Presented by
The Highland Society of Scotland
to
J. Clemmens
1827

PRIZE ESSAYS

AND

TRANSACTIONS

OF THE

HIGHLAND SOCIETY

OF

SCOTLAND.

TO WHICH IS PREFIXED,

AN ACCOUNT OF THE PRINCIPAL PROCEEDINGS OF THE SOCIETY FOR THE PERIOD FROM FEBRUARY 1816 TO NOVEMBER 1820, CAREFULLY REVISED AND CORRECTED,

BY

HENRY MACKENZIE, Esq.
ONE OF THE DIRECTORS.

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INTRODUCTION.

ACCOUNT OF THE PRINCIPAL PROCEEDINGS OF THE HIGHLAND SOCIETY OF SCOTLAND, FOR THE PERIOD FROM FEBRUARY 1816 TO NOVEMBER 1820.

The 4th Volume of the Transactions of The Highland Society was published early in 1816. In the Introductions to the former volumes, the nature of the Institution, its views and objects, together with the steps taken by the Society for their accomplishment, were so fully detailed, that it appears necessary now only to record the measures adopted by the Society in furtherance of these objects, for the period which the present account embraces. Those who had the merit of instituting the Society in 1784, contemplated, with some confidence, that it would be productive of essential and permanent advantages, not only to the Highlands of Scotland, but to the country at large. The extensive countenance and support it has received from the most respectable classes of the community, it is believed, has exceeded the most sanguine expectations of its original promoters: this indeed, the List of its existing Members, (App. No. I.) sufficiently evinces. * The Society has, in consequence, been enabled gradually to extend its exertions, which have for some time embraced every thing connected with rural economy, and agricultural improvement, over all parts of Scotland. While the chief attention of the Society is directed to these objects, it does not fail to encourage the introduction of such branches of manufactures as are most suited to the Highland and more remote parts of the country.—Useful Inventions, and Improvements in Machinery, or Implements of Husbandry (connected with its objects), are also promoted by the Society; and it is hoped its proceedings will show that, on all proper occasions, it is ready to lend its aid to the furtherance of such public measures as promise to be of real advantage to the country, and particularly to the industrious classes of the community, even when such measures may appear

* A List of the present Office-bearers of the Society, and Members who are in the Direction, is given in the Appendix, No. 2.

but remotely connected with the Society's principal objects. The Society, in this respect, possesses peculiar advantages, as few matters can come under its consideration upon which, from the influence and intelligence of its numerous members, it is not enabled readily to acquire and disseminate useful information.

In the following brief narrative, the arrangement adopted in the former volumes, of attending more to the classification of the subjects, than to the chronological order, shall be observed.

PUBLIC MEASURES, OR SUCH AS MAY BE CONSIDERED OF A GENERAL NATURE.

Steps taken in consequence of a Failure in the Crop 1816, *for insuring the Sowing of Wholesome Seed-Corn, and promoting an Early Supply of Food.*

The S[illegible] g satisfactorily ascertained, [illegible] f the crop 1816 had suffer- [illegible] inclemency of the season, [illegible] r seed, published, in Janu- [illegible] to its Members, to Country [illegible] lergy and Farmers, putting [illegible] l with respect to the kind of [illegible] l; and pointing out the means [illegible] experiment, the fitness of the various kinds of grain for seed. The Society was enabled to do this, from information previously obtained, in several Essays offered in competition for its premiums on that subject, more especially a very valuable paper of the late Benjamin Bell, Esq.; and was now assisted by the able suggestions of Dr Coventry, Professor of Agriculture.

In the same year, the Society, with the view of promoting the production of an early supply of food, offered premiums to the tenants who should raise and sell, on or before 16th August, 1817, the *greatest quantity* of *Early Potatoes*—the quantity in no instance to be under 200 bolls. Those premiums excited considerable competition; and had the effect of producing a very early supply of potatoes, more especially in the markets of large towns. The highest premium, of *Fifty* guineas, for the greatest quantity raised and sold (being above 670 bolls) within the period, was adjudged to Mr Dickson, farmer at Bangholm, near Edinburgh. Premiums were also voted on this occasion to Mr Finlay, a farmer near Glasgow, Mr Newham, in the vicinity of Paisley, Mr Inglis, who occupied farms in Lanark and Renfrewshires, and Mr Watlin, of the parish of St Quivox, Ayrshire;—all of whom had raised and sold large quantities of early potatoes, at a moderate price, previous to the middle of August 1817.

Distillery Laws.

In the Introduction to Vol. IV., the steps taken by the Society for obtaining such alterations in the Distillery Laws as to suit the circumstances and local situation of Scotland, were mentioned. In February 1816, the Society presented a Memorial to the Lords of the Treasury upon this subject, founded upon the principles stated in the Report of a Committee of the Society, printed in the Appendix to that volume, of which they also circulated copies to the counties, and to many Members of the Society who had seats in either House of Parliament, who took an anxious interest in the object. The Society had the satisfaction to find, that, in this instance, every suggestion which it had felt it to be its duty to urge, was fully attended to in the Act of Parliament passed in June 1816. By this act, what was called the *Highland Line*, was abolished, and a free intercourse of spirits allowed over all parts of the country. The licensing of small stills, of 40 gallons, was authorized, and the duty reduced to 5s. 6d. per gallon. The law of last Session (passed in July 1820) is founded on similar principles; and its main purpose is to discourage that illegal distillery so prevalent in the remote parts of the country, which is equally hostile to the revenue and to the morals of the people.

Malt Duties.

As connected with the preceding subject, it may be proper here to notice a Memorial presented by the Society to the Lords of the Treasury in April last, (App. No. 3.) It is well known that the departure from a principle long recognised, of imposing a smaller duty upon Malt made from Scotch Barley, and more especially from malt made from Scotch Bear or Bigg, than upon malt made from English Barley, was in Scotland generally complained of; and these complaints were still more strongly excited by certain acts passed at the close of the Session of Parliament 1819. The Highland Society, considering this a matter in which Scotland was deeply interested, and that, if the equity of the principle established by these acts were to be admitted, there would be little chance of redress being obtained at a future period, resolved to present the Memorial referred to, and to request the support of several of its leading Members then in London, for having effect given to the Society's Representation. In the Act of Parliament passed last Session, relief has been so far given, as to reduce the duties on malt from Scotch bear or bigg 6d. per bushel; and it is hoped that, at a future period, the reasonableness of an abatement of the duties on malt from Scotch grain, on account of its relative inferiority, and less productive qualities, when compared with malt made from English barley, will be admitted and acted upon.

