enlarged. 12mo, cloth **5/0**

THE IRON ORES OF GREAT BRITAIN and IRELAND.

Their Mode of Occurrence, Age and Origin, and the Methods of Searching for and Working Them. With a Notice of some of the Iron Ores of Spain. By J. D. KENDALL, F.G.S., Mining Engineer. Crown 8vo, cloth **16/0**

"The author has a thorough practical knowledge of his subject, and has supplemented a careful study of the available literature by unpublished information derived from his own observations. The result is a very useful volume, which cannot fail to be of value to all interested in the on industry of the country."—*Industries*.

ELECTRICITY, ELECTRICAL ENGINEERING, &c.

SUBMARINE TELEGRAPHS.

Their History, Construction, and Working. By CHARLES BRIGHT, F.R.S.E.
Super-royal 8vo, about 600 pp., fully Illustrated. [In the Press.]

[To Subscribers before publication, £2 2s. net; after publication the price
will be raised to £3 3s. net.]

THE ELECTRICAL ENGINEER'S POCKET-BOOK.

Consisting of Modern Rules, Formulæ, Tables, and Data. By H. R. KEMPE,
M.Inst.E.E., A.M.Inst.C.E., Technical Officer Postal Telegraphs, Author of
"A Handbook of Electrical Testing," "The Engineer's Year-Book," &c.
Second Edition, thoroughly Revised, with Additions. With numerous Illus-
trations. Royal 32mo, oblong, leather 5/0

"There is very little in the shape of formulæ or data which the electrician is likely to want in
a hurry which cannot be found in its pages."—*Practical Engineer.*

"A very useful book of reference for daily use in practical electrical engineering and its
various applications to the industries of the present day."—*Iron.*

"It is the best book of its kind."—*Electrical Engineer.*

"The Electrical Engineer's Pocket-Book is a good one."—*Electrician.*

"Strongly recommended to those engaged in the electrical industries."—*Electrical Review.*

ELECTRIC LIGHT FITTING.

A Handbook for Working Electrical Engineers, embodying Practical Notes on
Installation Management. By J. W. URQUHART, Electrician, Author of
"Electric Light," &c. With numerous Illustrations. Third Edition,
Revised, with Additions. Crown 8vo, cloth. [Just Published. 5/0

"This volume deals with what may be termed the mechanics of electric lighting, and is
addressed to men who are already engaged in the work, or are training for it. The work traverses
a great deal of ground, and may be read as a sequel to the same author's useful work on 'Electric
Light.'"—*Electrician.*

"This is an attempt to state in the simplest language the precautions which should be adopted
in installing the electric light, and to give information for the guidance of those who have to run the
plant when installed. The book is well worth the perusal of the workman, for whom it is written."
—*Electrical Review.*

"Eminently practical and useful. . . Ought to be in the hands of every one in charge of an
electric light plant."—*Electrical Engineer.*

ELECTRIC LIGHT.

Its Production and Use, Embodying Plain Directions for the Treatment of
Dynamo-Electric Machines, Batteries, Accumulators, and Electric Lamps.
By J. W. URQUHART, C.E., Author of "Electric Light Fitting," "Electro-
plating," &c. Sixth Edition, carefully Revised, with Additions and 145 Illus-
trations. Crown 8vo, cloth. [Just Published. 7/6

"The whole ground of electric lighting is more or less covered and explained in a very clear
and concise manner."—*Electrical Review.*

"Contains a good deal of very interesting information, especially in the parts where the author
gives dimensions and working costs."—*Electrical Engineer.*

"A *vade-mecum* of the salient facts connected with the science of electric lighting."—
Electrician.

"You cannot for your purpose have a better book than 'Electric Light' by Urquhart."—
Engineer.

"The book is by far the best that we have yet met with on the subject."—*Athenæum.*

DYNAMO CONSTRUCTION.

A Practical Handbook for the Use of Engineer-Constructors and Electricians-
in-Charge. Embracing Framework Building, Field Magnet and Armature
Winding and Grouping, Compounding, &c. With Examples of leading
English, American, and Continental Dynamos and Motors. By J. W.
URQUHART, Author of "Electric Light," &c. Second Edition, Enlarged.
With 114 Illustrations. Crown 8vo, cloth 7/6

"Mr. Urquhart's book is the first one which deals with these matters in such a way that the
engineering student can understand them. The book is very readable, and the author leads his
readers up to difficult subjects by reasonably simple tests."—*Engineering Review.*

"'Dynamo Construction' more than sustains the high character of the author's previous
publications. It is sure to be widely read by the large and rapidly-increasing number of practical
electricians."—*Glasgow Herald.*

"A book for which a demand has long existed."—*Mechanical World*

THE MANAGEMENT OF DYNAMOS.

A Handy Book of Theory and Practice for the Use of Mechanics, Engineers, Students, and others in Charge of Dynamos. By G. W. LUMMIS PATERSON. With numerous Illustrations. Crown 8vo, cloth **3/6**

"An example which deserves to be taken as a model by other authors. The subject is treated in a manner which any intelligent man who is fit to be entrusted with charge of an engine should be able to understand. It is a useful book to all who make, tend, or employ electric machinery."—*Architect.*

THE STANDARD ELECTRICAL DICTIONARY.

A Popular Dictionary of Words and Terms Used in the Practice of Electrical Engineering. Containing upwards of 3,000 Definitions. By T. O'CONNOR SLOANE, A.M., Ph.D. Crown 8vo, 630 pp., 350 Illustrations, cloth **7/6**

"The work has many attractive features in it, and is, beyond doubt, a well put together and useful publication. The amount of ground covered may be gathered from the fact that in the index about 5,000 references will be found."—*Electrical Review.*

ELECTRIC SHIP-LIGHTING.

A Handbook on the Practical Fitting and Running of Ships' Electrical Plant. For the Use of Shipowners and Builders, Marine Electricians, and Seagoing Engineers-in-Charge. By J. W. URQUHART, C.E. With 88 Illustrations, Crown 8vo, cloth **7/6**

"The subject of ship electric lighting is one of vast importance, and Mr. Urquhart is to be highly complimented for placing such a valuable work at the service of marine electricians."—*The Steamship.*

ELECTRIC LIGHT FOR COUNTRY HOUSES.

A Practical Handbook on the Erection and Running of Small Installations, with Particulars of the Cost of Plant and Working. By J. H. KNIGHT. Crown 8vo, wrapper **1/0**

"The book contains excellent advice and many practical hints for the help of those who wish to light their own houses."—*Building News.*

ELEMENTARY PRINCIPLES OF ELECTRIC LIGHTING.

By ALAN A. CAMPBELL SWINTON, Associate I.E.E. Third Edition, Enlarged and Revised. With 16 Illustrations. Crown 8vo, cloth **1/6**

"Any one who desires a short and thoroughly clear exposition of the elementary principles of electric lighting cannot do better than read this little work."—*Bradford Observer.*

DYNAMIC ELECTRICITY AND MAGNETISM.

By PHILIP ATKINSON, A.M., Ph.D., Author of "Elements of Static Electricity," &c. Crown 8vo, 417 pp., with 120 Illustrations, cloth **10/6**

THE ELECTRIC TRANSFORMATION OF POWER.

With its Application by the Electric Motor, including Electric Railway Construction. By P. ATKINSON, A.M., Ph.D. With 96 Illustrations. Crown 8vo, cloth **7/6**

HOW TO MAKE A DYNAMO.

A Practical Treatise for Amateurs. Containing numerous Illustrations and Detailed Instructions for Constructing a Small Dynamo to Produce the Electric Light. By ALFRED CROFTS. Fifth Edition, Revised and Enlarged. Crown 8vo, cloth. [Just Published. **2/0**

"The instructions given in this unpretentious little book are sufficiently clear and explicit to enable any amateur mechanic possessed of average skill and the usual tools to be found in an amateur's workshop to build a practical dynamo machine."—*Electrician.*

THE STUDENT'S TEXT-BOOK OF ELECTRICITY.

By H. M. NOAD, F.R.S. Newer Edition. 650 pp., with 470 Illustrations. Crown 8vo, cloth **9/0**

ARCHITECTURE, BUILDING, &c.

PRACTICAL BUILDING CONSTRUCTION.

A Handbook for Students Preparing for Examinations, and a Book of Reference for Persons Engaged in Building. By JOHN PARNELL ALLEN, Surveyor, Lecturer on Building Construction at the Durham College of Science, Newcastle-on-Tyne. Second Edition, Revised and Enlarged. Medium 8vo, 450 pp., with 1,000 Illustrations, cloth. [Just Published. 7/6

"The most complete exposition of building construction we have seen. It contains all that is necessary to prepare students for the various examinations in building construction."—*Building News*.

"The author depends nearly as much on his diagrams as on his type. The pages suggest the hand of a man of experience in building operations—and the volume must be a blessing to many teachers as well as to students."—*The Architect*.

"The work is sure to prove a formidable rival to great and small competitors alike, and bids fair to take a permanent place as a favourite student's text-book. The large number of illustrations deserve particular mention for the great merit they possess for purposes of reference in exactly corresponding to convenient scales."—*Journal of the Royal Institute of British Architects*.

PRACTICAL MASONRY.

A Guide to the Art of Stone Cutting. Comprising the Construction, Setting Out, and Working of Stairs, Circular Work, Arches, Niches, Domes, Pendentives, Vaults, Tracery Windows, &c., &c. For the Use of Students, Masons, and other Workmen. By WILLIAM R. PURCHASE, Building Inspector to the Town of Hove. Royal 8vo, 134 pp., with 50 Lithographic Plates, comprising nearly 400 separate Diagrams, cloth 7/6

"Mr. Purchase's 'Practical Masonry' will undoubtedly be found useful to all interested in this important subject, whether theoretically or practically. Most of the examples given are from actual work carried out, the diagrams being carefully drawn. The book is a practical treatise on the subject, the author himself having commenced as an operative mason, and afterwards acted as foreman mason on many large and important buildings prior to the attainment of his present position. It should be found of general utility to architectural students and others, as well as to those to whom it is specially addressed."—*Journal of the Royal Institute of British Architects*.

"The author has evidently devoted much time and conscientious labour in the production of his book, which will be found very serviceable to students, masons, and other workmen, while its value is much enhanced by the capital illustrations, consisting of fifty lithographic plates, comprising about 400 diagrams."—*Illustrated Carpenter and Builder*.

CONCRETE: ITS NATURE AND USES.

A Book for Architects, Builders, Contractors, and Clerks of Works. By GEORGE L. SUTCLIFFE, A.R.I.B.A. 350 pp., with numerous Illustrations. Crown 8vo, cloth 7/6

"The author treats a difficult subject in a lucid manner. The manual fills a long-felt gap. It is careful and exhaustive; equally useful as a student's guide and an architect's book of reference."—*Journal of the Royal Institute of British Architects*.

"There is room for this new book, which will probably be for some time the standard work on the subject for a builder's purpose."—*Glasgow Herald*.

THE MECHANICS OF ARCHITECTURE.

A Treatise on Applied Mechanics, especially Adapted to the Use of Architects. By E. W. TARN, M.A., Author of "The Science of Building," &c. Second Edition, Enlarged. Illustrated with 125 Diagrams. Crown 8vo, cloth 7/6

"The book is a very useful and helpful manual of architectural mechanics, and really contains sufficient to enable a careful and painstaking student to grasp the principles bearing upon the majority of building problems. . . . Mr. Tarn has added, by this volume, to the debt of gratitude which is owing to him by architectural students for the many valuable works which he has produced for their use."—*The Builder*.

"The mechanics in the volume are really mechanics, and are harmoniously wrought in with the distinctive professional matter proper to the subject. The diagrams and type are commendably clear."—*The Schoolmaster*.

LOCKWOOD'S BUILDER'S PRICE BOOK for 1898.

A Comprehensive Handbook of the Latest Prices and Data for Builders, Architects, Engineers, and Contractors. Re-constructed, Re-written, and Greatly Enlarged. By FRANCIS T. W. MILLER. 800 closely-printed pages, crown 8vo, cloth 4/0

"This book is a very useful one, and should find a place in every English office connected with the building and engineering professions."—*Industries*.

"An excellent book of reference."—*Architect*.

"In its new and revised form this Price Book is what a work of this kind should be—comprehensive, reliable, well arranged, legible, and well bound."—*British Architect*.

THE LONDON BUILDING ACT, 1894.

With the By-Laws and Regulations of the London County Council, and Introduction, Notes, Cases, and Index. By ALEX. J. DAVID, B.A., LL.M., of the Inner Temple, Barrister-at-Law. Crown 8vo, cloth **3/6**

"To all architects and district surveyors and builders Mr. David's manual will be welcome."
—*Building News*.

"The volume will doubtless be eagerly consulted by the building fraternity."—*Illustrated Carpenter and Builder*

THE DESIGN OF BUILDINGS.

Being Elementary Notes on the Planning, Sanitation, and Ornamentive Formation of Structures, based on Modern Practice. Illustrated with Nine Folding Plates. By W. WOODLEY. 8vo, cloth **6/0**

THE DECORATIVE PART of CIVIL ARCHITECTURE.

By Sir WILLIAM CHAMBERS, F.R.S. With Portrait, Illustrations, Notes, and an EXAMINATION OF GRECIAN ARCHITECTURE, by JOSEPH GWILT, F.S.A. Revised and Edited by W. H. LEEDS. 66 Plates, 4to, cloth **21/0**

A HANDY BOOK OF VILLA ARCHITECTURE.

Being a Series of Designs for Villa Residences in various Styles. With Outline Specifications and Estimates. By C. WICKES, Architect, Author of "The Spires and Towers of England," &c. 61 Plates, 4to, half-morocco, gilt edges **£1 11s. 6d.**

"The whole of the designs bear evidence of their being the work of an artistic architect, and they will prove very valuable and suggestive."—*Building News*.

THE ARCHITECT'S GUIDE.

Being a Text-book of Useful Information for Architects, Engineers, Surveyors, Contractors, Clerks of Works, &c., &c. By FREDERICK ROGERS, Architect. Third Edition. Crown 8vo, cloth **3/6**

"As a text-book of useful information for architects, engineers, surveyors, &c., it would be hard to find a handier or more complete little volume."—*Standard*

ARCHITECTURAL PERSPECTIVE.

The whole Course and Operations of the Draughtsman in Drawing a Large House in Linear Perspective. Illustrated by 43 Folding Plates. By F. O. FERGUSON. Second Edition, Enlarged. 8vo, boards **3/6**

"It is the most intelligible of the treatises on this ill-treated subject that I have met with."—E. INGRESS BELL, ESQ., in the *R.I.B.A. Journal*.

PRACTICAL RULES ON DRAWING.

For the Operative Builder and Young Student in Architecture. By GEORGE PYNE. 14 Plates, 4to, boards **7/6**

MEASURING AND VALUING ARTIFICER'S WORK.

(The Student's Guide to the Practice of.) Containing Directions for taking Dimensions, Abstracting the same, and bringing the Quantities into Bill, with Tables of Constants for Valuation of Labour, and for the Calculation of Areas and Solidities. Originally edited by E. DOBSON, Architect. With Additions by E. W. TARN, M.A. Sixth Edition. With 8 Plates and 63 Woodcuts. Crown 8vo, cloth **7/6**

"This edition will be found the most complete treatise on the principles of measuring and valuing artificer's work that has yet been published."—*Building News*.

TECHNICAL GUIDE, MEASURER, and ESTIMATOR.

For Builders and Surveyors. Containing Technical Directions for Measuring Work in all the Building Trades, Complete Specifications for Houses, Roads, and Drains, and an Easy Method of Estimating the parts of a Building collectively. By A. C. BEATON. Eighth Edition. Waistcoat-pocket size, gilt edges **1/6**

"No builder, architect, surveyor, or valuer should be without his 'Beaton.'"—*Building News*

CONSTRUCTIONAL IRON AND STEEL WORK.

As Applied to Public, Private, and Domestic Buildings. A Practical Treatise for Architects, Students, and Builders. By F. CAMPIN. Crown 8vo, cloth.

[Just Published. 3/6

"Any one who wants a book on ironwork, as employed in buildings for stanchions, columns, and beams, will find the present volume to be suitable. The author has had long and varied experience in designing this class of work. The illustrations have the character of working drawings. This practical book may be counted a most valuable work."—*British Architect*.

SPECIFICATIONS for PRACTICAL ARCHITECTURE.

A Guide to the Architect, Engineer, Surveyor, and Builder. With an Essay on the Structure and Science of Modern Buildings. Upon the Basis of the Work by ALFRED BARTHOLOMEW, thoroughly Revised, Corrected, and greatly added to by FREDERICK ROGERS, Architect. Third Edition, Revised. 8vo, cloth 15/0

"The work is too well known to need any recommendation from us. It is one of the books with which every young architect must be equipped."—*Architect*.

THE SCIENCE OF BUILDING.

An Elementary Treatise on the Principles of Construction. By E. WYNDHAM TARN, M.A., Architect. Third Edition, Revised and Enlarged, with 59 Engravings. Fcap. 8vo, cloth 3/6

"A very valuable book, which we strongly recommend to all students."—*Builder*.

THE HOUSE-OWNER'S ESTIMATOR.

Or, What will it Cost to Build, Alter, or Repair? A Price Book for Un-professional People as well as the Architectural Surveyor and Builder. By J. D. SIMON. Edited by F. T. W. MILLER, A.R.I.B.A. Fourth Edition. Crown 8vo, cloth 3/6

"In two years it will repay its cost a hundred times over."—*Field*.

A BOOK ON BUILDING.

Civil and Ecclesiastical, including Church Restoration; with the Theory of Domes and the Great Pyramid, &c. By Sir EDMUND BECKETT, Bart., LL.D., F.R.A.S. Second Edit. Fcap. 8vo, cloth 4/6

"A book which is always amusing and nearly always instructive."—*The Times*.

SANITARY ARRANGEMENT OF DWELLING-HOUSES.

A Handbook for Householders and Owners of Houses. By A. J. WALLIS-TAYLER, A.M.Inst.C.E. With Illustrations. Crown 8vo, cloth 2/6

"This book will be largely read; it will be of considerable service to the public. It is well arranged, easily read, and for the most part devoid of technical terms."—*Lancet*.

VENTILATION.

A Text-book to the Practice of the Art of Ventilating Buildings. By W. P. BUCHAN, R.P. 12mo, cloth 3/6

"Contains a great amount of useful practical information as thoroughly interesting as it is technically reliable."—*British Architect*.

PLUMBING.