In the act of last Session referred to, some additional beneficial Regulations have also been introduced, especially in the diminution of the quantity of spirits required to be produced from a given quantity of wash.

Fisheries.

Among other objects originally embraced by the Society, the important one of the improvement of the Scots Fisheries, was included. The information obtained upon this subject, and the endeavours of the Society to improve the Fisheries, are detailed in the former volumes. Much benefit is now admitted to have arisen from the adoption of the suggestion of the Society, to have a Special Board constituted at Edinburgh, for the superintendence and management of the White Herring Fishery, and the introduction of the use of large boats in that Fishery. Since the institution of the Herring Fishery Board, and considering that the other branches of the Fisheries are promoted by the Board of Trustees for Fisheries, &c. the Highland Society of Scotland has ceased to take a concern in that source of national wealth and industry; but, at a General Meeting, in January 1819, the Society voted a piece of plate to Mr John Mackenzie, of Richmond-Place, Edinburgh, who was formerly practically engaged in the fishery, for useful information furnished by him to the Society (particularly in regard to the advantages of employing large boats in the Fishery), which had enabled the Society to recommend that measure.

Roads and Bridges.

The anxious wish of the Society, for having easy means of communication opened up all over the country, especially in the more remote and less accessible parts of it, as an essential means of facilitating its improvement, and the successful representations made, and information communicated by the Society for effecting this highly desirable and national object, were detailed in the former volumes. From the liberality of Government and Parliament, and the public spirit of the Proprietors in the several counties where this essential improvement was most required, much has been effected, both in the construction of Roads and Bridges, and in providing the means of keeping them in repair; and it is hoped any interference on the part of the Society, in future, may in general be unnecessary. The Society, however, on account of the peculiar circumstances of *Shetland*, agreed, in June 1819, to vote a small sum towards a survey of projected Roads in that island.

Improvement of the Breed of Sheep, and Matters connected with the Woollen Manufactory, &c.

The Society, for several years after its institution, bestowed much of its attention, and appropriated a portion of its funds, towards the Improvement of the Breed of Sheep. That particular object was, however, for a time, in a great measure relinquished, upon the institution of the British Wool Society, which the patriotic zeal of Sir John Sinclair had induced him to establish. But as that Society has been for a considerable time discontinued, or dissolved, the Highland Society of Scotland has found it necessary to resume this branch; and has accordingly offered Premiums for Improving the Breed of Sheep in several districts of the country. These Premiums it is in view afterwards to transfer, in rotation, to other districts suited to sheep husbandry.

As connected with the subject just mentioned, the Society has, for several years past, given Premiums for the Improvement of Sheep Pasture, by means of *Sheep Drains*, which has been attended with very beneficial effects.

In the 4th volume will be found an able Essay, by the Rev. Dr Singer of Kirkpatrick-Juxta, on the Advantages, and on the Means of the Introduction of the Stapling of Wool into Scotland, with Extracts from other Communications to the Society on that subject. The Society being desirous of having the effect of this measure fairly tried by practical experiment, offered, in 1818, a Premium of *one hundred* guineas to the wool-stapler who should first establish himself in Scotland, in a situation approved by the Directors. The Society was aware, that, with due attention to other objects, and with the reduction of its funds, occasioned by the cessation of the annual sum of 800*l.*, allowed for several years from the Scotch Forfeited Estates' Money, it could not hold out a sufficient inducement to a person properly qualified for settling in Scotland as a wool-stapler; but it was hoped the advertisement would have the effect of calling the attention of proprietors of sheep-farms and wool-growers, who might aid the Society in attaining the object.

The Society, in 1817, voted a premium to James Kelly, manufacturer in the island of Ilay, Argyllshire, for erecting a manufactory there for the teasing, carding, and spinning of wool, and making the same into cloth; and in the same year, a premium to Mr Walter Mercer, of Gallashiels, for constructing an ingenious machine for doubling, twisting, and reeling hosiery and woollen yarn.

As connected with the several matters which have just been stated, it may be proper here to mention, that at the Anniversary Meeting in January 1820, the attention of the Society was called by Mr Horne of Langwell and other members, to the then low price of Scotch wool, and the applications making for the repeal of a duty recently imposed upon the importation of foreign wool; when it was urged, that the repeal of that duty would have the effect of still farther depressing the market for wool of home growth. The matter having been referred to a Committee, the Directors, in consequence of the Report of that Committee recommending that the repeal ought not to be acceded to, at any rate until the effect of the tax should be ascertained by experience, transmitted a Representation on the subject in the proper channels; and had the satisfaction to find, that the sentiment of Government and Parliament upon the subject, was in unison with that entertained by the Society.

EQUALIZATION OF WEIGHTS AND MEASURES.

The exertions of the Society for attaining this important object, and the Plan proposed for that purpose, were detailed in the Introduction to the 4th Volume. Some of the alterations upon that Plan, by the Committee of the House of Commons, were also there noticed. During the progress of the bill through that House, farther difficulties occurred on account of privileges claimed by some cities and incorporations in England to regulate their own weights and measures. The bill passed the House of Commons, with clauses giving effect to these privileges; but was lost in the House of Lords in May 1816.

The causes of this failure were understood to be, that the subject had not undergone such previous discussion in England as had taken place in Scotland, so as to familiarize the minds of the people of England to the proposed change. Farther, it was thought that Europe, now being in a state of peace, facilities for communication with other Governments would be afforded, which could hardly have been contemplated when the object was taken up by the Highland Society, and that something of a more general nature might be attempted, in concert with other States, for the benefit of commerce. Accordingly, when the bill was stopped in its progress in the House of Lords, the propriety of regulating future matters by a deliberate consideration of the measure in all its bearings, was admitted on all hands.