A Text-book to the Practice of the Art or Craft of the Plumber. By W. P. BUCHAN, R.P. Seventh Edition, Enlarged. Crown 8vo, cloth 3/6

"A text-book which may be safely put in the hands of every young plumber."—*Builder*.

PRACTICAL GEOMETRY.

For the Architect, Engineer, and Mechanic. Giving Rules for the Delineation and Application of various Geometrical Lines, Figures, and Curves. By E. W. TARN, M.A., Architect. 8vo, cloth 9/0

"No book with the same objects in view has ever been published in which the clearness of the rules laid down and the illustrative diagrams have been so satisfactory."—*Scotsman*.

THE GEOMETRY OF COMPASSES.

Or, Problems Resolved by the mere Description of Circles and the use of Coloured Diagrams and Symbols. By OLIVER BYRNE. Coloured Plates. Crown 8vo, cloth 3/6

CARPENTRY, TIMBER, &c.

THE ELEMENTARY PRINCIPLES OF CARPENTRY.

A Treatise on the Pressure and Equilibrium of Timber Framing, the Resistance of Timber, and the Construction of Floors, Arches, Bridges, Roofs, Uniting Iron and Stone with Timber, &c. To which is added an Essay on the Nature and Properties of Timber, &c., with Descriptions of the kinds of Wood used in Building; also numerous Tables of the Scantlings of Timber for different purposes, the Specific Gravities of Materials, &c. By THOMAS TREDGOLD, C.E. With an Appendix of Specimens of Various Roofs of Iron and Stone, Illustrated. Seventh Edition, thoroughly Revised and considerably Enlarged by E. WYNDHAM TARN, M.A., Author of "The Science of Building," &c. With 61 Plates, Portrait of the Author, and several Woodcuts. In One large Vol., 4to, cloth **25/0**

"Ought to be in every architect's and every builder's library."—*Builder*.

"A work whose monumental excellence must commend it wherever skillful carpentry is concerned. The author's principles are rather confined than impaired by time. The additional plates are of great intrinsic value."—*Building News*.

WOODWORKING MACHINERY.

Its Rise, Progress, and Construction. With Hints on the Management of Saw Mills and the Economical Conversion of Timber. Illustrated with Examples of Recent Designs by leading English, French, and American Engineers. By M. POWIS BALE, A.M.Inst.C.E., M.I.M.E. Second Edition, Revised, with large Additions, large crown 8vo, 440 pp., cloth **9/0**

"Mr. Bale is evidently an expert on the subject, and he has collected so much information that his book is all-sufficient for builders and others engaged in the conversion of timber."—*Architect*.

"The most comprehensive compendium of wood-working machinery we have seen. The author is a thorough master of his subject."—*Building News*.

SAW MILLS.

Their Arrangement and Management, and the Economical Conversion of Timber. By M. POWIS BALE, A.M.Inst.C.E. Second Edition, Revised. Crown 8vo, cloth. [*Just Published.*] **10/6**

"The *administration* of a large sawing establishment is discussed, and the subject examined from a financial standpoint. Hence the size, shape, order, and disposition of saw mills and the like are gone into in detail, and the course of the timber is traced from its reception to its delivery in its converted state. We could not desire a more complete or practical treatise."—*Builder*.

THE CARPENTER'S NEW GUIDE.

Or, Book of Lines for Carpenters; comprising all the Elementary Principles essential for acquiring a knowledge of Carpentry. Founded on the late PETER NICHOLSON'S standard work. A New Edition, Revised by ARTHUR ASHPITEL, F.S.A. Together with Practical Rules on Drawing, by GEORGE PYNE. With 74 Plates, 4to, cloth **£1 1s.**

A PRACTICAL TREATISE ON HANDRAILING.

Showing New and Simple Methods for Finding the Pitch of the Plank, Drawing the Moulds, Beveling, Jointing-up, and Squaring the Wreath. By GEORGE COLLINGS. Second Edition, Revised and Enlarged, to which is added A TREATISE ON STAIR-BUILDING. With Plates and Diagrams **2/6**

"Will be found of practical utility in the execution of this difficult branch of joinery."—*Builder*.

"Almost every difficult phase of this somewhat intricate branch of joinery is elucidated by the aid of plates and explanatory letterpress."—*Furniture Gazette*.

CIRCULAR WORK IN CARPENTRY AND JOINERY.

A Practical Treatise on Circular Work of Single and Double Curvature. By GEORGE COLLINGS. With Diagrams. Second Edition, 12mo, cloth **2/6**

"An excellent example of what a book of this kind should be. Cheap in price, clear in definition, and practical in the examples selected."—*Builder*.

HANDRAILING COMPLETE IN EIGHT LESSONS.

On the Square-Cut System. By J. S. GOLDTHORP, Head of Building Department, Halifax Technical School. With Eight Plates and over 150 Practical Exercises. 4to, cloth **3/6**

"Likely to be of considerable value to joiners and others who take a pride in good work. The arrangement of the book is excellent. We heartily commend it to teachers and students."—*Timber Trades Journal*.

TIMBER MERCHANT'S and BUILDER'S COMPANION.

Containing New and Copious Tables of the Reduced Weight and Measurement of Deals and Battens, of all sizes, from One to a Thousand Pieces, and the relative Price that each size bears per Lineal Foot to any given Price per Petersburg Standard Hundred; the Price per Cube Foot of Square Timber to any given Price per Load of 50 Feet, &c., &c. By WILLIAM DOWSING. Fourth Edition, Revised and Corrected. Crown 8vo, cloth **3/0**

"We are glad to see a fourth edition of these admirable tables, which for correctness and simplicity of arrangement leave nothing to be desired."—*Timber Trades Journal*.

THE PRACTICAL TIMBER MERCHANT.

A Guide for the Use of Building Contractors, Surveyors, Builders, &c., comprising useful Tables for all purposes connected with the Timber Trade, Marks of Wood, Essay on the Strength of Timber, Remarks on the Growth of Timber, &c. By W. RICHARDSON. Second Edition. Fcap. 8vo, cloth **3/6**

"This handy manual contains much valuable information for the use of timber merchants, builders, foresters, and all others connected with the growth, sale, and manufacture of timber."—*Journal of Forestry*.

PACKING=CASE TABLES.

Showing the number of Superficial Feet in Boxes or Packing-Cases, from six inches square and upwards. By W. RICHARDSON, Timber Broker. Third Edition. Oblong 4to, cloth **3/6**

"Invaluable labour-saving tables."—*Ironmonger*.

GUIDE TO SUPERFICIAL MEASUREMENT.

Tables calculated from 1 to 200 inches in length by 1 to 108 inches in breadth. For the use of Architects, Surveyors, Engineers, Timber Merchants, Builders, &c. By JAMES HAWKINGS. Fourth Edition. Fcap., cloth. **3/6**

"A useful collection of tables to facilitate rapid calculation of surfaces. The exact area of any surface of which the limits have been ascertained can be instantly determined. The book will be found of the greatest utility to all engaged in building operations."—*Scotsman*.

PRACTICAL FORESTRY.

Its Bearing on the Improvement of Estates. By CHARLES E. CURTIS, F.S.I., F.S.S. Second Edition, Revised. Crown 8vo, cloth. [Just Ready. **3/6**

THE ELEMENTS OF FORESTRY.

Designed to afford Information concerning the Planting and Care of Forest Trees for Ornament or Profit, with suggestions upon the Creation and Care of Woodlands. By F. B. HOUGH. Large crown 8vo, cloth **10/0**

THE TIMBER IMPORTER'S, TIMBER MERCHANT'S, AND BUILDER'S STANDARD GUIDE.

By RICHARD E. GRANDY. Comprising:—An Analysis of Deal Standards, Home and Foreign, with Comparative Values and Tabular Arrangements for fixing Net Landed Cost on Baltic and North American Deals, including all intermediate Expenses, Freight, Insurance, &c.; together with copious Information for the Retailer and Builder. Third Edition. 12mo, cloth **2/0**

"Everything it pretends to be: built up gradually, it leads one from a forest to a treenail, and throws in as a makeweight a host of material concerning bricks, columns, cisterns, &c."—*English Mechanic*.

DECORATIVE ARTS, &c.

SCHOOL OF PAINTING FOR THE IMITATION OF WOODS AND MARBLES.

As Taught and Practised by A. R. VAN DER BURG and P. VAN DER BURG, Directors of the Rotterdam Painting Institution. Royal folio, 18½ by 12½ in., Illustrated with 24 full-size Coloured Plates; also 12 plain Plates, comprising 154 Figures. Second and Cheaper Edition **£1 11s. 6d.**

LIST OF PLATES:—1. VARIOUS TOOLS REQUIRED FOR WOOD PAINTING.—2, 3. WALNUT; PRELIMINARY STAGES OF GRAINING AND FINISHED SPECIMEN.—4. TOOLS USED FOR MARBLE PAINTING AND METHOD OF MANIPULATION.—5, 6. ST. REMI MARBLE; EARLIER OPERATIONS AND FINISHED SPECIMEN.—7. METHODS OF SKETCHING DIFFERENT GRAINS, KNOTS, &c.—8, 9. ASH: PRELIMINARY STAGES AND FINISHED SPECIMEN.—10. METHODS OF SKETCHING MARBLE GRAINS.—11, 12. BRECHE MARBLE; PRELIMINARY STAGES OF WORKING AND FINISHED SPECIMEN.—13. MAPLE; METHODS OF PRODUCING THE DIFFERENT GRAINS.—14, 15. BIRD'S-EYE MAPLE; PRELIMINARY STAGES AND FINISHED SPECIMEN.—16. METHODS OF SKETCHING THE DIFFERENT SPECIES OF WHITE MARBLE.—17, 18. WHITE MARBLE; PRELIMINARY STAGES OF PROCESS AND FINISHED SPECIMEN.—19. MAHOGANY; SPECIMENS OF VARIOUS GRAINS AND METHODS OF MANIPULATION.—20, 21. MAHOGANY; EARLIER STAGES AND FINISHED SPECIMEN.—22, 23, 24. SIENNA MARBLE; VARIETIES OF GRAIN, PRELIMINARY STAGES AND FINISHED SPECIMEN.—25, 26, 27. JUNIPER WOOD; METHODS OF PRODUCING GRAIN, &c.; PRELIMINARY STAGES AND FINISHED SPECIMEN.—28, 29, 30. VERT DE MER MARBLE; VARIETIES OF GRAIN AND METHODS OF WORKING, UNFINISHED AND FINISHED SPECIMENS.—31, 32, 33. OAK; VARIETIES OF GRAIN, TOOLS EMPLOYED AND METHODS OF MANIPULATION, PRELIMINARY STAGES AND FINISHED SPECIMEN.—34, 35, 36. WAULSORT MARBLE; VARIETIES OF GRAIN, UNFINISHED AND FINISHED SPECIMENS.

"Those who desire to attain skill in the art of painting woods and marbles will find advantage in consulting this book. . . . Some of the Working Men's Clubs should give their young men the opportunity to study it."—*Builder*.

"A comprehensive guide to the art. The explanations of the processes, the manipulation and management of the colours, and the beautifully executed plates will not be the least valuable to the student who aims at making his work a faithful transcript of nature."—*Building News*.

"Students and novices are fortunate who are able to become the possessors of so noble a work."—*The Architect*

ELEMENTARY DECORATION.

A Guide to the Simpler Forms of Everyday Art. Together with PRACTICAL HOUSE DECORATION. By JAMES W. FACEY. With numerous Illustrations. In One Vol., strongly half-bound **5/0**

HOUSE PAINTING, GRAINING, MARBLING, and SIGN WRITING.

A Practical Manual of. By ELLIS A. DAVIDSON. Seventh Edition. With Coloured Plates and Wood Engravings. 12mo, cloth boards. **6/0**

"A mass of information of use to the amateur and of value to the practical man."—*English Mechanic*.

THE DECORATOR'S ASSISTANT.

A Modern Guide for Decorative Artists and Amateurs, Painters, Writers, Gilders, &c. Containing upwards of 600 Receipts, Rules, and Instructions; with a variety of Information for General Work connected with every Class of Interior and Exterior Decorations, &c. Sixth Edition. 152 pp., cr. 8vo **1/0**

"Full of receipts of value to decorators, painters, gilders, &c. The book contains the gist of larger treatises on colour and technical processes. It would be difficult to meet with a work so full of varied information on the painter's art."—*Building News*.

MARBLE DECORATION

And the Terminology of British and Foreign Marbles. A Handbook for Students. By GEORGE H. BLAGROVE, Author of "Shoring and its Application," &c. With 28 Illustrations. Crown 8vo, cloth **3/6**

"This most useful and much wanted handbook should be in the hands of every architect and builder."—*Building World*.

"A carefully and usefully written treatise; the work is essentially practical."—*Scotsman*.

DELAMOTTE'S WORKS ON ALPHABETS AND ILLUMINATION.

ORNAMENTAL ALPHABETS, ANCIENT & MEDIÆVAL.

From the Eighth Century, with Numerals; including Gothic, Church-Text, large and small, German, Italian, Arabesque, Initials for Illumination, Monograms, Crosses, &c., &c., for the use of Architectural and Engineering Draughtsmen, Missal Painters, Masons, Decorative Painters, Lithographers, Engravers, Carvers, &c., &c. Collected and Engraved by F. DELAMOTTE, and printed in Colours. New and Cheaper Edition. Royal 8vo, oblong, ornamental boards 2/6

"For those who insert enamelled sentences round gilded chalices, who blazon shop legends over shop-doors, who letter church walls with pithy sentences from the Decalogue, this book will be useful."—*Athenæum*.

MODERN ALPHABETS, PLAIN AND ORNAMENTAL.

Including German, Old English, Saxon, Italic, Perspective, Greek, Hebrew, Court Hand, Engrossing, Tuscan, Riband, Gothic, Rustic, and Arabesque; with several Original Designs, and an Analysis of the Roman and Old English Alphabets, large and small, and Numerals, for the use of Draughtsmen, Surveyors, Masons, Decorative Painters, Lithographers, Engravers, Carvers, &c. Collected and Engraved by F. DELAMOTTE, and printed in Colours. New and Cheaper Edition. Royal 8vo, oblong, ornamental boards 2/6

"There is comprised in it every possible shape into which the letters of the alphabet and numerals can be formed, and the talent which has been expended in the conception of the various plain and ornamental letters is wonderful."—*Standard*.

MEDIÆVAL ALPHABETS AND INITIALS FOR ILLUMINATORS.

By F. G. DELAMOTTE. Containing 21 Plates and Illuminated Title, printed in Gold and Colours. With an Introduction by J. WILLIS BROOKS. Fourth and Cheaper Edition. Small 4to, ornamental boards 4/0

"A volume in which the letters of the alphabet come forth glorified in gilding and all the colours of the prism interwoven and intertwined and intermingled."—*Sun*.

A PRIMER OF THE ART OF ILLUMINATION.

For the Use of Beginners; with a Rudimentary Treatise on the Art, Practical Directions for its Exercise, and Examples taken from Illuminated MSS., printed in Gold and Colours. By F. DELAMOTTE. New and Cheaper Edition. Small 4to, ornamental boards 6/0

"The examples of ancient MSS. recommended to the student, which, with much good sense, the author chooses from collections accessible to all, are selected with judgment and knowledge as well as taste."—*Athenæum*.

THE EMBROIDERER'S BOOK OF DESIGN.

Containing Initials, Emblems, Cyphers, Monograms, Ornamental Borders, Ecclesiastical Devices, Mediæval and Modern Alphabets, and National Emblems. Collected by F. DELAMOTTE, and printed in Colours. Oblong royal 8vo, ornamental wrapper 1/6

"The book will be of great assistance to ladies and young children who are endowed with the art of plying the needle in this most ornamental and useful pretty work."—*East Anglian Times*.

INSTRUCTIONS IN WOOD-CARVING FOR AMATEURS.

With Hints on Design. By A LADY. With 10 Plates. New and Cheaper Edition. Crown 8vo, in emblematic wrapper 2/0

"The handicraft of the wood-carver, so well as a book can impart it, may be learnt from 'A Lady's' publication."—*Athenæum*.

PAINTING POPULARLY EXPLAINED.

By THOMAS JOHN GULLICK, Painter, and JOHN TIMBS, F.S.A. Including Fresco, Oil, Mosaic, Water-Colour, Water-Glass, Tempera, Encaustic, Miniature, Painting on Ivory, Vellum, Pottery, Enamel, Glass, &c. Fifth Edition. Crown 8vo, cloth 5/0

* * * Adopted as a Prize Book at South Kensington.

"Much may be learned, even by those who fancy they do not require to be taught, from the careful perusal of this unpretending but comprehensive treatise."—*Art Journal*.

NATURAL SCIENCE, &c.

THE VISIBLE UNIVERSE.

Chapters on the Origin and Construction of the Heavens. By J. E. GORE, F.R.A.S., Author of "Star Groups," &c. Illustrated by 6 Stellar Photographs and 12 Plates. Demy 8vo, cloth 16/0

"A valuable and lucid summary of recent astronomical theory, rendered more valuable and attractive by a series of stellar photographs and other illustrations."—*The Times*.

"In presenting a clear and concise account of the present state of our knowledge Mr. Gore has made a valuable addition to the literature of the subject."—*Nature*.

"Mr. Gore's 'Visible Universe' is one of the finest works on astronomical science that have recently appeared in our language. In spirit and in method it is scientific from cover to cover, but the style is so clear and attractive that it will be as acceptable and as readable to those who make no scientific pretensions as to those who devote themselves specially to matters astronomical."—*Leeds Mercury*.

STAR GROUPS.

A Student's Guide to the Constellations. By J. ELLARD GORE, F.R.A.S., M.R.I.A., &c., Author of "The Visible Universe," "The Scenery of the Heavens," &c. With 30 Maps. Small 4to, cloth 5/0

"The volume contains thirty maps showing stars of the sixth magnitude—the usual naked-eye limit—and each is accompanied by a brief commentary adapted to facilitate recognition and bring to notice objects of special interest. For the purpose of a preliminary survey of the 'midnight pomp' of the heavens nothing could be better than a set of delineations averaging scarcely twenty square inches in area and including nothing that cannot at once be identified."—*Saturday Review*.

AN ASTRONOMICAL GLOSSARY.

Or, Dictionary of Terms used in Astronomy. With Tables of Data and Lists of Remarkable and Interesting Celestial Objects. By J. ELLARD GORE, F.R.A.S., Author of "The Visible Universe," &c. Small crown 8vo, cloth. 2/6

"A very useful little work for beginners in astronomy, and not to be despised by more advanced students."—*The Times*.