It now appears, by a letter from Sir George Clerk, Bart. M. P. (who had, at the request of the Society, brought forward the subject in Parliament), read at last general meeting of the Highland Society, that a commission had been issued, in 1818, to certain gentlemen eminent in science, to investigate the subject: That, in 1819, they had presented a Report to Parliament, that they were at present engaged in farther inquiries, which were expected to be completed in the course of the present year; so that some legislative measure, founded on their Reports, might be submitted to Parliament early in the next Session.

An equalization and uniformity of weights and measures is admitted to be highly desirable; but, at same time, this has been found to be attended with great difficulties. The Highland Society of Scotland does not now take any active concern in the business, being satisfied with having, in the first instance, brought the important subject under discussion. The Society will certainly feel, that the attention and expense it has bestowed for its attainment have not been misapplied, if the object shall be finally accomplished.

Friendly Societies.

Although it has been doubted by individuals, whose opinions are entitled to consideration, how far subjects of this description fall strictly within the objects to which the Highland Society of Scotland is called upon to direct its attention; yet the Society and Directors incline to think, that its endeavours to better the condition, and to promote the comfort of the labouring and poorer classes of the community, cannot be held as foreign to an Institution founded upon such general and patriotic principles. The Society, it is true, is not a Charitable Institution; and when it interferes in any way in matters of that description, it is with the wish and the hope of being useful—cautious, at the same time, as to the propriety of its interference.

The Society's endeavours to promote the establishment of *Savings Banks* upon the most eligible plan, as set forth in the 4th Volume, has been in general approved. In the detail given in that Volume, as to Savings Banks, some of the defects in the constitution of Friendly Societies were noticed. The subject of Friendly Societies was afterwards more pointedly brought under the consideration of the Highland Society, at a general meeting in June, 1819, by one of its members (Mr C. Oliphant), when a Committee was named to consider the same. That Committee made its Report to the Directors in June last; and the matter having been afterwards discussed in a general meeting, held on 10th July, it was agreed to enter upon an investigation of the subject, and to offer premiums for the purpose of eliciting information respecting existing Friendly Societies. The meeting farther recommended to its members to promote the inquiry, by their local influence in those parts of the country with which they are more immediately connected. It is expected that such information will be obtained, as may afford data for ascertaining the principles and plan upon which Friendly Societies should be instituted, with a view to their permanency and efficiency. The nature of the information required, and the premiums offered, will be found from an advertisement issued by the Society, which is given in the Appendix, No. 4.

AGRICULTURE.

Green Crops.

The introduction of this essential practical improvement in the Highland and more remote districts of the country, the Society has uniformly promoted by its premiums. During the period from 1816 to 1820 inclusive, which the present volume comprehends, these premiums have been given successively in the counties of Caithness, Nairn, certain parts of Inverness-shire, in the county of Wigton, stewartry of Kirkcudbright, in Orkney and Shetland, and in the islands of Ilay and Jura in Argyllshire.

In this volume will be found an account of the results of experiments made in the cultivation of the *Fiorin Grass* in the south of Scotland, either reported to the Society, in consequence of premiums offered, or as communications from its members.—It having been suggested by some eminent agriculturists, that, from the hardy nature of this plant, its cultivation may be introduced with success in the Highlands, in certain situations, the Society, with a view of ascertaining its aptitude for these regions, has this year offered premiums for experiments with Fiorin in the counties of Argyll, Inverness, Ross and Cromarty, including the Islands.

IMPROVING THE QUALITY OF GRAIN.

1. *Wheat of the greatest Weight.*

As the value of grain must principally depend upon its weight and productive qualities, the Society offered premiums, in the county of Edinburgh, for wheat of the greatest weight, raised and sold in that county, not less than a given quantity, previous to 12th March, 1816. These premiums excited the competition desired. The first premium, being a piece of plate of *twenty* guineas value, was voted to Mr Bagrie in Monkton, parish of Inveresk; and the second to Mr Reid in Monktonhall, in the same parish.

2. *Barley and Bigg of the greatest Weight.*

Soon after the passing of the act 1816, licensing small stills in Scotland, the Society, in its wish to improve the quality of grain, extended its premiums to raising Barley, and Bear or Bigg of the greatest weight in the Highland counties, partly with the view to a supply of good grain of a productive quality for the distilleries. These premiums have been offered successively since 1817, in certain districts of the counties of Perth, Inverness, Ross, Wigton, Stirling, Dumbarton, Aberdeen and Banff, and have excited competition. The Society has it in view afterwards to transfer these premiums to certain other counties in rotation.

3. *Drilled Wheat.*

The advantages of Drill Husbandry have been, for some time, matter of discussion among agriculturists. The Society was therefore desirous of having ascertained, by the test of fair experiment, the advantages of the Drill system, comparatively with the ordinary mode of sowing broadcast.—In this view, the Society offered premiums for having experiments made with wheat drilled and broadcast, in the county of Haddington, and some other of the most improved southern counties, under the inspection and superintendence of committees of the members of the Society, resident in these counties. In 1816, a piece of plate, of twenty guineas value, was voted to Mr Brodie of Scoughall, Haddingtonshire, who had made the experiment betwixt the drill and broadcast husbandry upon an extensive scale, and which had been regularly reported upon, in terms of the Society's regulations. From the experiments of Mr Brodie, and others which have been communicated to the Society, it appears to be satisfactorily ascertained, that, in certain soils and situations, more especially where it is essential to destroy or extirpate weeds, drilling possesses material advantages over sowing in broadcast. Besides that a smaller quantity of seed is required in the former mode, the crop is considerably more productive, and the grain of superior quality. Nor are the effects produced in pulverizing the ground to be overlooked. These advantages, it is believed, much more than compensate the additional expense of occasional hoeings, which are necessary under the Drill system.

The Society has, in the present year, transferred this description of premium to the counties of Moray, Nairn, Inverness, Ross and Cromarty; and if the result shall appear to be the same with the information already obtained by the Society, the advantages attending the Drill System will be still further ascertained and established.

Improvement of Waste Lands.