"A very handy book . . . the utility of which is much increased by its valuable tables of astronomical data."—*Athenæum*.

THE MICROSCOPE.

Its Construction and Management. Including Technique, Photo-micrography, and the Past and Future of the Microscope. By Dr. HENRI VAN HEURCK. Re-Edited and Augmented from the Fourth French Edition, and Translated by WYNNE E. BAXTER, F.G.S. 400 pp., with upwards of 250 Woodcuts, imp. 8vo, cloth 18/0

"A translation of a well-known work, at once popular and comprehensive."—*Times*.

"The translation is as felicitous as it is accurate."—*Nature*.

PHOTO-MICROGRAPHY.

By Dr. H. VAN HEURCK. Extracted from the above Work. Royal 8vo, with Illustrations, sewed 1/0

ASTRONOMY.

By the late Rev. ROBERT MAIN, M.A., F.R.S. Third Edition, Revised by WILLIAM THYNNE LYNN, B.A., F.R.A.S., formerly of the Royal Observatory, Greenwich. 12mo, cloth 2/0

"A sound and simple treatise, very carefully edited, and a capital book for beginners."—*Knowledge*.

"Accurately brought down to the requirements of the present time by Mr. Lynn."—*Educational Times*.

A MANUAL OF THE MOLLUSCA.

A Treatise on Recent and Fossil Shells. By S. P. WOODWARD, A.L.S., F.G.S. With an Appendix on RECENT AND FOSSIL CONCHOLOGICAL DISCOVERIES, by RALPH TATE, A.L.S., F.G.S. With 23 Plates and upwards of 300 Woodcuts. Reprint of Fourth Edition (1880). Crown 8vo, cloth 7/6

"A most valuable storehouse of conchological and geological information."—*Science Gossip*.

THE TWIN RECORDS OF CREATION.

Or, Geology and Genesis, their Perfect Harmony and Wonderful Concord. By G. W. V. LE VAUX. 8vo, cloth 5/0

"A valuable contribution to the evidences of Revelation, and disposes very conclusively of the arguments of those who would set God's Works against God's Word. No real difficulty is shirked, and no sophistry is left unexposed."—*The Rock*.

HANDBOOK OF MECHANICS.

By Dr. LARDNER. Enlarged and re-written by BENJAMIN LOEWY, F.R.A.S.
378 Illustrations. Post 8vo, cloth **6/0**

"The perspicuity of the original has been retained, and chapters which had become obsolete have been replaced by others of more modern character. The explanations throughout are studiously popular, and care has been taken to show the application of the various branches of physics to the industrial arts, and to the practical business of life."—*Mining Journal*.

HANDBOOK OF HYDROSTATICS AND PNEUMATICS.

By Dr. LARDNER. New Edition, Revised and Enlarged by BENJAMIN LOEWY, F.R.A.S. With 236 Illustrations. Post 8vo, cloth. **5/0**

For those 'who desire to attain an accurate knowledge of physical science without the profound methods of mathematical investigation,' this work is well adapted."—*Chemical News*.

HANDBOOK OF HEAT.

By Dr. LARDNER. Edited and re-written by BENJAMIN LOEWY, F.R.A.S., &c.
117 Illustrations. Post 8vo, cloth **6/0**

"The style is always clear and precise, and conveys instruction without leaving any cloudiness or lurking doubts behind."—*Engineering*.

HANDBOOK OF OPTICS.

By Dr. LARDNER. New Edition. Edited by T. OLVER HARDING, B.A. Lond.
With 298 Illustrations. Small 8vo, 448 pp., cloth **5/0**

"Written by one of the ablest English scientific writers, beautifully and elaborately illustrated."—*Mechanics' Magazine*.

ELECTRICITY, MAGNETISM, AND ACOUSTICS.

By Dr. LARDNER. Edited by GEO. CAREY FOSTER, B.A., F.C.S. With
400 Illustrations. Small 8vo, cloth **5/0**

"The book could not have been entrusted to any one better calculated to preserve the terse and lucid style of Lardner, while correcting his errors and bringing up his work to the present state of scientific knowledge."—*Popular Science Review*.

HANDBOOK OF ASTRONOMY.

By Dr. LARDNER. Fourth Edition. Revised and Edited by EDWIN DUNKIN, F.R.A.S., Royal Observatory, Greenwich. With 38 Plates and upwards of 100 Woodcuts. 8vo, cloth **9/6**

"Probably no other book contains the same amount of information in so compendious and well arranged a form—certainly none at the price at which this is offered to the public."—*Athenæum*.

"We can do no other than pronounce this work a most valuable manual of astronomy, and we strongly recommend it to all who wish to acquire a general—but at the same time correct—acquaintance with this sublime science."—*Quarterly Journal of Science*.

MUSEUM OF SCIENCE AND ART.

Edited by Dr. LARDNER. With upwards of 1,200 Engravings on Wood. In Six Double Volumes, **£1 1s.** in a new and elegant cloth binding; or handsomely bound in half-morocco **£1 11s. 6d.**

"A cheap and interesting publication, alike informing and attractive. The papers combine subjects of importance and great scientific knowledge, considerable inductive powers, and a popular style of treatment."—*Spectator*.

Separate books formed from the above.

Common Things Explained. 5s.	Steam and its Uses. 2s. cloth.
The Microscope. 2s. cloth.	Popular Astronomy. 4s. 6d. cloth.
Popular Geology. 2s. 6d. cloth.	The Bee and White Ants. 2s. cloth.
Popular Physics. 2s. 6d. cloth.	The Electric Telegraph. 1s. 6d.

NATURAL PHILOSOPHY FOR SCHOOLS.

By Dr. LARDNER. Fcap. 8vo **3/6**

"A very convenient class book for junior students in private schools."—*British Quarterly Review*.

ANIMAL PHYSIOLOGY FOR SCHOOLS.

By Dr. LARDNER. Fcap. 8vo **3/6**

"Clearly written, well arranged, and excellently illustrated."—*Gardener's Chronicle*.

THE ELECTRIC TELEGRAPH.

By Dr. LARDNER. Revised by E. B. BRIGHT, F.R.A.S. Fcap. 8vo. **2/6**

"One of the most readable books extant on the Electric Telegraph."—*English Mechanic*.

CHEMICAL MANUFACTURES, CHEMISTRY, &c.

WATER AND ITS PURIFICATION.

A Handbook for the Use of Local Authorities, Sanitary Officers, and others interested in Water Supply. By S. RIDEAL, D.Sc. Lond., F.I.C. With numerous Illustrations and Tables. Crown 8vo, cloth. [*Just Published.* 7/6

"Dr. Rideal's book is both interesting and accurate, and contains a most useful *résumé* of the latest knowledge upon the subject of which it treats. It ought to be of great service to all who are connected with the supply of water for domestic or manufacturing purposes."—*The Engineer*

"Dealing as clearly as it does with the various ramifications of such an important subject as water and its purification it may be warmly recommended. Local authorities and all engaged in sanitary affairs, and others interested in water supply, will read its pages with profit."—*Lancet*.

ENGINEERING CHEMISTRY.

A Practical Treatise for the Use of Analytical Chemists, Engineers, Iron Masters, Iron Founders, Students and others. Comprising Methods of Analysis and Valuation of the Principal Materials used in Engineering Work, with numerous Analyses, Examples and Suggestions. By H. J. PHILLIPS, F.I.C., F.C.S. Second Edition, Enlarged. Crown 8vo, 400 pp., with Illustrations, cloth 10/6

"In this work the author has rendered no small service to a numerous body of practical men. . . . The analytical methods may be pronounced most satisfactory, being as accurate as the despatch required of engineering chemists permits."—*Chemical News*.

"A handy and concise *résumé* of approved methods of analysing and valuing metals, oils, fuels, &c. It is, in fact, a work for chemists, a guide to the routine of the engineering laboratory. . . . The book is full of good things. As a handbook of technical analysis, it is very welcome."—*Builder*.

"The analytical methods given are, as a whole, such as are likely to give rapid and trustworthy results in experienced hands. . . . There is much excellent descriptive matter in the work, the chapter on 'Oils and Lubrication' being specially noticeable in this respect."—*Engineer*.

NITRO-EXPLOSIVES.

A Practical Treatise concerning the Properties, Manufacture, and Analysis of Nitrated Substances, including the Fulminates, Smokeless Powders, and Celluloid. By P. G. SANFORD, F.I.C., Consulting Chemist to the Cotton Powder Company, &c. With Illustrations. Crown 8vo, cloth. [*Just Published.* 9/0

"Any one having the requisite apparatus and materials could make nitro-glycerine or gun-cotton, to say nothing of other explosives, by the aid of the instructions contained in this volume. This is one of the very few text-books in which can be found just what is wanted. Mr. Sanford goes steadily through the whole list of explosives commonly used, he names any given explosive, and tells us of what it is composed and how it is manufactured. The book is excellent throughout."—*The Engineer*.

"A thoroughly practical account of the manufacture, properties, &c., of nitro-explosives. It is an admirable work, which reflects the highest credit on the author."—*Colliery Guardian*.

A HANDBOOK ON MODERN EXPLOSIVES.

A Practical Treatise on the Manufacture and Use of Dynamite, Gun-Cotton, Nitro-Glycerine and other Explosive Compounds, including Collodion-Cotton. With Chapters on Explosives in Practical Application. By M. EISSLER, Mining Engineer and Metallurgical Chemist. Second Edition, Enlarged. With 150 Illustrations. Crown 8vo, cloth. [*Just Published.* 12/6

"Useful not only to the miner, but also to officers of both services to whom blasting and the use of explosives generally may at any time become a necessary auxiliary."—*Nature*.

"A veritable mine of information on the subject of explosives employed for military, mining, and blasting purposes."—*Army and Navy Gazette*.

DANGEROUS GOODS.

Their Sources and Properties, Modes of Storage and Transport. With Notes and Comments on Accidents arising therefrom, together with the Government and Railway Classifications, Acts of Parliament, &c. A Guide for the Use of Government and Railway Officials, Steamship Owners, Insurance Companies and Manufacturers, and Users of Explosives and Dangerous Goods. By H. JOSHUA PHILLIPS, F.I.C., F.C.S. Crown 8vo, 374 pp., cloth 9/0

"We can with justice compliment the author upon the very satisfactory work he has produced, and can recommend it with confidence to all who have to handle, store, or ship any of the very large class of materials comprised in the heading of dangerous goods."—*Mining Journal*

"Merits a wide circulation, and an intelligent, appreciative study."—*Chemical News*.

A MANUAL OF THE ALKALI TRADE.

Including the Manufacture of Sulphuric Acid, Sulphate of Soda, and Bleaching Powder. By JOHN LOMAS, Alkali Manufacturer, Newcastle-upon-Tyne and London. 390 pp. of Text. With 232 Illustrations and Working Drawings. Second Edition, with Additions. Super-royal 8vo, cloth . . . **£1 10s.**

"This book is written by a manufacturer for manufacturers. The working details of the most approved forms of apparatus are given, and these are accompanied by no less than 232 wood engravings, all of which may be used for the purposes of construction. Every step in the manufacture is very fully described in this manual, and each improvement explained."—*Athenæum*.

"We find not merely a sound and luminous explanation of the chemical principles of the trade, but a notice of numerous matters which have a most important bearing on the successful conduct of alkali works, but which are generally overlooked by even experienced technological authors."—*Chemical Reviewer*.

THE BLOWPIPE in CHEMISTRY, MINERALOGY, and GEOLOGY.

Containing all known Methods of Anhydrous Analysis, many Working Examples, and Instructions for Making Apparatus. By Lieut.-Colonel W. A. ROSS, R.A., F.G.S. With 120 Illustrations. Second Edition, Enlarged. Crown 8vo, cloth **5/0**

"The student who goes conscientiously through the course of experimentation here laid down will gain a better insight into inorganic chemistry and mineralogy than if he had 'got up' any of the best text-books of the day, and passed any number of examinations in their contents."—*Chemical News*.

COMMERCIAL HANDBOOK OF CHEMICAL ANALYSIS.

Or, Practical Instructions for the Determination of the Intrinsic or Commercial Value of Substances used in Manufactures, in Trades, and in the Arts. By A. NORMANDY. New Edition by H. M. NOAD, Ph.D., F.R.S. Crown 8vo, cloth **12/6**

"We strongly recommend this book to our readers as a guide, alike indispensable to the housewife as to the pharmaceutical practitioner."—*Medical Times*.

THE MANUAL OF COLOURS AND DYE=WARES.

Their Properties, Applications, Valuations, Impurities and Sophistications. For the Use of Dyers, Printers, Drysalters, Brokers, &c. By J. W. SLATER. Second Edition, Revised and greatly Enlarged. Crown 8vo, cloth **7/6**

"A complete encyclopædia of the *materia tinctoria*. The information given respecting each article is full and precise, and the methods of determining the value of articles such as these, so liable to sophistication, are given with clearness, and are practical as well as valuable."—*Chemist and Druggist*.

"There is no other work which covers precisely the same ground. To students preparing for examinations in dyeing and printing it will prove exceedingly useful."—*Chemical News*.

A HANDY BOOK FOR BREWERS.

Being a Practical Guide to the Art of Brewing and Malting. Embracing the Conclusions of Modern Research which bear upon the Practice of Brewing. By HERBERT EDWARDS WRIGHT, M.A. Second Edition, Enlarged. Crown 8vo, 530 pp., cloth. [Just Published. **12/6**

"May be consulted with advantage by the student who is preparing himself for examinational tests, while the scientific brewer will find in it a *résumé* of all the most important discoveries of modern times. The work is written throughout in a clear and concise manner, and the author takes great care to discriminate between vague theories and well-established facts."—*Brewers' Journal*.

"We have great pleasure in recommending this handy book, and have no hesitation in saying that it is one of the best—if not the best—which has yet been written on the subject of beer-brewing in this country; it should have a place on the shelves of every brewer's library."—*Brewer's Guardian*.

"Although the requirements of the student are primarily considered, an acquaintance of half-an-hour's duration cannot fail to impress the practical brewer with the sense of having found a trustworthy guide and practical counsellor in brewery matters."—*Chemical Trade Journal*.

FUELS: SOLID, LIQUID, AND GASEOUS.

Their Analysis and Valuation. For the Use of Chemists and Engineers. By H. J. PHILLIPS, F.C.S., formerly Analytical and Consulting Chemist to the G.E. Rlwy. Third Edition, Revised and Enlarged. Crown 8vo, cloth **2/0**

"Ought to have its place in the laboratory of every metallurgical establishment and wherever fuel is used on a large scale."—*Chemical News*.

THE ARTISTS' MANUAL OF PIGMENTS.

Showing their Composition, Conditions of Permanency, Non-Permanency, and Adulterations; Effects in Combination with Each Other and with Vehicles; and the most Reliable Tests of Purity. By H. C. STANDAGE. Third Edition, crown 8vo, cloth **2 6**

"This work is indeed *multum-in-parvo*, and we can, with good conscience, recommend it to all who come in contact with pigments, whether as makers, dealers, or users."—*Chemical Review*.

A POCKET-BOOK OF MENSURATION AND GAUGING.

Containing Tables, Rules, and Memoranda for Revenue Officers, Brewers, Spirit Merchants, &c. By J. B. MANT, Inland Revenue. Second Edition, Revised. 18mo, leather **4/0**

"This handy and useful book is adapted to the requirements of the Inland Revenue Department, and will be a favourite book of reference. The range of subjects is comprehensive, and the arrangement simple and clear."—*Civilian*.

"Should be in the hands of every practical brewer."—*Brewers' Journal*.

INDUSTRIAL ARTS, TRADES AND MANUFACTURES.

MODERN CYCLES.

A Practical Handbook on their Construction and Repair. By A. J. WALLIS-TAYLER, A. M. Inst. C. E. Author of "Refrigerating Machinery," &c. With upwards of 300 Illustrations. Crown 8vo, cloth. [Just Published. **10/6**

"The large trade that is done in the component parts of bicycles has placed in the way of men mechanically inclined extraordinary facilities for building bicycles for their own use. . . . The book will prove a valuable guide for all those who aspire to the manufacture or repair of their own machines."—*The Field*.

"A most comprehensive and up-to-date treatise."—*The Cycle*.

"A very useful book, which is quite entitled to rank as a standard work for students of cycle construction."—*Wheeling*.

TEA PLANTING AND MANUFACTURE.

(A Text Book of.) Comprising Chapters on the History and Development of the Industry, the Cultivation of the Plant, the Preparation of the Leaf for the Market, the Botany and Chemistry of Tea, &c. With some Account of the Laws affecting Labour in Tea Gardens in Assam and elsewhere. By DAVID CROLE, late of the Jokai Tea Company, &c. With Plates and other Illustrations. Medium 8vo, cloth. [Just Published. **16/0**

"The author writes as an expert, and gives the result of his personal experiences. The work can hardly fail to be of practical interest to tea growers and tea manufacturers."—*British Trade Journal*.

COTTON MANUFACTURE.

A Manual of Practical Instruction of the Processes of Opening, Carding, Combing, Drawing, Doubling and Spinning of Cotton, the Methods of Dyeing, &c. For the Use of Operatives, Overlookers, and Manufacturers. By JOHN LISTER, Technical Instructor, Pendleton. 8vo, cloth **7/6**

"This invaluable volume is a distinct advance in the literature of cotton manufacture."—*Machinery*.

"It is thoroughly reliable, fulfilling nearly all the requirements desired."—*Glasgow Herald*.

FLOUR MANUFACTURE.

A Treatise on Milling Science and Practice. By FRIEDRICH KICK, Imperial Regierungsrath, Professor of Mechanical Technology in the Imperial German Polytechnic Institute, Prague. Translated from the Second Enlarged and Revised Edition with Supplement. By H. H. P. POWLES, Assoc. Memb. Institution of Civil Engineers. Nearly 400 pp. Illustrated with 28 Folding Plates, and 167 Woodcuts. Royal 8vo, cloth **£1 5s.**

"This valuable work is, and will remain, the standard authority on the science of milling. . . . The miller who has read and digested this work will have laid the foundation, so to speak, of a successful career; he will have acquired a number of general principles which he can proceed to apply. In this handsome volume we at last have the accepted text-book of modern milling in good, sound English, which has little, if any, trace of the German idiom."—*The Miller*.

"The appearance of this celebrated work in English is very opportune, and British millers will, we are sure, not be slow in availing themselves of its pages."—*Millers' Gazette*.

CEMENTS, PASTES, GLUES AND GUMS.