From the failure of crops in some of the years since the publication of the last Volume, and the low price of grain in other years, an opinion appeared to be entertained by many, that the expense attending the improvement of barren or less productive soils, was not compensated by their produce; and that it was inexpedient to encourage the system. This induced the Society, for some years, to suspend the premiums it had been in the practice of offering for improving waste lands. It has, however, again resumed that branch; and premiums of this class are offered this year, in certain districts of the county of Argyll. The Society, besides awarding premiums in competition for any species of improvement for which it has offered specific premiums, is in the practice of encouraging, by marks of its approbation, extensive improvements in agriculture and relative branches of national industry, where example promises to have a beneficial effect. It having been regularly certified to the Society, that Dr James Wishart, who occupies the farm of Waterloo, valley of Strathpeffer, Ross-shire, though only a tenant on a lease of moderate duration, had, at a great expense, executed an improvement on that farm, to the extent of about 70 acres, with great success,—the Society, at its General Meeting in July 1816, noticed this improvement, by voting an honorary premium to Dr Wishart. It appeared from the communications made to the Society on this occasion, that a successful attempt had been previously made by Mr Mackenzie of Hilton, an active Member of this Society, and a proprietor in the valley of Strathpeffer.

Ploughing.

The Highland Society encouraged this branch of husbandry operations for a number of years, by voting sums for defraying the expense of public competitions in most districts all over the country. Ploughing competitions have now, however, been very generally instituted by local agricultural societies, and promoted by the public spirit and liberality of the gentlemen resident in the several districts.—Recently, therefore, the Highland Society has felt it necessary only to bestow an honorary medal on the person found to be the best ploughman at these competitions, when regularly reported by the Society's Members who attend them.

Salt used for Agricultural purposes, and in the Feeding of Stock.

It had been long understood that the application of salt, when properly regulated as to quantity, and applied upon certain descriptions of soil, was useful as a manure, and that its beneficial effects in the feeding and fattening of live stock, had been ascertained with still greater certainty. Proceeding upon this opinion, the Legislature, in the session 1818, passed an act, reducing the duties on salt to be used for the purposes mentioned, to 2s. 6d. per bushel. The Highland Society, on this occasion, offered premiums of *Sixty* guineas for having the experiments tried in Scotland—*First*, as to the effects of salt as a manure in general; and, *2dly*, its effects in the feeding and fattening of live stock. The Society was enabled, at the same time, to point the attention of the farmer to several matters connected with the subject, by publishing, along with its premiums, some useful suggestions which had been prepared by Sir John Sinclair, and communicated by him to the Society.

Though the period for deciding these premiums has not yet arrived, the Society has, in the mean time, received some valuable information as to the experiments made with a view to its premiums, which will be afterwards published.

Reclaiming Land from Drift Sand.

It had been for some time known to the Society, not only that large tracts of land adjoining the sea, on some parts of the northern coast of Scotland, had been destroyed by blowing sand, or sand-drift, but that in some instances such land, by proper management, had been reclaimed; and, in particular, that this had been effected by Mr Young of Inverugie, on the coast of Morayshire. The attention of the Society was more particularly drawn to this subject, at its anniversary meeting in January 1819, by Mr Macleod of Harris, who suggested the propriety of the Society's offering premiums for successful experiments of this description in the Hebrides, including the coasts of Orkney and

Shetland, where the injury was known to be most extensive. The Society accordingly has offered premiums for reclaiming land from drift sand in these districts; and they have the satisfaction to find that experiments are in consequence making, which there is every reason to hope will be attended with success, and merit the encouragements held out by the Society.

Black Cattle.

Improving the breed of Black Cattle, has always been a favourite object with the Society, to which it has appropriated a considerable portion of its funds. There are few parts of the country to which these premiums have not been extended; and they have been given in many of the Highland districts in this way, by rotation, at two or three different periods, and in general for three successive years at each period. Of late years, the competitions for meliorating the breed of cattle, have, on an average, embraced from 12 to 20 districts. The several competitions are superintended by the Members of the Society resident in, or connected with, the respective districts. The premiums are awarded for the best bulls, and for queys or heifers bred by the competitors. In several instances where local farming societies exist, these societies, and the country gentlemen, have added premiums for other descriptions of live stock, which are in general competed for at the same time with the premiums given by the Highland Society.

Improvement of the Dairy.

Several intelligent Members of the Society have, at different periods, directed its attention to the subject of the Dairy. A few years ago, upon a Report from Kirkman Finlay, Esq. and other Members of the Society at Glasgow, of the beneficial effects attending Mr William Harley's extensive dairy establishment at Willowbank, in the vicinity of that city, the Highland Society, as a mark of its approbation, voted a piece of plate of twenty guineas value to Mr Harley. The importance of promoting a general system of improvement in the dairy throughout Scotland, as one great branch of rural economy which has not received sufficient notice, having been recently submitted to the Society, premiums are now offered for the best managed dairy, to be competed for in 1821. It having been found by experience that, in promoting improvements, when premiums are limited to districts of moderate extent, competition is more readily excited, the Society has, in the first instance, offered these premiums in the counties of Haddington and Linlithgow; having it in view, however, afterwards to extend them to other districts of the country.

Work Horses.

It had been for some time observed, that the hardy breed of work horses, suited to the ordinary class of farmers in many districts of the Highlands, was either deteriorated or had altogether disappeared. The species of horse known by the name of *Garron*, possessed the quality of superior strength in proportion to their size; while the ordinary provender, the produce of those parts of the country, was found sufficient for their sustenance. In 1816, Colonel Macdonald of Lyndale suggested to the Society the propriety of offering premiums in certain districts of the Highlands, for improving the breed of work horses. Premiums have in consequence been given for this purpose, in certain parts of Argyll, Ross, and Inverness-shires. These premiums are awarded for the best stallions, brood mares, and fillies, bred by the competitors, as in the case of black cattle, at public competitions, under the management of Committees of Members of the Society, connected with the several districts.

It may be useful here to mention, for the information of Members of the Society who are resident in the country, that the Directors, being desirous of adapting the premiums offered, to the local circumstances and wants of particular districts, they therefore will be happy to consider, and, so far as may be consistent with a due distribution of encouragements, give effect to, such suggestions or communications from its Members, in regard to the premiums which may be thought most beneficial for the districts with which they are connected.

Inventions, and Improvements in Machinery, connected with Agriculture, &c.