A Practical Guide to the Manufacture and Application of the various Agglutinants required in the Building, Metal-Working, Wood-Working, and Leather-Working Trades, and for Workshop, Laboratory or Office Use. With upwards of 900 Recipes and Formulæ. By H. C. STANDAGE, Chemist. Third Edition. Crown 8vo, cloth. [Just Published. 2/0

"We have pleasure in speaking favourably of this volume. So far as we have had experience, which is not inconsiderable, this manual is trustworthy."—*Athenæum*.

"As a revelation of what are considered trade secrets, this book will arouse an amount of curiosity among the large number of industries it touches."—*Daily Chronicle*.

THE ART OF SOAP-MAKING.

A Practical Handbook of the Manufacture of Hard and Soft Soaps, Toilet Soaps, &c. Including many New Processes, and a Chapter on the Recovery of Glycerine from Waste Leys. By ALX. WATT. Fifth Edition, Revised, with an Appendix on Modern Candlemaking. Crown 8vo, cloth 7/6

"The work will prove very useful, not merely to the technological student, but to the practical soap boiler who wishes to understand the theory of his art."—*Chemical News*.

"A thoroughly practical treatise on an art which has almost no literature in our language. We congratulate the author on the success of his endeavour to fill a void in English technical literature."—*Nature*.

PRACTICAL PAPER-MAKING.

A Manual for Paper-Makers and Owners and Managers of Paper-Mills. With Tables, Calculations, &c. By G. CLAPPERTON, Paper-Maker. With Illustrations of Fibres from Micro-Photographs. Crown 8vo, cloth 5/0

"The author caters for the requirements of responsible mill hands, apprentices, &c., whilst his manual will be found of great service to students of technology, as well as to veteran paper-makers and mill owners. The illustrations form an excellent feature."—*The World's Paper Trade Review*.

"We recommend everybody interested in the trade to get a copy of this thoroughly practical book."—*Paper Making*.

THE ART OF PAPER-MAKING.

A Practical Handbook of the Manufacture of Paper from Rags, Esparto, Straw, and other Fibrous Materials. Including the Manufacture of Pulp from Wood Fibre, with a Description of the Machinery and Appliances used. To which are added Details of Processes for Recovering Soda from Waste Liquors. By ALEXANDER WATT, Author of "The Art of Soap-Making." With Illustrations. Crown 8vo, cloth 7/6

"It may be regarded as the standard work on the subject. The book is full of valuable information. The 'Art of Paper-Making' is in every respect a model of a text-book, either for a technical class, or for the private student."—*Paper and Printing Trades Journal*.

THE ART OF LEATHER MANUFACTURE.

Being a Practical Handbook, in which the Operations of Tanning, Currying, and Leather Dressing are fully Described, and the Principles of Tanning Explained, and many Recent Processes Introduced; as also Methods for the Estimation of Tannin, and a Description of the Arts of Glue Boiling, Gut Dressing, &c. By ALEXANDER WATT, Author of "Soap-Making," &c. Fourth Edition. Crown 8vo, cloth 9/0

"A sound, comprehensive treatise on tanning and its accessories. The book is an eminently valuable production, which redounds to the credit of both author and publishers."—*Chemical Review*.

THE ART OF BOOT AND SHOE MAKING.

A Practical Handbook, including Measurement, Last-Fitting, Cutting-Out, Closing and Making, with a Description of the most approved Machinery Employed. By JOHN B. LENO, late Editor of *St. Crispin*, and *The Boot and Shoe-Maker*. 12mo, cloth 2/0

MECHANICAL DENTISTRY.

A Practical Treatise on the Construction of the various kinds of Artificial Dentures. Comprising also Useful Formulæ, Tables, and Receipts for Gold Plate, Clasps, Solders, &c., &c. By C. HUNTER. Third Edition. With 100 Wood Engravings. Crown 8vo, cloth 3/6

WOOD ENGRAVING.

A Practical and Easy Introduction to the Study of the Art. By W. N. BROWN.
12mo, cloth **1/6**

"The book is clear and complete, and will be useful to any one wanting to understand the first elements of the beautiful art of wood engraving."—*Graphic*.

MODERN HOROLOGY, IN THEORY AND PRACTICE.

Translated from the French of CLAUDIUS SAUNIER, ex-Director of the School of Horology at Macon, by JULIEN TRIPPLIN, F.R.A.S., Besancon Watch Manufacturer, and EDWARD RIGG, M.A., Assayer in the Royal Mint. With Seventy-eight Woodcuts and Twenty-two Coloured Copper Plates. Second Edition. Super-royal 8vo, cloth, **£2 2s.**; half-calf . . . **£2 10s.**

"There is no horological work in the English language at all to be compared to this production of M. Saunier's for clearness and completeness. It is alike good as a guide for the student and as a reference for the experienced horologist and skilled workman."—*Horological Journal*.

"The latest, the most complete, and the most reliable of those literary productions to which continental watchmakers are indebted for the mechanical superiority over their English brethren—in fact, the Book of Books, is M. Saunier's 'Treatise.'"—*Watchmaker, Jeweller, and Silversmith*.

THE WATCH ADJUSTER'S MANUAL.

A Practical Guide for the Watch and Chronometer Adjuster in Making, Springing, Timing and Adjusting for Isochronism, Positions and Temperatures. By C. E. FRITTS. 370 pp., with Illustrations, 8vo, cloth **16/0**

THE WATCHMAKER'S HANDBOOK.

Intended as a Workshop Companion for those engaged in Watchmaking and the Allied Mechanical Arts. Translated from the French of CLAUDIUS SAUNIER, and enlarged by JULIEN TRIPPLIN, F.R.A.S., and EDWARD RIGG, M.A., Assayer in the Royal Mint. Third Edition. 8vo, cloth. **9/0**

"Each part is truly a treatise in itself. The arrangement is good and the language is clear and concise. It is an admirable guide for the young watchmaker."—*Engineering*.

"It is impossible to speak too highly of its excellence. It fulfils every requirement in a handbook intended for the use of a workman. Should be found in every workshop."—*Watch and Clockmaker*.

A HISTORY OF WATCHES & OTHER TIMEKEEPERS.

By JAMES F. KENDAL, M.B.H. Inst. Boards, **1/6**; or cloth, gilt . . . **2/6**

"The best which has yet appeared on this subject in the English language."—*Industries*.

"Open the book where you may, there is interesting matter in it concerning the ingenious devices of the ancient or modern horologer."—*Saturday Review*.

ELECTRO-DEPOSITION.

A Practical Treatise on the Electrolysis of Gold, Silver, Copper, Nickel, and other Metals and Alloys. With Descriptions of Voltaic Batteries, Magneto and Dynamo-Electric Machines, Thermopiles, and of the Materials and Processes used in every Department of the Art, and several Chapters on ELECTRO-METALLURGY. By ALEXANDER WATT, Author of "Electro-Metallurgy," &c. Third Edition, Revised. Crown 8vo, cloth **9/0**

"Eminently a book for the practical worker in electro-deposition. It contains practical descriptions of methods, processes and materials, as actually pursued and used in the workshop."—*Engineer*.

ELECTRO-METALLURGY.

Practically Treated. By ALEXANDER WATT. Tenth Edition, including the most recent Processes. 12mo, cloth **3/6**

"From this book both amateur and artisan may learn everything necessary for the successful prosecution of electroplating."—*Iron*.

JEWELLER'S ASSISTANT IN WORKING IN GOLD.

A Practical Treatise for Masters and Workmen, Compiled from the Experience of Thirty Years' Workshop Practice. By GEORGE E. GEE, Author of "The Goldsmith's Handbook," &c. Crown 8vo, cloth **7/6**

"This manual of technical education is apparently destined to be a valuable auxiliary to a handicraft which is certainly capable of great improvement."—*The Times*.

ELECTROPLATING.

A Practical Handbook on the Deposition of Copper, Silver, Nickel, Gold, Aluminium, Brass, Platinum, &c., &c. By J. W. URQUHART, C.E. Third Edition, Revised. Crown 8vo, cloth **5/0**

"An excellent practical manual."—*Engineering*.

"An excellent work, giving the newest information."—*Horological Journal*.

ELECTROTYPING.

The Reproduction and Multiplication of Printing Surfaces and Works of Art by the Electro-Deposition of Metals. By J. W. URQUHART, C.E. Crown 8vo, cloth **5/0**

"The book is thoroughly practical; the reader is, therefore, conducted through the leading laws of electricity, then through the metals used by electrotypers, the apparatus, and the depositing processes, up to the final preparation of the work."—*Art Journal*.

GOLDSMITH'S HANDBOOK.

By GEORGE E. GEE, Jeweller, &c. Fourth Edition. 12mo, cloth. **3/6**

"A good, sound educator, and will be generally accepted as an authority."—*Horological Journal*.

SILVERSMITH'S HANDBOOK.

By GEORGE E. GEE, Jeweller, &c. Third Edition, with numerous Illustrations. 12mo, cloth **3/6**

"The chief merit of the work is its practical character. . . . The workers in the trade will speedily discover its merits when they sit down to study it."—*English Mechanic*.

* * * *The above two works together, strongly half-bound, price 7s.*

SHEET METAL WORKER'S INSTRUCTOR.

Comprising a Selection of Geometrical Problems and Practical Rules for Describing the Various Patterns Required by Zinc, Sheet-Iron, Copper, and Tin-Plate Workers. By REUBEN HENRY WARN. New Edition, Revised and greatly Enlarged by JOSEPH G. HORNER, A.M.I.M.E. Crown 8vo, 254 pp., with 430 Illustrations, cloth. **7/6**
[Just Published.]

BREAD & BISCUIT BAKER'S & SUGAR-BOILER'S ASSISTANT.

Including a large variety of Modern Recipes. With Remarks on the Art of Bread-making. By ROBERT WELLS. Third Edition. Crown 8vo, cloth **2/0**

"A large number of wrinkles for the ordinary cook, as well as the baker."—*Saturday Review*.

PASTRYCOOK & CONFECTIONER'S GUIDE.

For Hotels, Restaurants, and the Trade in general, adapted also for Family Use. By R. WELLS, Author of "The Bread and Biscuit Baker." Crown 8vo, cloth **2/0**

"We cannot speak too highly of this really excellent work. In these days of keen competition our readers cannot do better than purchase this book."—*Baker's Times*.

ORNAMENTAL CONFECTIONERY.

A Guide for Bakers, Confectioners and Pastrycooks; including a variety of Modern Recipes, and Remarks on Decorative and Coloured Work. With 120 Original Designs. By ROBERT WELLS. Second Edition. Crown 8vo **5/0**

"A valuable work, practical, and should be in the hands of every baker and confectioner. The illustrative designs are alone worth treble the amount charged for the whole work."—*Baker's Times*.

THE MODERN FLOUR CONFECTIONER, WHOLESALE & RETAIL.

Containing a large Collection of Recipes for Cheap Cakes, Biscuits, &c. With remarks on the Ingredients Used in their Manufacture. By ROBERT WELLS, Author of "The Bread and Biscuit Baker," &c. Crown 8vo, cloth **2/0**

"The work is of a decidedly practical character, and in every recipe regard is had to economical working."—*North British Daily Mail*.

LAUNDRY MANAGEMENT.


A Handbook for Use in Private and Public Laundries. By the EDITOR OF "The Laundry Journal." Third Edition. Crown 8vo, cloth **2/0**

"This book should certainly occupy an honoured place on the shelves of all housekeepers who wish to keep themselves au courant of the newest appliances and methods."—*The Queen*.

HANDYBOOKS FOR HANDICRAFTS.

BY PAUL N. HASLUCK.

Editor of "Work" (New Series), Author of "Lathe Work," "Milling Machines," &c.
Crown 8vo, 144 pp., cloth, price 1s. each.

 These **HANDYBOOKS** have been written to supply information for **WORKMEN, STUDENTS, and AMATEURS** in the several **Handicrafts**, on the actual **PRACTICE** of the **WORKSHOP**, and are intended to convey in plain language **TECHNICAL KNOWLEDGE** of the several **CRAFTS**. In describing the processes employed, and the manipulation of material, workshop terms are used; workshop practice is fully explained; and the text is freely illustrated with drawings of modern tools, appliances, and processes.

THE METAL TURNER'S HANDYBOOK.

A Practical Manual for Workers at the Foot-Lathe. With over 100 Illustrations. **1/0**

"The book will be of service alike to the amateur and the artisan turner. It displays thorough knowledge of the subject."—*Scotsman*.

THE WOOD TURNER'S HANDYBOOK.

A Practical Manual for Workers at the Lathe. With over 100 Illustrations **1/0**

"We recommend the book to young turners and amateurs. A multitude of workmen have hitherto sought in vain for a manual of this special industry."—*Mechanical World*.

THE WATCH JOBBER'S HANDYBOOK.

A Practical Manual on Cleaning, Repairing, and Adjusting. With upwards of 100 Illustrations **1/0**

"We strongly advise all young persons connected with the watch trade to acquire and study this inexpensive work."—*Clerkenwell Chronicle*.

THE PATTERN MAKER'S HANDYBOOK.

A Practical Manual on the Construction of Patterns for Founders. With upwards of 100 Illustrations **1/0**

"A most valuable, if not indispensable manual for the pattern maker."—*Knowledge*.

THE MECHANIC'S WORKSHOP HANDYBOOK.

A Practical Manual on Mechanical Manipulation, embracing Information on various Handicraft Processes. With Useful Notes and Miscellaneous Memoranda. Comprising about 200 Subjects **1/0**

"A very clever and useful book, which should be found in every workshop; and it should certainly find a place in all technical schools."—*Saturday Review*.

THE MODEL ENGINEER'S HANDYBOOK.

A Practical Manual on the Construction of Model Steam Engines. With upwards of 100 Illustrations. **1/0**

"Mr. Hasluck has produced a very good little book."—*Builder*.

THE CLOCK JOBBER'S HANDYBOOK.

A Practical Manual on Cleaning, Repairing, and Adjusting. With upwards of 100 Illustrations **1/0**

"It is of inestimable service to those commencing the trade."—*Coventry Standard*.

THE CABINET MAKER'S HANDYBOOK.

A Practical Manual on the Tools, Materials, Appliances, and Processes employed in Cabinet Work. With upwards of 100 Illustrations **1/0**

"Mr. Hasluck's thorough-going little Handybook is amongst the most practical guides we have seen for beginners in cabinet-work."—*Saturday Review*.

THE WOODWORKER'S HANDYBOOK OF MANUAL INSTRUCTION.

Embracing Information on the Tools, Materials, Appliances and Processes Employed in Woodworking. With 104 Illustrations. **1/0**

OPINIONS OF THE PRESS.

"Written by a man who knows, not only how work ought to be done, but how to do it, and how to convey his knowledge to others."—*Engineering*.

"Mr. Hasluck writes admirably, and gives complete instructions."—*Engineer*.

"Mr. Hasluck combines the experience of a practical teacher with the manipulative skill and scientific knowledge of processes of the trained mechanic, and the manuals are marvels of what can be produced at a popular price."—*Schoolmaster*.

"Helpful to workmen of all ages and degrees of experience."—*Daily Chronicle*.

"Practical, sensible, and remarkably cheap."—*Journal of Education*.

"Concise, clear, and practical."—*Saturday Review*.

COMMERCE, COUNTING-HOUSE WORK, TABLES, &c.

LESSONS IN COMMERCE.

By Professor R. GAMBARO, of the Royal High Commercial School at Genoa.
Edited and Revised by JAMES GAULT, Professor of Commerce and Commercial
Law in King's College, London. Second Edition, Revised. Crown 8vo **3/6**

"The publishers of this work have rendered considerable service to the cause of commercial education by the opportune production of this volume. . . . The work is peculiarly acceptable to English readers and an admirable addition to existing class books. In a phrase, we think the work attains its object in furnishing a brief account of those laws and customs of British trade with which the commercial man interested therein should be familiar."—*Chamber of Commerce Journal*.

"An invaluable guide in the hands of those who are preparing for a commercial career, and, in fact, the information it contains on matters of business should be impressed on every one."—*Counting House*.

THE FOREIGN COMMERCIAL CORRESPONDENT.

Being Aids to Commercial Correspondence in Five Languages—English,
French, German, Italian, and Spanish. By CONRAD E. BAKER. Second
Edition. Crown 8vo, cloth **3/6**

"Whoever wishes to correspond in all the languages mentioned by Mr. Baker cannot do better than study this work, the materials of which are excellent and conveniently arranged. They consist not of entire specimen letters, but—what are far more useful—short passages, sentences, or phrases expressing the same general idea in various forms."—*Athenæum*.

"A careful examination has convinced us that it is unusually complete, well arranged and reliable. The book is a thoroughly good one."—*Schoolmaster*.

A NEW BOOK OF COMMERCIAL FRENCH.

Grammar — Vocabulary — Correspondence — Commercial Documents — Geo-
graphy—Arithmetic—Lexicon. By P. CARROUÉ, Professor in the City High
School J.—B. Say (Paris). Crown 8vo, cloth **4/6**

"M. Carroué's book is a *vade mecum* of commercial French, and would be distinctly in its place in every merchant's office. Nothing better could be desired."—*Educational Times*.

FACTORY ACCOUNTS: their PRINCIPLES & PRACTICE.

A Handbook for Accountants and Manufacturers, with Appendices on the
Nomenclature of Machine Details; the Income Tax Acts; the Rating of
Factories; Fire and Boiler Insurance; the Factory and Workshop Acts, &c.,
including also a Glossary of Terms and a large number of Specimen Rulings.
By EMILE GARCKE and J. M. FELLs. Fourth Edition, Revised and Enlarged.
Demy 8vo, 250 pp., strongly bound **6/0**

"A very interesting description of the requirements of Factory Accounts. . . . The principle of assimilating the Factory Accounts to the general commercial books is one which we thoroughly agree with."—*Accountants' Journal*.

"Characterised by extreme thoroughness. There are few owners of factories who would not derive great benefit from the perusal of this most admirable work."—*Local Government Chronicle*

MODERN METROLOGY.

A Manual of the Metrical Units and Systems of the present Century. With
an Appendix containing a proposed English System. By LOWIS D. A.
JACKSON, A. M. Inst. C. E., Author of "Aid to Survey Practice," &c. Large
crown 8vo, cloth **12/6**

"We recommend the work to all interested in the practical reform of our weights and measures."—*Nature*.

A SERIES OF METRIC TABLES.

In which the British Standard Measures and Weights are compared with those
of the Metric System at present in Use on the Continent. By C. H. DOWLING,
C.E. 8vo, strongly bound **10/6**

"Mr. Dowling's Tables are well put together as a ready reckoner for the conversion of one system into the other."—*Athenæum*.

THE IRON AND METAL TRADES' COMPANION.

For Expediently Ascertaining the Value of any Goods bought or sold by
Weight, from 1s. per cwt. to 112s. per cwt., and from one farthing per pound to
one shilling per pound. By THOMAS DOWNIE. 396 pp., leather **9/0**

"A most useful set of tables, nothing like them before existed."—*Building News*.

"Although specially adapted to the iron and metal trades, the tables will be found useful in every other business in which merchandise is bought and sold by weight."—*Railway News*.

NUMBER, WEIGHT, AND FRACTIONAL CALCULATOR.

Containing upwards of 250,000 Separate Calculations, showing at a Glance the Value at 422 Different Rates, ranging from $\frac{1}{128}$ th of a Penny to 20s. each, or per cwt., and £20 per ton, of any number of articles consecutively, from 1 to 470. Any number of cwts., qrs., and lbs., from 1 cwt. to 470 cwts. Any number of tons, cwts., qrs., and lbs., from 1 to 1,000 tons. By WILLIAM CHADWICK, Public Accountant. Third Edition, Revised. 8vo, strongly bound **18/0**

"It is as easy of reference for any answer or any number of answers as a dictionary. For making up accounts or estimates the book must prove invaluable to all who have any considerable quantity of calculations involving price and measure in any combination to do."—*Engineer*.

"The most perfect work of the kind yet prepared."—*Glasgow Herald*.

THE WEIGHT CALCULATOR.

Being a Series of Tables upon a New and Comprehensive Plan, exhibiting at one Reference the exact Value of any Weight from 1 lb. to 15 tons, at 300 Progressive Rates, from 1d. to 168s. per cwt., and containing 186,000 Direct Answers, which, with their Combinations, consisting of a single addition (mostly to be performed at sight), will afford an aggregate of 10,266,000 Answers; the whole being calculated and designed to ensure correctness and promote despatch. By HENRY HARBEN, Accountant. Fifth Edition, carefully Corrected. Royal 8vo, strongly half-bound **£1 5s.**

"A practical and useful work of reference for men of business generally."—*Ironmonger*.

"Of priceless value to business men. It is a necessary book in all mercantile offices."—*Sheffield Independent*.

THE DISCOUNT GUIDE.

Comprising several Series of Tables for the Use of Merchants, Manufacturers, Ironmongers, and Others, by which may be ascertained the Exact Profit arising from any mode of using Discounts, either in the Purchase or Sale of Goods, and the method of either Altering a Rate of Discount, or Advancing a Price, so as to produce, by one operation, a sum that will realise any required Profit after allowing one or more Discounts: to which are added Tables of Profit or Advance from $1\frac{1}{4}$ to 90 per cent., Tables of Discount from $1\frac{1}{4}$ to $98\frac{3}{4}$ per cent., and Tables of Commission, &c., from $\frac{1}{8}$ to 10 per cent. By HENRY HARBEN, Accountant. New Edition, Corrected. Demy 8vo, half-bound **£1 5s.**

"A book such as this can only be appreciated by business men, to whom the saving of time means saving of money. The work must prove of great value to merchants, manufacturers, and general traders."—*British Trade Journal*.

DIRECT CALCULATORS.

A Series of Tables and Calculations varied in Arrangement to Suit the Needs of Particular Trades. By M. B. COTSWORTH. The Series comprises 13 distinct Books, at prices ranging from **2/6** to **10/6**. (Detailed prospectus on application.)

TABLES OF WAGES.

At 54, 52, 50 and 48 Hours per Week. Showing the Amounts of Wages from One-quarter-of-an-hour to Sixty-four hours, in each case at Rates of Wages advancing by One Shilling from 4s. to 55s. per week. By THOS. GARBUTT, Accountant. Square crown 8vo, half-bound **6/0**

IRON-PLATE WEIGHT TABLES.

For Iron Shipbuilders, Engineers, and Iron Merchants. Containing the Calculated Weights of upwards of 150,000 different sizes of Iron Plates from 1 foot by 6 in. by $\frac{1}{4}$ in. to 10 feet by 5 feet by 1 in. Worked out on the Basis of 40 lbs. to the square foot of Iron of 1 inch in thickness. By H. BURLINSON and W. H. SIMPSON. 4to, half-bound **£1 5s.**

MATHEMATICAL TABLES (ACTUARIAL).

Comprising Commutation and Conversion Tables, Logarithms, Cologarithms, Antilogarithms and Reciprocals. By J. W. GORDON. Royal 8vo, mounted on canvas, in cloth case. **[Just Published. 5/0]**

AGRICULTURE, FARMING, GARDENING, &c.

THE COMPLETE GRAZIER AND FARMER'S AND CATTLE BREEDER'S ASSISTANT.

A Compendium of Husbandry. Originally Written by WILLIAM YOUATT. Thirteenth Edition, entirely Re-written, considerably Enlarged, and brought up to the Present Requirements of Agricultural Practice, by WILLIAM FREAM, LL.D., Steven Lecturer in the University of Edinburgh, Author of "The Elements of Agriculture," &c. Royal 8vo, 1,100 pp., with over 450 Illustrations, strongly and handsomely bound. **£1 11s. 6d.**

EXTRACT FROM PUBLISHERS' ADVERTISEMENT.

"A treatise that made its original appearance in the first decade of the century, and that enters upon its Thirteenth Edition before the century has run its course, has undoubtedly established its position as a work of permanent value. . . . The phenomenal progress of the last dozen years in the Practice and Science of Farming has rendered it necessary, however, that the volume should be re-written, . . . and for this undertaking the Publishers were fortunate enough to secure the services of Dr. FREAM, whose high attainments in all matters pertaining to agriculture have been so emphatically recognised by the highest professional and official authorities. In carrying out his editorial duties, Dr. FREAM has been favoured with valuable contributions by Prof. J. WORTLEY AXE, Mr. E. BROWN, Dr. BERNARD DYER, Mr. W. J. MALDEN, Mr. R. H. REW, Prof. SHELDON, Mr. J. SINCLAIR, Mr. SANDERS SPENCER, and others.

"As regards the illustrations of the work, no pains have been spared to make them as representative and characteristic as possible, so as to be practically useful to the Farmer and Grazier."

SUMMARY OF CONTENTS.

BOOK I. ON THE VARIETIES, BREEDING, REARING, FATTENING AND MANAGEMENT OF CATTLE.
BOOK II. ON THE ECONOMY AND MANAGEMENT OF THE DAIRY.
BOOK III. ON THE BREEDING, REARING, AND MANAGEMENT OF HORSES.
BOOK IV. ON THE BREEDING, REARING, AND FATTENING OF SHEEP.
BOOK V. ON THE BREEDING, REARING, AND FATTENING OF SWINE.
BOOK VI. ON THE DISEASES OF LIVE STOCK.

BOOK VII. ON THE BREEDING, REARING, AND MANAGEMENT OF POULTRY.
BOOK VIII. ON FARM OFFICES AND IMPLEMENTS OF HUSBANDRY.
BOOK IX. ON THE CULTURE AND MANAGEMENT OF GRASS LANDS.
BOOK X. ON THE CULTIVATION AND APPLICATION OF GRASSES, PULSE AND ROOTS.
BOOK XI. ON MANURES AND THEIR APPLICATION TO GRASS LAND AND CROPS.
BOOK XII. MONTHLY CALENDARS OF FARMWORK.

*** OPINIONS OF THE PRESS ON THE NEW EDITION.

"Dr. Fream is to be congratulated on the successful attempt he has made to give us a work which will at once become the standard classic of the farm practice of the country. We believe that it will be found that it has no compeer among the many works at present in existence. The illustrations are admirable, while the frontispiece, which represents the well-known bull, New Year's Gift, bred by the Queen, is a work of art."—*The Times*.

"The book must be recognised as occupying the proud position of the most exhaustive work of reference in the English language on the subject with which it deals."—*Athenaeum*.

"The most comprehensive guide to modern farm practice that exists in the English language to-day. . . . The book is one that ought to be on every farm and in the library of every land owner."—*Mark Lane Express*.

"In point of exhaustiveness and accuracy the work will certainly hold a pre-eminent and unique position among books dealing with scientific agricultural practice. It is, in fact, an agricultural library of itself."—*North British Agriculturist*.

"A compendium of authoritative and well-ordered knowledge on every conceivable branch of the work of the live stock farmer; probably without an equal in this or any other country."—*Yorkshire Post*.

"The best and brightest guide to the practice of husbandry: one that has no superior—no equal we might truly say—among the agricultural literature now before the public. . . . In every section in which we have tested it, the work has been found thoroughly up to date."—*Bell's Weekly Messenger*.

FARM LIVE STOCK OF GREAT BRITAIN.

By ROBERT WALLACE, F.L.S., F.R.S.E., &c., Professor of Agriculture and Rural Economy in the University of Edinburgh. Third Edition, thoroughly Revised and considerably Enlarged. With over 120 Phototypes of Prize Stock. Demy 8vo, 384 pp., with 79 Plates and Maps, cloth. **12/6**

"A really complete work on the history, breeds, and management of the farm stock of Great Britain, and one which is likely to find its way to the shelves of every country gentleman's library."—*The Times*.

"The latest edition of 'Farm Live Stock of Great Britain' is a production to be proud of, and its issue not the least of the services which its author has rendered to agricultural science."—*Scottish Farmer*.

"The book is very attractive, . . . and we can scarcely imagine the existence of a farmer who would not like to have a copy of this beautiful and useful work."—*Mark Lane Express*.

"A work which will long be regarded as a standard authority whenever a concise history and description of the breeds of live stock in the British Isles is required."—*Bell's Weekly Messenger*.

BRITISH DAIRYING.

A Handy Volume on the Work of the Dairy-Farm. For the Use of Technical Instruction Classes, Students in Agricultural Colleges and the Working Dairy-Farmer. By Prof. J. P. SHELDON. With Illustrations. Second Edition, Revised. Crown 8vo, cloth. [Just Published. 2/6

"Confidently recommended as a useful text-book on dairy farming."—*Agricultural Gazette*.
 "Probably the best half-crown manual on dairy work that has yet been produced."—*North British Agriculturist*.

"It is the soundest little work we have yet seen on the subject."—*The Times*.

MILK, CHEESE, AND BUTTER.

A Practical Handbook on their Properties and the Processes of their Production. Including a Chapter on Cream and the Methods of its Separation from Milk. By JOHN OLIVER, late Principal of the Western Dairy Institute, Berkeley. With Coloured Plates and 200 Illustrations. Crown 8vo, cloth. 7/6

"An exhaustive and masterly production. It may be cordially recommended to all students and practitioners of dairy science."—*North British Agriculturist*.

"We recommend this very comprehensive and carefully-written book to dairy-farmers and students of dairying. It is a distinct acquisition to the library of the agriculturist."—*Agricultural Gazette*.

NOTE-BOOK OF AGRICULTURAL FACTS & FIGURES FOR FARMERS AND FARM STUDENTS.

By PRIMROSE MCCONNELL, B.Sc. Fifth Edition. Royal 32mo, roan, gilt edges, with band. 4/0

"Literally teems with information, and we can cordially recommend it to all connected with agriculture."—*North British Agriculturist*.

SYSTEMATIC SMALL FARMING.

Or, The Lessons of My Farm. Being an Introduction to Modern Farm Practice for Small Farmers. By R. SCOTT BURN, Author of "Outlines of Modern Farming," &c. Crown 8vo, cloth. 6/0

"This is the completest book of its class we have seen, and one which every amateur farmer will read with pleasure, and accept as a guide."—*Field*.

OUTLINES OF MODERN FARMING.

By R. SCOTT BURN. Soils, Manures, and Crops—Farming and Farming Economy—Cattle, Sheep, and Horses—Management of Dairy, Pigs, and Poultry—Utilisation of Town-Sewage, Irrigation, &c. Sixth Edition. In One Vol., 1,250 pp., half-bound, profusely illustrated. 12/0

FARM ENGINEERING, The COMPLETE TEXT-BOOK of.

Comprising Draining and Embanking; Irrigation and Water Supply; Farm Roads, Fences and Gates; Farm Buildings; Barn Implements and Machines; Field Implements and Machines; Agricultural Surveying, &c. By Professor JOHN SCOTT. In One Vol., 1,150 pp., half-bound, with over 600 Illustrations. 12/0

"Written with great care, as well as with knowledge and ability. The author has done his work well; we have found him a very trustworthy guide wherever we have tested his statements. The volume will be of great value to agricultural students."—*Mark Lane Express*.

THE FIELDS OF GREAT BRITAIN.

A Text-Book of Agriculture. Adapted to the Syllabus of the Science and Art Department. For Elementary and Advanced Students. By HUGH CLEMENTS (Board of Trade). Second Edition, Revised, with Additions. 18mo, cloth. 2/6

"It is a long time since we have seen a book which has pleased us more, or which contains such a vast and useful fund of knowledge."—*Educational Times*.

TABLES and MEMORANDA for FARMERS, GRAZIERS, AGRICULTURAL STUDENTS, SURVEYORS, LAND AGENTS, AUCTIONEERS, &c.

With a New System of Farm Book-keeping. By SIDNEY FRANCIS. Third Edition, Revised. 272 pp., waistcoat-pocket size, limp leather. 1/6

"Weighing less than 1 oz., and occupying no more space than a match-box, it contains a mass of facts and calculations which has never before, in such handy form, been obtainable. Every operation on the farm is dealt with. The work may be taken as thoroughly accurate, the whole of the tables having been revised by Dr. Freani. We cordially recommend it."—*Bell's Weekly Messenger*.

THE ROTHAMSTED EXPERIMENTS AND THEIR PRACTICAL LESSONS FOR FARMERS.

Part I. STOCK. Part II. CROPS. By C. J. R. TIPPER. Crown 8vo, cloth.
[Just Published. 3/6

FERTILISERS AND FEEDING STUFFS.

A Handbook for the Practical Farmer. By BERNARD DYER, D.Sc. (Lond.).
With the Text of the Fertilisers and Feeding Stuffs Act of 1893, &c. Second
Edition, Revised. Crown 8vo, cloth. [Just Published. 1/0

BEEES FOR PLEASURE AND PROFIT.

A Guide to the Manipulation of Bees, the Production of Honey, and the
General Management of the Apiary. By G. GORDON SAMSON. With
numerous Illustrations. Crown 8vo, cloth 1/0

BOOK-KEEPING for FARMERS and ESTATE OWNERS.

A Practical Treatise, presenting, in Three Plans, a System adapted for all
Classes of Farms. By JOHNSON M. WOODMAN, Chartered Accountant.
Second Edition, Revised. Crown 8vo, cloth boards, 3/6; or, cloth limp, 2/6
"The volume is a capital study of a most important subject."—*Agricultural Gazette*.

WOODMAN'S YEARLY FARM ACCOUNT BOOK.

Giving Weekly Labour Account and Diary, and showing the Income and
Expenditure under each Department of Crops, Live Stock, Dairy, &c., &c.
With Valuation, Profit and Loss Account, and Balance Sheet at the End of the
Year. By JOHNSON M. WOODMAN, Chartered Accountant. Second Edition.
Folio, half-bound 7/6 Net.
"Contains every requisite form for keeping farm accounts readily and accurately."—
Agriculture.

THE FORCING GARDEN.

Or, How to Grow Early Fruits, Flowers and Vegetables. With Plans and
Estimates for Building Glasshouses, Pits and Frames. With Illustrations.
By SAMUEL WOOD. Crown 8vo, cloth 3/6
"A good book, containing a great deal of valuable teaching."—*Gardener's Magazine*.

A PLAIN GUIDE TO GOOD GARDENING.

Or, How to Grow Vegetables, Fruits, and Flowers. By S. WOOD. Fourth
Edition, with considerable Additions, and numerous Illustrations. Crown
8vo, cloth 3/6
"A very good book, and one to be highly recommended as a practical guide. The practical
directions are excellent."—*Athenæum*.

MULTUM=IN=PARVO GARDENING.

Or, How to Make One Acre of Land produce £620 a year, by the Cultivation
of Fruits and Vegetables; also, How to Grow Flowers in Three Glass Houses,
so as to realise £176 per annum clear Profit. By SAMUEL WOOD, Author of
"Good Gardening," &c. Fifth and Cheaper Edition, Revised, with Additions.
Crown 8vo, sewed 1/0
"We are bound to recommend it as not only suited to the case of the amateur and gentle-
man's gardener, but to the market grower."—*Gardeners' Magazine*.

THE LADIES' MULTUM=IN=PARVO FLOWER GARDEN.

And Amateur's Complete Guide. By S. WOOD. Crown 8vo, cloth 3/6
"Full of shrewd hints and useful instructions, based on a lifetime of experience."—*Scotsman*.

POTATOES: HOW TO GROW AND SHOW THEM.

A Practical Guide to the Cultivation and General Treatment of the Potato.
By J. PINK. Crown 8vo 2/0

MARKET AND KITCHEN GARDENING.

By C. W. SHAW, late Editor of "Gardening Illustrated." Cloth 3/6
"The most valuable compendium of kitchen and market-garden work published."—*Farmer*.

AUCTIONEERING, VALUING, LAND SURVEYING, ESTATE AGENCY, &c.

THE APPRAISER, AUCTIONEER, BROKER, HOUSE AND ESTATE AGENT AND VALUER'S POCKET ASSISTANT.

For the Valuation for Purchase, Sale, or Renewal of Leases, Annuities, and Reversions, and of Property generally; with Prices for Inventories, &c. By JOHN WHEELER, Valuer, &c. Sixth Edition, Re-written and greatly Extended by C. NORRIS, Surveyor, Valuer, &c. Royal 32mo, cloth **5/0**

"A neat and concise book of reference, containing an admirable and clearly-arranged list of prices for inventories, and a very practical guide to determine the value of furniture, &c."—*Standard*.

"Contains a large quantity of varied and useful information as to the valuation for purchase, sale, or renewal of leases, annuities and reversions, and of property generally, with prices for inventories, and a guide to determine the value of interior fittings and other effects."—*Builder*.

AUCTIONEERS: THEIR DUTIES AND LIABILITIES.

A Manual of Instruction and Counsel for the Young Auctioneer. By ROBERT SQUIBBS, Auctioneer. Second Edition, Revised and partly Re-written. Demy 8vo, cloth **12/6**

"The standard text-book on the topics of which it treats."—*Athenæum*.