The Society has uniformly encouraged useful inventions, or improvements on implements of husbandry, or machinery, connected with the Society's objects, when the merits of such inventions or improvements have been satisfactorily ascertained. Although the Society has not in general found it necessary to offer specific premiums for such inventions or improvements, yet articles of this description submitted to the consideration of the Society, have of late years greatly increased. Sometimes machines are submitted to the Society in their finished state, ready for actual operation, but more frequently by means of models or drawings, accompanied with the necessary descriptive references; the general rule being, that the models, drawings and descriptions approved of, shall become the property of the Society, and remain at the Society's Chambers for the inspection of the Members. Some of the principal articles which have been under consideration during the period to which this volume applies, shall be here briefly noticed.

Grubber, or Scarifier.

A particular account and drawing of this implement, known under different names, which had been long used in England, and had been recently introduced into East Lothian, was given in the 4th Volume. Among its advantages are, its effectually stirring summer fallows, or lands which have been under turnip the preceding year, previously to sowing; destroying weeds, and in some cases rendering an additional ploughing unnecessary. Improvements on this implement have since been made. The Society, in 1816, voted a piece of plate, of fifteen guineas value, to Thomas Butler, Esq. of Hambledean, Hampshire, for the improvements suggested by him on the grubber, or scarifier.—One upon Mr Butler's plan, executed by Mr Morton of Leith Walk, was submitted to the inspection of the Society, by Mr Menteith of Closeburn.

Revolving Break Harrow.

Mr Morton, agricultural implement maker, Leith Walk, was the inventor of the *Revolving Break Harrow*, which has been found so useful in extirpating weeds. The nature of its construction being already known, any particular description of it here seems superfluous. Upon the Report of a Committee of the Society who had seen its effects, a piece of plate, of ten guineas value, was voted to Mr Morton, at the Anniversary Meeting in January 1817.

Water Wheel, for superseding the necessity of Water Courses in certain situations.

This water wheel was constructed by an ingenious mechanic, Andrew Clark, blacksmith at Carnacuin, on the estate of Mr Farquharson of Monaltry, Aberdeenshire, and was first used on the river Dee in that county. It has been found that bulwarks, or mill-leads, on the banks of large and rapid rivers liable to frequent floods, are very difficult to be kept in repair. This water wheel may be placed in any part of the stream which may be desired; and while the machinery to which it communicates motion is required to be stopt, it is raised entirely out of the water. The wheel admits of being raised or lowered in the stream at pleasure, by means of a crane, and of an universal joint, allowing it to work at any angle. Hence the degree of power to be employed is regulated. The Society, in 1817, voted a premium of ten guineas to Clark the inventor.

Mr Thom *of Rothsay's Plan and Apparatus for Economizing of Water, and Regulating its Supply and Passage from the Reservoir to Rothsay Cotton Mills.*

Mr Robert Thom, who is a principal proprietor and manager of these mills, had long found a difficulty in procuring a supply of water sufficient for working them, which was attended with trouble, delay, and the expense of several hands employed in regulating that supply. The reservoir being about two miles distant from the mills, it was necessary to send a man there to open the sluice, when the mills were to be set to work, and again to shut it, when they were to be stopt; and it frequently happened, that either too much or too little water escaped from the sluice. Mr Thom, however, contrived a self-regulating apparatus, whereby the sluice of the reservoir opens and shuts of itself, and the quantity of water necessary for working the mills is discharged from the reservoir without waste. It was thought that some parts of Mr Thom's plan, in particular a self-regulating sluice, to discharge superfluous water of floods, might be advantageously employed in preserving the banks of reservoirs, and mill-leads or canals, from damage.—The Society, at a General Meeting, in June 1819, voted a piece of plate, of fifteen guineas value, to Mr Thom.

Portable Corn Mill.

Sir John Sinclair having informed the Society, that a mill of this description had been constructed in France, which had been found efficacious in supplying the French army with flour, while traversing the frozen regions of Russia, the Directors commissioned one of them. It is found to combine, in an eminent degree, the qualities of portability and simplicity. These mills are made at a small expense, not exceeding six guineas, and require only one person to work them. It is thought the invention may be useful in some remote parts of Scotland, where the operation of ordinary corn-mills is sometimes interrupted, by great falls of snow and intense frosts.

HASTIE'S *Apparatus for applying Mill-Seeds, as Fuel to Kilns, in drying Corn.*

An ingenious apparatus for this purpose, constructed by Mr John Hastie, at Hutton-Mill, Berwickshire, was brought under the notice of the Society by Mr Swinton of Broadmeadows. It is calculated to save fuel and labour.—The Society, at the General Meeting in June 1817, voted a premium of ten guineas to Mr Hastie.

Reaping Machines.

The machine for the purpose of reaping, invented by Mr Smith, of Deanston Cotton-works, to whom the Society voted a piece of plate of fifty guineas value, and of which an account was given in the Introduction to the 4th volume, in so far as regards the principle upon which it is constructed, is thought to promise fairest for success of any thing of this description which has hitherto been submitted to the consideration of the Society, or known to the public. Several models of machines for reaping corn have since been examined by the Society; one of these, upon an ingenious plan, different from Mr Smith's, by Mr Wetherspoon of Tranent, to whom a small premium was voted in 1818.

Ploughs.

The former volume served to record the encouragements given by the Society for improvements made on this essential implement of husbandry. The Society has since voted a piece of plate to the Rev. Mr Campbell of Kilcalmonell, Argyllshire, for some improvements made by him, upon the common and double mouldboard ploughs.

Double Drill Turnip Sower.

John Common, at Denwick, near Alnwick, Northumberland, having transmitted to the Society a model of a Turnip Sower, constructed by him, the Directors, from the advantages which it appeared to possess, were induced to order one of the machines on the operating scale. A Committee of the Society, after examining the machine in operation, reported, 'That a material 'improvement on the principle of Sowing Machines has been made by Mr Common, by introducing rollers, which shift on axes independent of each other, with a tube or sower 'attached to each, so as to accommodate themselves to any curvature in the drills, and ensuring the depositation of the seed in the centre 'of each drill.' The Society, in 1818, voted the sum of twenty guineas to Mr Common.

Machine for watering Turnips, or other Drilled Crops.