"The work is one of general excellent character, and gives much information in a compendious and satisfactory form."—*Builder*.

"May be recommended as giving a great deal of information on the law relating to auctioneers, in a very readable form."—*Law Journal*.

"Auctioneers may be congratulated on having so pleasing a writer to minister to their special needs."—*Solicitors' Journal*.

TABLES FOR THE PURCHASING OF ESTATES: FREEHOLD, COPYHOLD, OR LEASEHOLD; ANNUITIES, ADVOWSONS, &c.

And for the Renewing of Leases held under Cathedral Churches, Colleges, or other Corporate bodies, for Terms of Years certain, and for Lives; also for Valuing Reversionary Estates, Deferred Annuities, Next Presentations, &c.; together with SMART'S Five Tables of Compound Interest, and an Extension of the same to Lower and Intermediate Rates. By W. INWOOD. 24th Edition, with considerable Additions, and new and valuable Tables of Logarithms for the more difficult Computations of the Interest of Money, Discount, Annuities, &c., by M. FÉDOR THOMAN. Crown 8vo, cloth **8/0**

"Those interested in the purchase and sale of estates, and in the adjustment of compensation cases, as well as in transactions in annuities, life insurances, &c., will find the present edition of eminent service."—*Engineering*.

"Inwood's Tables still maintain a most enviable reputation. The new issue has been enriched by large additional contributions by M. Fédor Thoman, whose carefully arranged Tables cannot fail to be of the utmost utility."—*Mining Journal*.

THE AGRICULTURAL VALUER'S ASSISTANT.

A Practical Handbook on the Valuation of Landed Estates; including Rules and Data for Measuring and Estimating the Contents, Weights and Values of Agricultural Produce and Timber, and the Values of Feeding Stuffs, Manures, and Labour; with Forms of Tenant-Right Valuations, Lists of Local Agricultural Customs, Scales of Compensation under the Agricultural Holdings Act, &c., &c. By TOM BRIGHT, Agricultural Surveyor. Second Edition, Enlarged. Crown 8vo, cloth **5/0**

"Full of tables and examples in connection with the valuation of tenant-right, estates, labour, contents and weights of timber, and farm produce of all kinds."—*Agricultural Gazette*.

"An eminently practical handbook, full of practical tables and data of undoubted interest and value to surveyors and auctioneers in preparing valuations of all kinds."—*Farmer*.

POLE PLANTATIONS AND UNDERWOODS.

A Practical Handbook on Estimating the Cost of Forming, Renovating, Improving, and Grubbing Plantations and Underwoods, their Valuation for Purposes of Transfer, Rental, Sale or Assessment. By TOM BRIGHT. Crown 8vo, cloth **3/6**

"To valuers, foresters and agents it will be a welcome aid."—*North British Agriculturist*.

"Well calculated to assist the valuer in the discharge of his duties, and of undoubted interest and use both to surveyors and auctioneers in preparing valuations of all kinds."—*Kent Herald*.

THE LAND VALUER'S BEST ASSISTANT.

Being Tables on a very much Improved Plan, for Calculating the Value of Estates. With Tables for reducing Scotch, Irish, and Provincial Customary Acres to Statute Measure, &c. By R. HUDSON, C.E. New Edition. Royal 32mo, leather, elastic band 4/0

"Of incalculable value to the country gentleman and professional man."—*Farmers' Journal*.

THE LAND IMPROVER'S POCKET-BOOK.

Comprising Formulæ, Tables, and Memoranda required in any Computation relating to the Permanent Improvement of Landed Property. By JOHN EWART, Surveyor. Second Edition, Revised. Royal 32mo, oblong, leather 4/0

"A compendious and handy little volume."—*Spectator*.

THE LAND VALUER'S COMPLETE POCKET-BOOK.

Being the above Two Works bound together. Leather 7/6

HANDBOOK OF HOUSE PROPERTY.

A Popular and Practical Guide to the Purchase, Mortgage, Tenancy, and Compulsory Sale of Houses and Land, including the Law of Dilapidations and Fixtures: with Examples of all kinds of Valuations, Useful Information on Building and Suggestive Elucidations of Fine Art. By E. L. TARBUCK, Architect and Surveyor. Fifth Edition, Enlarged. 12mo, cloth 5/0

LAW AND MISCELLANEOUS.

MODERN JOURNALISM.

A Handbook of Instruction and Counsel for the Young Journalist. By JOHN B. MACKIE, Fellow of the Institute of Journalists. Crown 8vo, cloth 2/0

"This invaluable guide to journalism is a work which all aspirants to a journalistic career will read with advantage."—*Journalist*.

HANDBOOK FOR SOLICITORS AND ENGINEERS

Engaged in Promoting Private Acts of Parliament and Provisional Orders for the Authorisation of Railways, Tramways, Gas and Water Works, &c. By L. LIVINGSTONE MACASSEY, of the Middle Temple, Barrister-at-Law, M. Inst. C. E. 8vo, cloth £1 5s.

PATENTS for INVENTIONS, HOW to PROCURE THEM.

Compiled for the Use of Inventors, Patentees and others. By G. G. M. HARDINGHAM, Assoc. Mem. Inst. C. E., &c. Demy 8vo, cloth 1/6

CONCILIATION & ARBITRATION in LABOUR DISPUTES.

A Historical Sketch and Brief Statement of the Present Position of the Question at Home and Abroad. By J. S. JEANS, Author of "England's Supremacy," &c. Crown 8vo, 200 pp., cloth 2/6

THE HEALTH OFFICER'S POCKET-BOOK.

A Guide to Sanitary Practice and Law. For Medical Officers of Health, Sanitary Inspectors, Members of Sanitary Authorities, &c. By EDWARD F. WILLOUGHBY, M.D. (Lond.), &c. Fcap. 8vo, cloth 7/6

A mine of condensed information of a pertinent and useful kind on the various subjects of which it treats. The matter seems to have been carefully compiled and arranged for facility of reference, and it is well illustrated by diagrams and woodcuts. The different subjects are succinctly but fully and scientifically dealt with."—*The Lancet*.

"Ought to be welcome to those for whose use it is designed, since it practically boils down a reference library into a pocket volume. . . . It combines, with an uncommon degree of efficiency, the qualities of accuracy, conciseness and comprehensiveness."—*Scotsman*.

EVERY MAN'S OWN LAWYER.

A Handy-Book of the Principles of Law and Equity. With a Concise Dictionary of Legal Terms. By A BARRISTER. Thirty-fourth Edition, carefully Revised, and including New Acts of Parliament of 1896. Comprising the *Locomotives on Highways Act, 1896*, amending the law to meet the case of the New Motor Cars or Horseless Carriages; the *Finance Act, 1896*; the *Agricultural Rates Act, 1896*; the *Conciliation Act, 1896*; the *Truck Act, 1896*; the *Light Railways Act, 1896*; the *Judicial Trustees Act, 1896*; the *Vexatious Actions Act, 1896*; the *Wild Birds Protection Act, 1896*; the *London Cab Act, 1896*, &c. Judicial Decisions during the year have also been duly noted. Crown 8vo, 750 pp. Price 6/8 (saved at every consultation!), strongly bound in cloth. [Just Published.]

The Book will be found to comprise (amongst other matter)—

THE RIGHTS AND WRONGS OF INDIVIDUALS—LANDLORD AND TENANT—VENDORS AND PURCHASERS—LEASES AND MORTGAGES—PRINCIPAL AND AGENT—PARTNERSHIP AND COMPANIES—MASTERS, SERVANTS AND WORKMEN—CONTRACTS AND AGREEMENTS—BORROWERS, LENDERS AND SURETIES—SALE AND PURCHASE OF GOODS—CHEQUES, BILLS AND NOTES—BILLS OF SALE—BANKRUPTCY—RAILWAY AND SHIPPING LAW—LIFE, FIRE, AND MARINE INSURANCE—ACCIDENT AND FIDELITY INSURANCE—CRIMINAL LAW—PARLIAMENTARY ELECTIONS—COUNTY COUNCILS—DISTRICT COUNCILS—PARISH COUNCILS—MUNICIPAL CORPORATIONS—LIBEL AND SLANDER—PUBLIC HEALTH AND NUISANCES—COPYRIGHT, PATENTS, TRADE MARKS—HUSBAND AND WIFE—DIVORCE—INFANCY—CUSTODY OF CHILDREN—TRUSTEES AND EXECUTORS—CLERGY, CHURCHWARDENS, &c.—GAME LAWS AND SPORTING—INNKEEPERS—HORSES AND DOGS—TAXES AND DEATH DUTIES—FORMS OF AGREEMENTS, WILLS, CODICILS, NOTICES, &c.

The object of this work is to enable those who consult it to help themselves to the law; and thereby to dispense, as far as possible, with professional assistance and advice. There are many wrongs and grievances which persons submit to from time to time through not knowing how or where to apply for redress; and many persons have as great a dread of a lawyer's office as of a lion's den. With this book at hand it is believed that many a SIX-AND-EIGHTPENCE may be saved; many a wrong redressed; many a right reclaimed; many a law suit avoided; and many an evil abated. The work has established itself as the standard legal adviser of all classes, and has also made a reputation for itself as a useful book of reference for lawyers residing at a distance from law libraries, who are glad to have at hand a work embodying recent decisions and enactments.

OPINIONS OF THE PRESS.

"It is a complete code of English Law written in plain language, which all can understand. . . . Should be in the hands of every business man, and all who wish to abolish lawyers' bills."—*Weekly Times*.

"A useful and concise epitome of the law, compiled with considerable care."—*Law Magazine*.

"A complete digest of the most useful facts which constitute English law."—*Globe*.

"This excellent handbook. . . . Admirably done, admirably arranged, and admirably cheap."—*Leeds Mercury*.

"A concise, cheap, and complete epitome of the English law. So plainly written that he who runs may read, and he who reads may understand."—*Figaro*.

"A dictionary of legal facts well put together. The book is a very useful one."—*Spectator*.

THE PAWNBROKERS', FACTORS', AND MERCHANTS' GUIDE TO THE LAW OF LOANS AND PLEDGES.

With the Statutes and a Digest of Cases. By H. C. FOLKARD, Barrister-at-Law. Cloth 3/6

LABOUR CONTRACTS.

A Popular Handbook on the Law of Contracts for Works and Services. By DAVID GIBBONS. Fourth Edition, with Appendix of Statutes by T. F. UTTELEY, Solicitor. Fcap. 8vo, cloth 3/6

SUMMARY OF THE FACTORY AND WORKSHOP ACTS

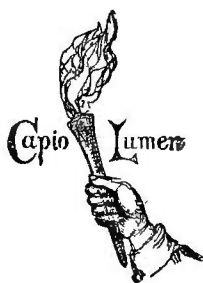
(1878-1891). For the Use of Manufacturers and Managers. By EMILE GARCKE and J. M. FELLS. (Reprinted from "FACTORY ACCOUNTS.") Crown 8vo, sewed 6d.

WEALE'S SERIES OF SCIENTIFIC AND TECHNICAL WORKS.

“It is not too much to say that no books have ever proved more popular with or more useful to young engineers and others than the excellent treatises comprised in WEALE'S SERIES.”—Engineer.

A New Classified List.

	PAGE		PAGE
CIVIL ENGINEERING AND SURVEYING	2	ARCHITECTURE AND BUILDING	8
MINING AND METALLURGY	3	INDUSTRIAL AND USEFUL ARTS.	9
MECHANICAL ENGINEERING.	4	AGRICULTURE, GARDENING, ETC.	10
NAVIGATION, SHIPBUILDING, ETC.	5	MATHEMATICS, ARITHMETIC, ETC.	12
BOOKS OF REFERENCE AND MISCELLANEOUS VOLUMES		14	



CROSBY LOCKWOOD AND SON,
7, STATIONERS' HALL COURT, LONDON, E.C.

1897.

CIVIL ENGINEERING & SURVEYING.**Civil Engineering.**

By HENRY LAW, M. Inst. C.E. Including a Treatise on HYDRAULIC ENGINEERING by G. R. BURNELL, M.I.C.E. Seventh Edition, revised, with LARGE ADDITIONS by D. K. CLARK, M.I.C.E. 6/6

Pioneer Engineering:

A Treatise on the Engineering Operations connected with the Settlement of Waste Lands in New Countries. By EDWARD DOBSON, A.I.C.E. With numerous Plates. Second Edition 4/6

Iron Bridges of Moderate Span:

Their Construction and Erection. By HAMILTON W. PENDRED. With 40 Illustrations 2/0

Iron (Application of) to the Construction of Bridges, Roofs, and other Works.

By FRANCIS CAMPIN, C.E. Fourth Edition 2/6

Constructional Iron and Steel Work,

as applied to Public, Private, and Domestic Buildings. By FRANCIS CAMPIN, C.E. 3/6

Tubular and other Iron Girder Bridges.

Describing the Britannia and Conway Tubular Bridges. By G. DRYSDALE DEMPSEY, C.E. Fourth Edition 2/0

Materials and Construction:

A Theoretical and Practical Treatise on the Strains, Designing, and Erection of Works of Construction. By FRANCIS CAMPIN, C.E. 3/0

Sanitary Work in the Smaller Towns and in Villages.

By CHARLES SLAGG, Assoc. M. Inst. C.E. Second Edition 3/0

Roads and Streets (The Construction of).

In Two Parts: I. THE ART OF CONSTRUCTING COMMON ROADS, by H. LAW, C.E., Revised by D. K. CLARK, C.E.; II. RECENT PRACTICE: Including Pavements of Wood, Asphalte, etc. By D. K. CLARK, C.E. 4/6

Gas Works (The Construction of),

And the Manufacture and Distribution of Coal Gas. By S. HUGHES, C.E. Re-written by WILLIAM RICHARDS, C.E. Eighth Edition 5/6

Water Works

For the Supply of Cities and Towns. With a Description of the Principal Geological Formations of England as influencing Supplies of Water. By SAMUEL HUGHES, F.G.S., C.E. Enlarged Edition. 4/0

The Power of Water,

As applied to drive Flour Mills, and to give motion to Turbines and other Hydrostatic Engines. By JOSEPH GLYNN, F.R.S. New Edition 2/0

Wells and Well-Sinking.

By JOHN GEO. SWINDELL, A.R.I.B.A., and G. R. BURNELL, C.E. Revised Edition. With a New Appendix on the Qualities of Water. Illustrated 2/0

The Drainage of Lands, Towns, and Buildings.

By G. D. DEMPSEY, C.E. Revised, with large Additions on Recent Practice, by D. K. CLARK, M.I.C.E. Second Edition, corrected 4/6

Embanking Lands from the Sea.

With Particulars of actual Embankments, &c. By JOHN WIGGINS. 2/0

The Blasting and Quarrying of Stone,

For Building and other Purposes. With Remarks on the Blowing up of Bridges. By Gen. Sir J. BURGoyNE, K.C.B. 1/6

Foundations and Concrete Works.

With Practical Remarks on Footings, Planking, Sand, Concrete, Béton, Pile-driving, Caissons, and Cofferdams. By E. DOBSON, M.R.I.B.A. Seventh Edition 1/6

Pneumatics,

Including Acoustics and the Phenomena of Wind Currents, for the Use of Beginners. By CHARLES TOMLINSON, F.R.S. Fourth Edition 1/6

Land and Engineering Surveying.

For Students and Practical Use. By T. BAKER, C.E. Fifteenth Edition, revised and corrected by J. R. YOUNG, formerly Professor of Mathematics, Belfast College. Illustrated with Plates and Diagrams 2/0

Mensuration and Measuring.

For Students and Practical Use. With the Mensuration and Levelling of Land for the purposes of Modern Engineering. By T. BAKER, C.E. New Edition by E. NUGENT, C.E. 1/6

MINING AND METALLURGY**Mineralogy,**

Rudiments of. By A. RAMSAY, F.G.S. Third Edition, revised and enlarged. Woodcuts and Plates. 3/6

Coal and Coal Mining,

A Rudimentary Treatise on. By the late Sir WARINGTON W. SMYTH, F.R.S. Seventh Edition, revised and enlarged. 3/6

Metallurgy of Iron.

Containing Methods of Assay, Analyses of Iron Ores, Processes of Manufacture of Iron and Steel, &c. By H. BAUERMAN, F.G.S. With numerous Illustrations. Sixth Edition, revised and enlarged. 5/0

The Mineral Surveyor and Valuer's Complete Guide.

By W. LINTERN. Third Edition, with an Appendix on Magnetic and Angular Surveying 3/6

Slate and Slate Quarrying:

Scientific, Practical, and Commercial. By D. C. DAVIES, F.G.S. With numerous Illustrations and Folding Plates. Third Edition 3/0

A First Book of Mining and Quarrying,

with the Sciences connected therewith, for Primary Schools and Self Instruction. By J. H. COLLINS, F.G.S. Second Edition 1/6

Subterraneous Surveying,

with and without the Magnetic Needle. By T. FENWICK and T. BAKER, C.E. Illustrated. 2/6

Mining Tools.

Manual of. By WILLIAM MORGANS, Lecturer on Practical Mining at the Bristol School of Mines 2/6

Mining Tools, Atlas

of Engravings to Illustrate the above, containing 235 Illustrations of Mining Tools, drawn to Scale. 4to. 4/6

Physical Geology,

Partly based on Major-General PORTLOCK's "Rudiments of Geology." By RALPH TATE, A.L.S., &c. Woodcuts. 2/0

Historical Geology,

Partly based on Major-General PORTLOCK's "Rudiments." By RALPH TATE, A.L.S., &c. Woodcuts 2/6

Geology, Physical and Historical.

Consisting of "Physical Geology," which sets forth the Leading Principles of the Science; and "Historical Geology," which treats of the Mineral and Organic Conditions of the Earth at each successive epoch. By RALPH TATE, F.G.S. 4/6

Electro-Metallurgy,

Practically Treated. By ALEXANDER WATT. Ninth Edition, enlarged and revised, including the most Recent Processes 3/6

MECHANICAL ENGINEERING.

- The Workman's Manual of Engineering Drawing.**
By JOHN MAXTON, Instructor in Engineering Drawing, Royal Naval College, Greenwich. Seventh Edition. 300 Plates and Diagrams 3/6
- Fuels: Solid, Liquid, and Gaseous.**
Their Analysis and Valuation. For the Use of Chemists and Engineers. By H. J. PHILLIPS, F.C.S., formerly Analytical and Consulting Chemist to the Great Eastern Railway. Second Edition, Revised. 2/0
- Fuel, Its Combustion and Economy.**
Consisting of an Abridgment of "A Treatise on the Combustion of Coal and the Prevention of Smoke." By C. W. WILLIAMS, A.I.C.E. With Extensive Additions by D. K. CLARK, M. Inst. C.E. Third Edition 3/6
- The Boilermaker's Assistant**
in Drawing, Templating, and Calculating Boiler Work, &c. By J. COURTNEY, Practical Boilermaker. Edited by D. K. CLARK, C.E. 2/0
- The Boiler-Maker's Ready Reckoner,**
with Examples of Practical Geometry and Templating for the Use of Platers, Smiths, and Riveters. By JOHN COURTNEY. Edited by D. K. CLARK, M.I.C.E. Second Edition, revised, with Additions 4/0
- * *The last two Works in One Volume, half-bound, entitled "THE BOILER-MAKER'S READY-RECKONER AND ASSISTANT."* By J. COURTNEY and D. K. CLARK. Price 7s.
- Steam Boilers:**
Their Construction and Management. By R. ARMSTRONG, C.E. Illustrated 1/6
- Steam and Machinery Management.**
A Guide to the Arrangement and Economical Management of Machinery. By M. POWIS BALE, M. Inst. M.E. 2/6
- Steam and the Steam Engine,**
Stationary and Portable. Being an Extension of the Treatise on the Steam Engine of Mr. J. SEWELL. By D. K. CLARK, C.E. Third Edition 3/6
- The Steam Engine,**
A Treatise on the Mathematical Theory of, with Rules and Examples for Practical Men. By T. BAKER, C.E. 1/6
- The Steam Engine.**
By Dr. LARDNER. Illustrated 1/6
- Locomotive Engines,**
By G. D. DEMPSEY, C.E. With large Additions treating of the Modern Locomotive, by D. K. CLARK, M. Inst. C.E. 3/0
- Locomotive Engine-Driving.**
A Practical Manual for Engineers in charge of Locomotive Engines. By MICHAEL REYNOLDS. Eighth Edition. 3s. 6d. limp; cloth boards 4/6
- Stationary Engine-Driving.**
A Practical Manual for Engineers in charge of Stationary Engines. By MICHAEL REYNOLDS. Fourth Edition. 3s. 6d. limp; cloth boards. 4/6
- The Smithy and Forge.**
Including the Farrier's Art and Coach Smithing. By W. J. E. CRANE. Second Edition, revised 2/6
- Modern Workshop Practice,**
As applied to Marine, Land, and Locomotive Engines, Floating Docks, Dredging Machines, Bridges, Ship-building, &c. By J. G. WINTON. Fourth Edition, Illustrated. 3/6
- Mechanical Engineering.**
Comprising Metallurgy, Moulding, Casting, Forging, Tools, Workshop Machinery, Mechanical Manipulation, Manufacture of the Steam Engine, &c. By FRANCIS CAMPIN, C.E. Third Edition 2/6
- Details of Machinery.**
Comprising Instructions for the Execution of various Works in Iron in the Fitting-Shop, Foundry, and Boiler-Yard. By FRANCIS CAMPIN, C.E. 3/0

Elementary Engineering:

A Manual for Young Marine Engineers and Apprentices. In the Form of Questions and Answers on Metals, Alloys, Strength of Materials, &c. By J. S. BREWER. Second Edition 2/0

Power in Motion:

Horse-power Motion, Toothed-Wheel Gearing, Long and Short Driving Bands, Angular Forces, &c. By JAMES ARMOUR, C.E. Third Edition 2/0

Iron and Heat,

Exhibiting the Principles concerned in the Construction of Iron Beams, Pillars, and Girders. By J. ARMOUR, C.E. 2/6

Practical Mechanism,

And Machine Tools. By T. BAKER, C.E. With Remarks on Tools and Machinery, by J. NASMYTH, C.E. 2/6

Mechanics:

Being a concise Exposition of the General Principles of Mechanical Science, and their Applications. By CHARLES TOMLINSON, F.R.S. 1/6

Cranes (The Construction of),

And other Machinery for Raising Heavy Bodies for the Erection of Buildings, &c. By JOSEPH GLYNN, F.R.S. 1/6

NAVIGATION, SHIPBUILDING, ETC.**The Sailor's Sea Book:**

A Rudimentary Treatise on Navigation. By JAMES GREENWOOD, B.A. With numerous Woodcuts and Coloured Plates. New and enlarged Edition. By W. H. ROSSER 2/6

Practical Navigation.

Consisting of THE SAILOR'S SEA-BOOK, by JAMES GREENWOOD and W. H. ROSSER; together with Mathematical and Nautical Tables for the Working of the Problems, by HENRY LAW, C.E., and Prof. J. R. YOUNG. 7/0

Navigation and Nautical Astronomy,

In Theory and Practice. By Prof. J. R. YOUNG. New Edition. 2/6

Mathematical Tables,

For Trigonometrical, Astronomical, and Nautical Calculations; to which is prefixed a Treatise on Logarithms. By H. LAW, C.E. Together with a Series of Tables for Navigation and Nautical Astronomy. By Professor J. R. YOUNG. New Edition 4/0

Masting, Mast-Making, and Rigging of Ships.

Also Tables of Spars, Rigging, Blocks; Chain, Wire, and Hemp Ropes, &c., relative to every class of vessels. By ROBERT KIPPING, N.A. 2/0

Sails and Sail-Making.

With Draughting, and the Centre of Effort of the Sails. By ROBERT KIPPING, N.A. 2/6

Marine Engines and Steam Vessels.

By R. MURRAY, C.E. Eighth Edition, thoroughly Revised, with Additions by the Author and by GEORGE CARLISLE, C.E. 4/6

Iron Ship-Building.

With Practical Examples. By JOHN GRANTHAM. Fifth Edition 4/0

Naval Architecture:

An Exposition of Elementary Principles. By JAMES PEAKE 3/6

Ships for Ocean and River Service,

Principles of the Construction of. By HAKON A. SOMMERFELDT 1/6

Atlas of Engravings

To Illustrate the above. Twelve large folding Plates. Royal 4to, cloth 7/6

The Forms of Ships and Boats.

By W. BLAND. Seventh Edition, revised, with numerous Illustrations and Models 1/6

*ARCHITECTURE AND THE
BUILDING ARTS.*

- Constructional Iron and Steel Work,**
as applied to Public, Private, and Domestic Buildings. By FRANCIS
CAMPIN, C.E. 3/6
- Building Estates:**
A Treatise on the Development, Sale, Purchase, and Management of Build-
ing Land. By F. MAITLAND. Second Edition, revised 2/0
- The Science of Building:**
An Elementary Treatise on the Principles of Construction. By E. WYND-
HAM TARN, M.A. Lond. Third Edition, revised and enlarged 3/6
- The Art of Building:**
General Principles of Construction, Strength, and Use of Materials, Working
Drawings, Specifications, &c. By EDWARD DOBSON, M.R.I.B.A. . 2/0
- A Book on Building,**
Civil and Ecclesiastical. By Sir EDMUND BECKETT, Q.C. (Lord GRIM-
THORPE). Second Edition 4/6
- Dwelling-Houses (The Erection of),**
Illustrated by a Perspective View, Plans, and Sections of a Pair of Villas, with
Specification, Quantities, and Estimates. By S. H. BROOKS, Architect 2/6
- Cottage Building.**
By C. BRUCE ALLEN. Eleventh Edition, with Chapter on Economic Cot-
tages for Allotments, by E. E. ALLEN, C.E. 2/0
- Acoustics in Relation to Architecture and Building:**
The Laws of Sound as applied to the Arrangement of Buildings. By Pro-
fessor T. ROGER SMITH, F.R.I.B.A. New Edition, Revised 1/6
- The Rudiments of Practical Bricklaying.**
General Principles of Bricklaying; Arch Drawing, Cutting, and Setting;
Pointing; Paving, Tiling, &c. By ADAM HAMMOND. With 68 Woodcuts
1/6
- The Art of Practical Brick Cutting and Setting.**
By ADAM HAMMOND. With 90 Engravings 1/6
- Brickwork:**
A Practical Treatise, embodying the General and Higher Principles of
Bricklaying, Cutting and Setting; with the Application of Geometry to Roof
Tiling, &c. By F. WALKER 1/6
- Bricks and Tiles,**
Rudimentary Treatise on the Manufacture of; containing an Outline of the
Principles of Brickmaking. By E. DOBSON, M.R.I.B.A. Additions by
C. TOMLINSON, F.R.S. Illustrated 3/0
- The Practical Brick and Tile Book.**
Comprising: BRICK AND TILE MAKING, by E. DOBSON, A.I.C.E.; Prac-
tical BRICKLAYING, by A. HAMMOND; BRICKWORK, by F. WALKER.
550 pp. with 270 Illustrations, strongly half-bound 6/0
- Carpentry and Joinery—**
•
THE ELEMENTARY PRINCIPLES OF CARPENTRY. Chiefly composed from the
Standard Work of THOMAS TREDGOLD, C.E. With Additions, and TREATISE
ON JOINERY, by E. W. TARN, M.A. Fifth Edition, Revised 3/6
- Carpentry and Joinery—Atlas**
Of 35 Plates to accompany and illustrate the foregoing book. With
Descriptive Letterpress. 4to. 6/0

- A Practical Treatise on Handrailing;**
Showing New and Simple Methods. By GEO. COLLINGS. Second Edition.
Revised, including a TREATISE ON STAIRBUILDING. With Plates 2/6
- Circular Work in Carpentry and Joinery.**
A Practical Treatise on Circular Work of Single and Double Curvature.
By GEORGE COLLINGS. Second Edition 2/6
- Roof Carpentry:**
Practical Lessons in the Framing of Wood Roofs. For the Use of Working
Carpenters. By GEO. COLLINGS 2/0
- The Construction of Roofs of Wood and Iron;**
Deduced chiefly from the Works of Robison, Tredgold, and Humber. By
E. WYNDHAM TARN, M.A., Architect. Second Edition, revised 1/6
- The Joints Made and Used by Builders.**
By WYVILL J. CHRISTY, Architect. With 160 Woodcuts 3/0
- Shoring**
And Its Application: A Handbook for the Use of Students. By GEORGE
H. BLAGROVE. With 31 Illustrations 1/6
- The Timber Importer's, Timber Merchant's, and
Builder's Standard Guide.**
By R. E. GRANDY 2/0
- Plumbing:**
A Text-Book to the Practice of the Art or Craft of the Plumber. With
Chapters upon House Drainage and Ventilation. By WM. PATON BUCHAN.
Sixth Edition, revised and enlarged, with 380 Illustrations 3/6
- Ventilation:**
A Text Book to the Practice of the Art of Ventilating Buildings. By W. P.
BUCHAN, R.P., Author of "Plumbing," &c. With 170 Illustrations 3/6
- The Practical Plasterer:**
A Compendium of Plain and Ornamental Plaster Work. By W. KEMP 2/0
- House Painting, Graining, Marbling, & Sign Writing.**
With a Course of Elementary Drawing, and a Collection of Useful Receipts.
By ELLIS A. DAVIDSON. Sixth Edition. Coloured Plates 5/0
**.* The above, in cloth boards, strongly bound, 6s.*
- A Grammar of Colouring,**
Applied to Decorative Painting and the Arts. By GEORGE FIELD. New
Edition, enlarged, by ELLIS A. DAVIDSON. With Coloured Plates 3/0
- Elementary Decoration**
As applied to Dwelling Houses, &c. By JAMES W. FACEY. Illustrated 2/0
- Practical House Decoration.**
A Guide to the Art of Ornamental Painting, the Arrangement of Colours in
Apartments, and the Principles of Decorative Design. By JAMES W. FACEY.
2/6
**.* The last two Works in One handsome Vol., half-bound, entitled "HOUSE
DECORATION, ELEMENTARY AND PRACTICAL," price 5s.*
- Warming and Ventilation**
Of Domestic and Public Buildings, Mines, Lighthouses, Ships, &c. By
CHARLES TOMLINSON, F.R.S. 3/0
- Portland Cement for Users.**
By HENRY FAIJA, A.M. Inst. C.E. Third Edition, Corrected 2/0
- Limes, Cements, Mortars, Concretes, Mastics, Plas-
tering, &c.**
By G. R. BURNELL, C.E. Thirteenth Edition 1/6

Masonry and Stone-Cutting.

The Principles of Masonic Projection and their application to Construction.
By EDWARD DOBSON, M.R.I.B.A. 2/6

Arches, Piers, Buttresses, &c.:

Experimental Essays on the Principles of Construction. By W. BLAND. 1/6

Quantities and Measurements,

In Bricklayers', Masons', Plasterers', Plumbers', Painters', Paperhangers',
Gilders', Smiths', Carpenters' and Joiners' Work. By A. C. BEATON 1/6

The Complete Measurer:

Setting forth the Measurement of Boards, Glass, Timber and Stone. By R.
HORTON. Fifth Edition 4/0

*** The above, strongly bound in leather, price 5s.*

Light:

An Introduction to the Science of Optics. Designed for the Use of Students
of Architecture, Engineering, and other Applied Sciences. By E. WYND-
HAM TARN, M.A., Author of "The Science of Building," &c. 1/6

Hints to Young Architects.

By GEORGE WIGHTWICK, Architect. Fifth Edition, revised and enlarged
by G. HUSKISSON GUILLAUME, Architect 3/6

Architecture—Orders:

The Orders and their Æsthetic Principles. By W. H. LEEDS. Illustrated. 1/6

Architecture—Styles:

The History and Description of the Styles of Architecture of Various
Countries, from the Earliest to the Present Period. By T. TALBOT BURY,
F.R.I.B.A. Illustrated 2/0

*** ORDERS AND STYLES OF ARCHITECTURE, in One Vol., 3s. 6d.*

Architecture—Design:

The Principles of Design in Architecture, as deducible from Nature and
exemplified in the Works of the Greek and Gothic Architects. By EDW.
LACY GARBETT, Architect. Illustrated 2/6

*** The three preceding Works in One handsome Vol., half bound, entitled
"MODERN ARCHITECTURE," price 6s.*

Perspective for Beginners.

Adapted to Young Students and Amateurs in Architecture, Painting, &c.
By GEORGE PYNE 2/0

Architectural Modelling in Paper.

By T. A. RICHARDSON. With Illustrations, engraved by O. JEWITT 1/6

Glass Staining, and the Art of Painting on Glass.

From the German of Dr. GESSERT and EMANUEL OTTO FROMBERG. With
an Appendix on THE ART OF ENAMELLING 2/6

Vitruvius—The Architecture of.

In Ten Books. Translated from the Latin by JOSEPH GWILT, F.S.A.,
F.R.A.S. With 23 Plates 5/0

N.B.—This is the only Edition of VITRUVIUS procurable at a moderate price

Grecian Architecture,

An Inquiry into the Principles of Beauty in. With an Historical View of the
Rise and Progress of the Art in Greece. By the EARL OF ABERDEEN 1/0

*** The two preceding Works in One handsome Vol., half bound, entitled
"ANCIENT ARCHITECTURE," price 6s.*

INDUSTRIAL AND USEFUL ARTS.

- Cements, Pastes, Glues, and Gums.**
A Practical Guide to the Manufacture and Application of the various Agglutinants required for Workshop, Laboratory, or Office Use. With upwards of 900 Recipes and Formulæ. By H. C. STANDAGE 2/0
- Clocks and Watches, and Bells,**
A Rudimentary Treatise on. By Sir EDMUND BECKETT, Q.C. (Lord GRIMTHORPE). Seventh Edition. .. 4/6
- The Goldsmith's Handbook.**
Containing full Instructions in the Art of Alloying, Melting, Reducing, Colouring, Collecting and Refining, Recovery of Waste, Solders, Enamels, &c., &c. By GEORGE E. GEE. Third Edition, enlarged. 3/0
- The Silversmith's Handbook,**
On the same plan as the GOLDSMITH'S HANDBOOK. By GEORGE E. GEE. Second Edition, Revised 3/0
** *The last two Works, in One handsome Vol., half-bound, 7s.*
- The Hall-Marking of Jewellery.**
Comprising an account of all the different Assay Towns of the United Kingdom; with the Stamps and Laws relating to the Standards and Hall-Marks at the various Assay Offices. By GEORGE E. GEE 3/0
- Practical Organ Building.**
By W. E. DICKSON, M.A. Second Edition, Revised, with Additions 2/6
- Coach-Building:**
A Practical Treatise. By JAMES W. BURGESS. With 57 Illustrations 2/6
- The Brass Founder's Manual:**
Instructions for Modelling, Pattern Making, Moulding, Turning, &c. By W. GRAHAM. 2/0
- The Sheet-Metal Worker's Guide.**
A Practical Handbook for Tinsmiths, Coppermiths, Zincworkers, &c., with 46 Diagrams. By W. J. E. CRANE. Second Edition, revised 1/6
- Sewing Machinery:**
Its Construction, History, &c. With full Technical Directions for Adjusting, &c. By J. W. URQUHART, C.E. 2/0
- Gas Fitting:**
A Practical Handbook. By JOHN BLACK. Second Edition, Enlarged. With 130 Illustrations 2/6
- Construction of Door Locks.**
From the Papers of A. C. HOBBS. Edited by CHARLES TOMLINSON, F.R.S. With a Note upon IRON SAFES by ROBERT MALLET. Illustrated. 2/6
- The Model Locomotive Engineer, Fireman, and Engine-Boy.**
Comprising an Historical Notice of the Pioneer Locomotive Engines and their Inventors. By MICHAEL REYNOLDS. Second Edition. With numerous Illustrations, and Portrait of George Stephenson 3/6
- The Art of Letter Painting made Easy.**
By J. G. BAENOCH. With 12 full-page Engravings of Examples 1/6
- The Art of Boot and Shoemaking.**
Including Measurement, Last-fitting, Cutting-out, Closing and Making. By JOHN BEDFORD LENO. With numerous Illustrations. Third Edition 2/0
- Mechanical Dentistry:**
A Practical Treatise on the Construction of the Various Kinds of Artificial Dentures. By CHARLES HUNTER. Third Edition, revised 3/0
- Wood Engraving:**
A Practical and Easy Introduction to the Art. By W. N. BROWN 1/6
- Laundry Management.**
A Handbook for Use in Private and Public Laundries. Including Accounts of Modern Machinery and Appliances. By the EDITOR of "The Laundry Journal." With numerous Illustrations. Second Edition 2/0

AGRICULTURE, GARDENING, ETC.