The Society voted its gold medal to Mr John Young, Fellow of the Royal College of Surgeons, Edinburgh, for a machine of this description, upon a simple construction, whereby several drills are watered at a time, by discharging a barrel filled with water, from apertures in horizontal tubes.

Wheel Carriages.

Sir Alexander Gordon of Culvennan having submitted to the Society certain improvements effected by him in the construction of Wheel Carriages, and in particular in the Waggon, these were examined, and reported upon, by a Committee of the Society, assisted by the late Professor Playfair of Edinburgh, and Mr Stevenson, engineer. As a description of these improvements has already been published, it does not seem necessary to give such description here. The Committee reported, that Waggons, on the principle recommended by Sir Alexander Gordon, may be used with great advantage in many situations: That the *Spring-draught Gage* invented by him, and which is attached to the axle, and by which the waggon is drawn, appears to be highly ingenious and useful. 1st, It ascertains the power of draught required to set in motion, and to draw the carriage, by the index adapted to the spring. 2dly, That the effects of *jolts* are lessened, by the spring suffering compression or expansion in a degree proportionate to the propelling or resisting force, which may be communicated by stones or other inequalities in the road.—The Society, at its Anniversary Meeting, in January 1817, voted its gold medal to Sir Alexander Gordon on account of these improvements, particularly his invention of the Spring-draught Gage on a new principle.

Self-regulating Calender, or Mangle.

The Society also, at the General Meeting in January 1817, voted its gold medal to John Graham Dalyell, Esq. advocate, for a Self-regulating *Calender*, invented by him, reported by the same Committee to be ingenious, and promising to be very useful for its intended purpose.

Bridges of Wire and of Malleable Iron, for Foot Passengers.

The Society being desirous of encouraging the introduction in Scotland of any thing which may be useful, or even ornamental, in facilitating communication, or otherways connected with its objects, at its General Meeting, in July 1818, voted a premium of ten guineas to Messrs Lees & Bathgate of Galashiels, for constructing a Bridge of Wire over the river Gala, near that place, for foot passengers, which was stated to be the first of the kind attempted in Scotland.

For the same reasons, the Society, at its anniversary meeting in January 1819, voted a premium of twelve guineas to Andrew Hislop, smith at Fountainhall, for constructing a Bridge of Malleable Iron over the Water of Gala, being the first bridge of this description erected in Scotland, which was attended with very small expense.

Rail Roads.

The great advantages of Canals, and where these, on account of local situation or other circumstances, cannot be obtained, of Rail Roads, for the transport or conveyance of various commodities connected with agriculture, manufactures, and commerce, could not fail to be fully known and appretiated, in an age which is peculiarly remarkable for attempts at the abridgment of labour. The Highland Society of Scotland has been ready on every occasion to elicit and communicate information connected with these branches, and otherwise to promote them, in so far as its means admit. The Society some time ago subscribed towards the expense of the survey of a projected Railway from Lanarkshire to Berwick. At the general meeting in June 1817, the Society's gold medal was voted to Mr John Baird, of the Shotts Iron-works, for an improved Cast-iron Rail Road, particularly suited to being laid down in places where considerable acclivities occur in ordinary roads, and admitting common carts to get off and on the Railway as requisite, without injuring or altering its position.—In 1817, the Society offered premiums for Essays on the Construction of Rail Roads, and especially on the means of laden carriages surmounting elevations occurring in their course, and for investigating whether the wheels of carriages may be so constructed as to be applicable to ordinary roads as well as to Rail Roads.—In consequence of these premiums, the Society has received several papers, accompanied with illustrative Models or Drawings. But as the subject is an important one, and the premiums continued for the present year, it has been deemed expedient to delay any publication upon the subject, until the additional information expected in consequence of these premiums is obtained.—The persons to whom premiums were voted last year, for Essays and Illustrative Models, &c. are, George Robertson, esq. of Bower-Lodge, Ayrshire; Mr John Ruthven, printer, and Mr George Douglas, both of Edinburgh; Mr James Allen at Cockenzie; Mr Witherspoon at Tranent; Mr Walker of Falkirk; Mr Fraser of the Chemical Works, Portobello; and Mr Walker at Carron.

Self-acting Pump, or Fountain and Syphon; and Level for ascertaining the relative altitude of unequal Surfaces.

The Society is sometimes favoured with ingenious inventions or improvements in machinery from its own members, who, either from having previously received honorary medals, or being in the direction at the time, look for no other notice than the acknowledgement and approbation of the Society. Of this description are, 1*st*, A Self-acting Pump or Fountain, on a very ingenious principle, invented by James Hunter, Esq. of Thurston; by means of which a supply of water can be raised to any given altitude, above a cistern receiving the stream. It is of simple construction, not liable to go out of repair, and can be executed at a moderate expense, thus presenting a combination of advantages wanting in most machines for raising water. Likewise a Syphon, always remaining charged, invented by Mr Hunter, which is extremely useful in drawing off fluids, without disturbing them. 2*dly*, An Instrument or Level, on a simple principle, invented by Mr Graham Dalyell, which may be conveniently employed in road-making, draining, and other works, by persons who are not acquainted with the more complicated levels commonly in use. For these different inventions the thanks of the Society were voted at General Meetings in January 1819, and July 1820.

☞ Descriptions and Engravings of these several articles are given in the Appendix, No. 5 and 6.

ESSAYS FOR WHICH PREMIUMS HAVE BEEN ADJUDGED.

Papers published in the present Volume, &c.

Since the publication of the 4th Volume, it was suggested by those who take a principal concern in the Society's publications, that it would be of advantage to publish future volumes in numbers or parts, as affording the means of more immediate communication to the public of any information of material interest which might be obtained. This, with the occasional publication of Reports on matters of general interest which had been discussed, it was thought would answer all the purposes in this way aimed at by the Society. These suggestions have been accordingly acted upon; and Part I. of the present volume was published in May 1817.

Kelp.

The Manufacture of Kelp is known to be of very considerable importance to the country, more especially to the Highlands and Islands. Besides its producing a large revenue to many proprietors, it is a source of industry and emolument to the inhabitants at a period of the year when their labours are but little required, either in the operations of agriculture or the fishery: The importance of Kelp as a material ingredient in several manufactures, especially in those of glass and soap, is sufficiently known. The inquiries instituted by the Society relative to Kelp, were noticed in the Introduction of the 4th Volume. In the commencement of the present volume are given the results of these inquiries. 1*st*, In a Report by a Committee of the Society on the Manufacture of Kelp. 2*d*, In two very valuable Essays upon the subject of Kelp. The first by Dr Andrew Fyfe junior, of Edinburgh; the second by Samuel Parkes Esq., of Goswell Street, London. To Dr Fyfe a piece of plate of fifty guineas value was voted, and a piece of plate of the value of twenty-five guineas was awarded to Mr Parkes.

Economy in the Feeding of Horses.

After a short Report on Drilled Wheat, a subject already adverted to, an Essay by William Fraser Tytler Esq., Sheriff of Inverness-shire, upon the Economy of Feeding Horses, is next given, which contains a very accurate and satisfactory account of certain experiments made by him, for several successive years, in the practical substitution of *Whins (furze)* for Corn, in the feeding of horses. The premium which had been offered on this subject was adjudged to Mr Fraser Tytler.

Means of ascertaining the Richness of Milk.

After an account of the experiments on Fiorin Grass, to which reference has been already made, will be found, a Report prepared by Dr Hope, Professor of Chemistry in the University of Edinburgh, on the use of Mrs *Lovi's* Aerometric Beads, in ascertaining the richness of milk. The Society is happy in this opportunity of expressing its thanks to Dr Hope for the aid of his professional talents, not only in this Report, but also in the analyzing of specimens of kelp, and several other matters requiring chemical analysis.

Woods and Plantations.

A very full and valuable paper on this subject will be found in the present volume, which was designed for volume fourth. The object of the Society in having this paper prepared and published, was to collect the information to be found in a variety of publications, and every thing material that was known in regard to the planting, rearing, and management of Woods and Plantations, published in one General Abstract. It has now been prepared at the desire of the Society, in a very satisfactory manner, by the Reverend Mr Hamilton, minister of Ashkirk, from several Essays on the subject, for which premiums had been voted by the Society, and a variety of other sources of information. Though, from the delay which has taken place, some of the matter may have been anticipated in Sir John Sinclair's Reports of the Husbandry of Scotland, and other publications, the subject is of sufficient importance to merit insertion in the present volume.

As connected with it, a communication from William Howieson, M. D. of Edinburgh, suggesting the practicability of extracting turpentine from certain descriptions of the Scotch pine, has been allotted a place in the present volume.

Construction of Wooden Bridges.

The last paper to be noticed is an Essay by Mr George Robertson of Bower Lodge, Ayrshire, on the application of timber to the construction of Bridges, with illustrative engravings. The Society being of opinion, that in remote parts of the country, where there may be a plentiful supply of wood, and where the access to other materials is difficult and expensive, wood may be advantageously applied in the construction of bridges, voted a premium to Mr Robertson for this paper.

Celtic Literature and Antiquities.

This being one of the original objects, though perhaps a minor one of the Institution, the Society has at all times countenanced and promoted matters therewith connected, as stated in the Introductions to the former volumes. Of this description, the compilation and publication of a proper Dictionary of the Gaelic language, appeared to be particularly called for;—besides that no such work of any authority existed, to assist the Gaelic student, the Society was of opinion that such a dictionary, upon an approved and comprehensive plan, would go far towards fixing and illustrating the nature and structure of a language, admitted to be ancient and expressive; and that if, in the progress of society, this language should come to be less known or spoken even than it is at present, a Thesaurus of it might, as a standard, be referred to, as showing what at least the language had formerly been. The work is now in progress, and is perhaps farther advanced towards completion than could have been expected, considering the nature and difficulty of the undertaking. Since the publication of the former volume, the Highland Society of London has joined its patronage to that of Scotland, in promoting a subscription, which is now going on, and has reached a considerable amount, for defraying the expense of the work; and his present Majesty, at the solicitation of both Societies, has been graciously pleased to permit the Gaelic Dictionary to be dedicated to him.

Origin and Descent of the Gael.

James Grant, Esq. of Corrymony, advocate, having published a very learned and ingenious treatise, entitled, 'Thoughts on the Origin and 'Descent of the Gael,' in which the author had thrown much light upon points connected with the history, manners, and language of the Gael, the Society, at the anniversary meeting in January 1819, voted its gold medal to Mr Grant, as a mark of the Society's approbation of the work.

Translation of the Poem of Fingal, into Latin Heroic Verse.

The Reverend Alexander Macdonald of Crieff having executed a translation of Ossian's Poem, Fingal, into Latin heroic verse, the Society, at the general meeting in July last, in token of its approbation, voted a sum of ten guineas to Mr Macdonald, for a copy of the work.

Communications with other Societies, &c. in regard to Celtic Literature and Antiquities.

Besides a regular correspondence with the Highland Society of London, upon matters connected with these subjects, the Royal Antiquarian Society of France, and the Cambrian Society, have recently opened communications with the Society in regard to Celtic Literature and Antiquities. The Society has also to express its acknowledgements to Mr Owen Pughe, for his translation of Paradise Lost into the ancient British or Welsh language—to Mr Dyer of Exeter, for his Treatise on the origin of Ancient Names in Mythology, Topography, History, &c.—and to Dr C. W. Ahlwardt of Leipsig, for his translation of the Poem of Ossian into the German language.

Funds of the Society—Correspondence with other Institutions relative to Agriculture and principal Objects of the Society.

Notwithstanding the annual expenditure of the Society in promoting its objects, the Society, from the extensive countenance it has received, has been enabled to accumulate a moderate capital. As more than three-fourths of the Members, on an average, pay life subscriptions in place of the annual payment, it was early perceived that the permanency of the Institution would not be effectually secured, or its objects successfully promoted, unless those life subscriptions were formed into a capital. Much of the Society's success is to be attributed to the zealous and judicious exertions of the late *Mr Macdonald of St Martins*, who filled the office of Secretary for a long period after the Society was instituted, and his careful administration of its funds, in the capacity of Treasurer, which situation he latterly undertook. It was mentioned in the Introduction to last volume, that the Society, in token of its gratitude, had resolved to erect a monument to Mr Macdonald's memory, in the parish church of St Martins; which resolution has been accordingly some time ago carried into effect. Though not within the period comprehended in this volume, it may be gratifying to its Members to insert here the substance of the speech of Henry Mackenzie Esq., on occasion of announcing to a general meeting of the Society the death of Mr Macdonald, and moving the appointment of his successor. It is a tribute to the merits of these officers, the more valuable to the memory of the deceased and to the merits of the living, that it will be acknowledged by every person most conversant in the business and concerns of the Society, to be strictly correct, without any of that flattery or partiality that sometimes mixes itself with such eulogiums.