Draining and Embanking:

A Practical Treatise. By Prof. JOHN SCOTT. With 68 Illustrations 1/6

Irrigation and Water Supply:

A Practical Treatise on Water Meadows, Sewage Irrigation, Warping, &c.; on the Construction of Wells, Ponds, Reservoirs, &c. By Prof. JOHN SCOTT. With 34 Illustrations 1/6

Farm Roads, Fences, and Gates:

A Practical Treatise on the Roads, Tramways, and Waterways of the Farm; the Principles of Enclosures; and the different kinds of Fences, Gates, and Stiles. By Prof. JOHN SCOTT. With 75 Illustrations 1/6

Farm Buildings:

A Practical Treatise on the Buildings necessary for various kinds of Farms, their Arrangement and Construction, with Plans and Estimates. By Prof. JOHN SCOTT. With 105 Illustrations. 2/0

Barn Implements and Machines:

Treating of the Application of Power and Machines used in the Threshing-barn, Stockyard, Dairy, &c. By Prof. J. SCOTT. With 123 Illustrations. 2/0

Field Implements and Machines:

With Principles and Details of Construction and Points of Excellence, their Management, &c. By Prof. JOHN SCOTT. With 138 Illustrations 2/0

Agricultural Surveying:

A Treatise on Land Surveying, Levelling, and Setting-out; with Directions for Valuing Estates. By Prof. J. SCOTT. With 62 Illustrations 1/6

Farm Engineering.

By Professor JOHN SCOTT. Comprising the above Seven Volumes in One, 1,150 pages, and over 600 Illustrations. Half-bound 12/0

Outlines of Farm Management.

Treating of the General Work of the Farm; Stock; Contract Work; Labour, &c. By R. SCOTT BURN 2/6

Outlines of Landed Estates Management.

Treating of the Varieties of Lands, Methods of Farming, Setting-out of Farms, Roads, Fences, Gates, Drainage, &c. By R. SCOTT BURN. 2/6

*** The above Two Vols. in One, handsomely half-bound, price 6s.*

Soils, Manures, and Crops.

(Vol. I. OUTLINES OF MODERN FARMING.) By R. SCOTT BURN 2/0

Farming and Farming Economy.

(Vol. II. OUTLINES OF MODERN FARMING.) By R. SCOTT BURN 3/0

Stock: Cattle, Sheep, and Horses.

(Vol. III. OUTLINES OF MODERN FARMING.) By R. SCOTT BURN 2/6

Dairy, Pigs, and Poultry.

(Vol. IV. OUTLINES OF MODERN FARMING.) By R. SCOTT BURN 2/0

Utilization of Sewage, Irrigation, and Reclamation of Waste Land.

(Vol. V. OUTLINES OF MODERN FARMING.) By R. SCOTT BURN 2/6

Outlines of Modern Farming.

By R. SCOTT BURN. Consisting of the above Five Volumes in One, 1,250 pp., profusely Illustrated, half-bound 12/0

- Book-keeping for Farmers and Estate Owners.**
A Practical Treatise, presenting, in Three Plans, a System adapted for all classes of Farms. By J. M. WOODMAN. Third Edition, revised 2/6
- Ready Reckoner for the Admeasurement of Land.**
By A. ARMAN. Third Edition, revised and extended by C. NORRIS 2/0
- Miller's, Corn Merchant's, and Farmer's Ready Reckoner.**
Second Edition, revised, with a Price List of Modern Flour Mill Machinery, by W. S. HUTTON, C.E. 2/0
- The Hay and Straw Measurer.**
New Tables for the Use of Auctioneers, Valuers, Farmers, Hay and Straw Dealers, &c. By JOHN STEELE. 2/0
- Meat Production.**
A Manual for Producers, Distributors, and Consumers of Butchers' Meat. By JOHN EWART 2/6
- Sheep:**
The History, Structure, Economy, and Diseases of. By W. C. SPOONER, M.R.V.S. Fifth Edition, with fine Engravings. 3/6
- Market and Kitchen Gardening.**
By C. W. SHAW, late Editor of "Gardening Illustrated" 3/0
- Kitchen Gardening Made Easy.**
Showing the best means of Cultivating every known Vegetable and Herb, &c., with directions for management all the year round. By GEORGE M. F. GLENNY. Illustrated 1/6
- Cottage Gardening:**
Or Flowers, Fruits, and Vegetables for Small Gardens. By E. HOBBDAY. 1/6
- Garden Receipts.**
Edited by CHARLES W. QUIN 1/6
- Fruit Trees,**
The Scientific and Profitable Culture of. From the French of M. DU BREUIL. Fourth Edition, carefully Revised by GEORGE GLENNY. With 187 Woodcuts 3/6
- The Tree Planter and Plant Propagator:**
With numerous Illustrations of Grafting, Layering, Budding, Implements, Houses, Pits, &c. By SAMUEL WOOD 2/0
- The Tree Pruner:**
● A Practical Manual on the Pruning of Fruit Trees, Shrubs, Climbers, and
● Flowering Plants. With numerous Illustrations. By SAMUEL WOOD 1/6
● *³. *The above Two Vols. in One, handsomely half-bound, price 3s. 6d.*
- The Art of Grafting and Budding.**
By CHARLES BALTET. With Illustrations. 2/6

MATHEMATICS, ARITHMETIC, ETC.

Descriptive Geometry,

An Elementary Treatise on ; with a Theory of Shadows and of Perspective, extracted from the French of G. MONGE. To which is added a Description of the Principles and Practice of Isometrical Projection. By J. F. HEATHER, M.A. With 14 Plates 2/0

Practical Plane Geometry :

Giving the Simplest Modes of Constructing Figures contained in one Plane and Geometrical Construction of the Ground. By J. F. HEATHER, M.A. With 215 Woodcuts 2/0

Analytical Geometry and Conic Sections,

A Rudimentary Treatise on. By JAMES HANN. A New Edition, re-written and enlarged by Professor J. R. YOUNG 2/0

Euclid (The Elements of).

With many Additional Propositions and Explanatory Notes ; to which is prefixed an Introductory Essay on Logic. By HENRY LAW, C.E. 2/6

* * Sold also separately, viz :—

Euclid. The First Three Books. By HENRY LAW, C.E. 1/6

Euclid. Books 4, 5, 6, 11, 12. By HENRY LAW, C.E. 1/6

Plane Trigonometry,

The Elements of. By JAMES HANN 1/6

Spherical Trigonometry,

The Elements of. By JAMES HANN. Revised by CHARLES H. DOWLING, C.E. 1/0

* * Or with "The Elements of Plane Trigonometry," in One Volume, 2s. 6d.

Differential Calculus,

Elements of the. By W. S. B. WOOLHOUSE, F.R.A.S., &c. 1/6

Integral Calculus.

By HOMERSHAM COX, B.A. 1/0

Algebra,

The Elements of. By JAMES HADDON, M.A. With Appendix, containing Miscellaneous Investigations, and a collection of Problems 2/0

A Key and Companion to the Above.

An extensive repository of Solved Examples and Problems in Algebra. By J. R. YOUNG. 1/6

Commercial Book-keeping.

With Commercial Phrases and Forms in English, French, Italian, and German. By JAMES HADDON, M.A. 1/6

Arithmetic,

A Rudimentary Treatise on. With full Explanations of its Theoretical Principles, and numerous Examples for Practice. For the Use of School and for Self-Instruction. By J. R. YOUNG, late Professor of Mathematics in Belfast College. Eleventh Edition. 1/6

A Key to the Above.

By J. R. YOUNG 1/6

Equational Arithmetic,

Applied to Questions of Interest, Annuities, Life Assurance, and General Commerce ; with various Tables by which all Calculations may be greatly facilitated. By W. HIPSLEY 2/0

Arithmetic,

Rudimentary, for the Use of Schools and Self-Instruction. By JAMES HADDON, M.A. Revised by ABRAHAM ARMAN 1/6

A Key to the Above.

By A. ARMAN 1/6

Mathematical Instruments:

Their Construction, Adjustment, Testing, and Use concisely explained. By J. F. HEATHER, M.A., of the Royal Military Academy, Woolwich. Fourteenth Edition, Revised, with Additions, by A. T. WALMISLEY, M.I.C.E. Original Edition, in 1 vol., Illustrated . . . 2/0

* *In ordering the above, be careful to say "Original Edition," or give the number in the Series (32), to distinguish it from the Enlarged Edition in 3 vols. (Nos. 168-9-70).*

Drawing and Measuring Instruments.

Including—I. Instruments employed in Geometrical and Mechanical Drawing, and in the Construction, Copying, and Measurement of Maps and Plans. II. Instruments used for the purposes of Accurate Measurement, and for Arithmetical Computations. By J. F. HEATHER, M.A. 1/6

Optical Instruments.

Including (more especially) Telescopes, Microscopes, and Apparatus for producing copies of Maps and Plans by Photography. By J. F. HEATHER, M.A. Illustrated 1/6

Surveying and Astronomical Instruments.

Including—I. Instruments used for Determining the Geometrical Features of a portion of Ground. II. Instruments employed in Astronomical Observations. By J. F. HEATHER, M.A. Illustrated . . . 1/6

** *The above three volumes form an enlargement of the Author's original work, "Mathematical Instruments:" price 2s. (See No. 32 in the Series.)*

Mathematical Instruments:

Their Construction, Adjustment, Testing and Use. Comprising Drawing, Measuring, Optical, Surveying, and Astronomical Instruments. By J. F. HEATHER, M.A. Enlarged Edition, for the most part entirely re-written. The Three Parts as above, in One thick Volume 4/6

The Slide Rule, and How to Use It.

Containing full, easy, and simple Instructions to perform all Business Calculations with unexampled rapidity and accuracy. By CHARLES HOARE, C.E. With a Slide Rule, in tuck of cover. Fifth Edition 2/6

Logarithms.

With Mathematical Tables for Trigonometrical, Astronomical, and Nautical Calculations. By HENRY LAW, C.E. Revised Edition. (Forming part of the above work.) 3/0

Compound Interest and Annuities (Theory of).

With Tables of Logarithms for the more Difficult Computations of Interest, Discount, Annuities, &c., in all their Applications and Uses for Mercantile and State Purposes. By FEDOR THOMAN, Paris. Fourth Edition 4/0

Mathematical Tables,

For Trigonometrical, Astronomical, and Nautical Calculations; to which is prefixed a Treatise on Logarithms. By H. LAW, C.E. Together with a Series of Tables for Navigation and Nautical Astronomy. By Professor J. R. YOUNG. New Edition 4/0

Mathematics,

As applied to the Constructive Arts. By FRANCIS CAMPIN, C.E., &c. Second Edition 3/0

Astronomy.

● By the late Rev. ROBERT MAIN, F.R.S. Third Edition, revised and corrected to the Present Time. By W. T. LYNN, F.R.A.S. 2/0

Statics and Dynamics,

The Principles and Practice of. Embracing also a clear development of Hydrostatics, Hydrodynamics, and Central Forces. By T. BAKER, C.E. Fourth Edition 1/6

**BOOKS OF REFERENCE AND
MISCELLANEOUS VOLUMES.**

A Dictionary of Painters, and Handbook for Picture Amateurs.

Being a Guide for Visitors to Public and Private Picture Galleries, and for Art-Students, including Glossary of Terms, Sketch of Principal Schools of Painting, &c. By PHILIPPE DARYL, B.A. 2/6

Painting Popularly Explained.

By T. J. GULLICK, Painter, and JOHN TIMBS, F.S.A. Including Fresco, Oil, Mosaic, Water Colour, Water-Glass, Tempera, Encaustic, Miniature, Painting on Ivory, Vellum, Pottery, Enamel, Glass, &c. Fifth Edition 5/0

A Dictionary of Terms used in Architecture, Building, Engineering, Mining, Metallurgy, Archæology, the Fine Arts, &c.

By JOHN WEALE. Sixth Edition. Edited by ROBT. HUNT, F.R.S. Numerous Illustrations 5/0

Music:

A Rudimentary and Practical Treatise. With numerous Examples. By CHARLES CHILD SPENCER 2/6

Pianoforte,

The Art of Playing the. With numerous Exercises and Lessons. By CHARLES CHILD SPENCER 1/6

The House Manager.

Being a Guide to Housekeeping, Practical Cookery, Pickling and Preserving, Household Work, Dairy Management, Cellarage of Wines, Home-brewing and Wine-making, Stable Economy, Gardening Operations, &c. By AN OLD HOUSEKEEPER 3/6

Manual of Domestic Medicine.

By R. GOODING M.D. Intended as a Family Guide in all cases of Accident and Emergency Third Edition, carefully revised 2/0

Management of Health.

A Manual of Home and Personal Hygiene. By Rev. JAMES BAIRD 1/0

Natural Philosophy,

For the Use of Beginners. By CHARLES TOMLINSON, F.R.S. 1/6

The Electric Telegraph,

Its History and Progress. With Descriptions of some of the Apparatus. By R. SABINE, C.E., F.S.A., &c. 3/0

Handbook of Field Fortification.

By Major W. W. KNOLLYS, F.R.G.S. With 163 Woodcuts 3/0

Logic,

Pure and Applied. By S. H. EMMENS. Third Edition 1/6

Locke on the Human Understanding,

Selections from. With Notes by S. H. EMMENS 1/6

The Compendious Calculator

(*Intuitive Calculations*). Or Easy and Concise Methods of Performing the various Arithmetical Operations required in Commercial and Business Transactions; together with Useful Tables, &c. By DANIEL O'GORMAN. Twenty-seventh Edition, carefully revised by C. NORRIS 2/6

- Measures, Weights, and Moneys of all Nations.**
With an Analysis of the Christian, Hebrew, and Mahometan Calendars.
By W. S. B. WOOLHOUSE, F.R.A.S., F.S.S. Seventh Edition 2/6
- Grammar of the English Tongue,**
Spoken and Written. With an Introduction to the Study of Comparative
Philology. By HVDE CLARKE, D.C.L. Fifth Edition. 1/6
- Dictionary of the English Language,**
As Spoken and Written. Containing above 100,000 Words. By HVDE
CLARKE, D.C.L. . . . 3/6
Complete with the GRAMMAR 5/6
- Composition and Punctuation,**
Familiarly Explained for those who have neglected the Study of Grammar.
By JUSTIN BRENNAN. 18th Edition 1/6
- French Grammar.**
With Complete and Concise Rules on the Genders of French Nouns. By
G. L. STRAUSS, Ph.D. 1/6
- French-English Dictionary.**
Comprising a large number of New Terms used in Engineering, Mining,
&c. By ALFRED ELWES 1/6
- English-French Dictionary.**
By ALFRED ELWES 2/0
- French Dictionary.**
The two Parts, as above, complete in One Vol. . . . 3/0
*** *Or with the GRAMMAR, 4/6.*
- French and English Phrase Book.**
Containing Introductory Lessons, with Translations, Vocabularies of Words,
Collection of Phrases, and Easy Familiar Dialogues 1/6
- German Grammar.**
Adapted for English Students, from Heyse's Theoretical and Practical
Grammar, by Dr. G. L. STRAUSS 1/6
- German Triglot Dictionary.**
By N. E. S. A. HAMILTON. Part I. German-French-English. Part II.
English-German-French. Part III. French-German-English 3/0
- German Triglot Dictionary**
(As above). Together with German Grammar in One Volume 5/0
- Italian Grammar**
Arranged in Twenty Lessons, with Exercises. By ALFRED ELWES. 1/6
- Italian Triglot Dictionary,**
Wherein the Genders of all the Italian and French Nouns are carefully
noted down. By ALFRED ELWES. Vol. 1. Italian-English-French. 2/6
- Italian Triglot Dictionary.**
By ALFRED ELWES. Vol. 2. English-French-Italian 2/6
- Italian Triglot Dictionary.**
By ALFRED ELWES. Vol. 3. French-Italian-English 2/6
- Italian Triglot Dictionary**
(As above). In One Vol. 7/6
- Spanish Grammar.**
• In a Simple and Practical Form. With Exercises. By ALFRED ELWES 1/6
- Spanish-English and English-Spanish Dictionary.**
Including a large number of Technical Terms used in Mining, Engineering,
&c., with the proper Accents and the Gender of every Noun. By ALFRED
ELWES 4.0
*** *Or with the GRAMMAR, 6/0.*

Portuguese Grammar,

In a Simple and Practical Form. With Exercises. By ALFRED ELWES 1/6

Portuguese-English and English-Portuguese Dictionary.

Including a large number of Technical Terms used in Mining, Engineering, &c., with the proper Accents and the Gender of every Noun. By ALFRED ELWES. Third Edition, revised . 5/0

* Or with the GRAMMAR, 7/0.

Animal Physics,

Handbook of. By DIONYSIUS LARDNER, D.C.L. With 520 Illustrations. In One Vol. (732 pages), cloth boards 7/6

** Sold also in Two Parts, as follows:—

ANIMAL PHYSICS. By Dr. LARDNER. Part I., Chapters I.—VII. 4/0

ANIMAL PHYSICS. By Dr. LARDNER. Part II., Chapters VIII.—XVIII. 3/0

ORIENTAÇÕES PARA O USO

Esta é uma cópia digital de um documento (ou parte dele) que pertence a um dos acervos que fazem parte da Biblioteca Digital de Obras Raras e Especiais da USP. Trata-se de uma referência a um documento original. Neste sentido, procuramos manter a integridade e a autenticidade da fonte, não realizando alterações no ambiente digital – com exceção de ajustes de cor, contraste e definição.

1. Você apenas deve utilizar esta obra para fins não comerciais. Os livros, textos e imagens que publicamos na Biblioteca Digital de Obras Raras e Especiais da USP são de domínio público, no entanto, é proibido o uso comercial das nossas imagens.

2. Atribuição. Quando utilizar este documento em outro contexto, você deve dar crédito ao autor (ou autores), à Biblioteca Digital de Obras Raras e Especiais da USP e ao acervo original, da forma como aparece na ficha catalográfica (metadados) do repositório digital. Pedimos que você não republique este conteúdo na rede mundial de computadores (internet) sem a nossa expressa autorização.

3. Direitos do autor. No Brasil, os direitos do autor são regulados pela Lei n.º 9.610, de 19 de Fevereiro de 1998. Os direitos do autor estão também respaldados na Convenção de Berna, de 1971. Sabemos das dificuldades existentes para a verificação se uma obra realmente encontra-se em domínio público. Neste sentido, se você acreditar que algum documento publicado na Biblioteca Digital de Obras Raras e Especiais da USP esteja violando direitos autorais de tradução, versão, exibição, reprodução ou quaisquer outros, solicitamos que nos informe imediatamente (dtsibi@usp.br).