"I rise with peculiar feelings, which I hope the Society will think it only a venial egotism if I attempt to express. On such occasions as the present, and when making such motions as that with which I mean to conclude, I used to stand abreast with my excellent friend our late Treasurer, Mr Macdonald of St Martins, with whom I had been one of the original Members of the Society, and with whom, since the time of its institution, (now for *thirty* years and upwards), I had been connected and cooperated in almost every concern of this Society. I now, Sir, in common with every Member who hears me, have to lament his loss. Sir, in honour of his memory, I need only adopt the language of the epitaph of *Sir Cristopher Wren*, the architect of St Paul's, on his monument erected in that sublime cathedral—"*Si monumentum quæris, circumspice.*" We need only read the List of the Members of this Society, and look at the volumes of its Transactions; to see the various objects to which it has attended—the various important public interests it has promoted and encouraged—in short contemplate the dignified and important position it has acquired, and then judge how much it owes to that excellent officer. It was, I believe, not the least gratifying circumstance in his lot, (and he had many both in fortune and family), that lightened the close of his useful and honourable life, to think that this Society, which he had fostered at its birth, and supported in its progress, had now arrived at that maturity, at that most respectable situation, to which his zeal and exertions had so materially contributed. But, my Lord, it would be a waste of words, and indeed an abatement of impression, were I to detain the meeting any longer on this topic.

"But in the midst of our just regrets for the loss of such an officer, the Committee of your Directors have to congratulate the Society on having been fortunate enough to find a successor worthy to succeed their late Treasurer. In naming Mr Innes of Stow, his general respectability will be immediately acknowledged; but I may add, that he has also the peculiar merit with the Society, of having been a most constant attendant on all the meetings of its Directors, equally attentive and zealous to promote all the objects concerning which they were employed; and was frequently consulted by our late excellent Treasurer in the business of his particular department, the investment of the funds of the Society. I repeat, most sincerely and impartially, that I congratulate the Society on that gentleman's acceptance of this appointment; and beg to conclude, by moving, that Gilbert Innes Esq. of Stow be appointed Treasurer of this Society, in the room of the late Mr Macdonald of St Martins."

The only public aid which the Society has obtained, were certain comparatively small Parliamentary grants from the Scotch forfeited estates' money. When the last volume was published, a hope was expressed that some further aid of this description would be obtained; but this, it would appear, Government had not deemed it expedient to renew. The Society, however, will continue its exertions for the improvement and prosperity of the country, with such means as it possesses. These means, it is hoped, have been, and will continue to be properly directed. That this at least is the intention and anxious wish of the Society and the Directors, it is believed is generally acknowledged. If the Society is to depend exclusively on its own funds, while this may have the effect in some measure of limiting its means of being useful, on the other hand the expectations of the country, from its exertions, will not be so great; and the Society will have more credit with the public for any good which the Institution may be enabled to effect.

The annual accounts of the Society, embracing every item of its income and expenditure, have for many years been regularly audited by a professional accountant, under the inspection of a Committee of the Society; and these accounts are open at all times for inspection. Claud Russel, Esq. has been recently appointed to the office of Auditor of Accounts, in the room of the late Mr Robert Wilson.*

* It having been ascertained, previous to the General Meeting of the Society held on 1st July 1816, that an appli-

The Society continues to correspond, on all necessary occasions, with the principal Agricul-

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cation made by the Society, for obtaining a continuance of a small grant of public money, which it had received for several years, had not been acceded to, Henry Mackenzie Esq., at the request of his brother Directors, gave to that General Meeting a summary view of the history of the Society—of the principal objects to which its attention had been directed since its institution, and the important services rendered by the Society to the agricultural, commercial, and manufacturing interests of the country,—this was done by Mr Mackenzie in his usual luminous, impressive, and eloquent manner. From some notes taken at the time, it appears, that in the course of his address, he said—" From the title of the Society, *The* HIGHLAND *Society of Scotland*, it has been sometimes supposed (and I have reason to believe to the prejudice of the Institution) that its exertions were confined to *Highland* objects only. The reverse is the truth. It began with an attention to the Highlands, indeed;—that more distant part of the kingdom where improvement was less known and less active, than in the Lowland and more cultivated districts; but it very soon extended its views to *every part of Scotland.*—From every part of Scotland its Members are chosen; and by much the greatest number of its objects and encouragements are now equally applicable to the Lowland districts. The Society may be compared by a simile, which must be familiar to most of the gentlemen who hear me, to those mountain streams of our country, which take their rise indeed in the Highlands, but in their course water and fertilize the plains below.

" The idea of economy, now so strongly urged on Government, and a desire in Government to obey that call, probably prevented a grant at the present time, of the continuance of this public aid, which had hitherto been used by the Society so much to the advantage of the country. My Lord, tural Institutions in England and Ireland. Among these may be mentioned the Board of Agriculture—the Society of Arts, Manufactures and Commerce—the Bath, or West-of-England Agricultural Society—the Dublin Society and Farming Society of Ireland—and with many of the Local Agricultural Societies in Scotland. These last have been found to be productive of great benefits to the districts in which they are instituted. The Highland Society of Scotland, therefore, has been always desirous of promoting their formation, and encouraging their exertions. The Society takes this opportunity of expressing its acknowledgments to the Agricultural Society of Philadelphia, North America, for the communication of its published Transactions; and also its high approbation of the Agricultural Association recently formed at Halifax in Nova Scotia, under the auspices of a distinguished Member of

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I admire, I revere economy in a Minister; a principle always laudable, and at this juncture so peculiarly necessary. But I cannot help, with every deference to that principle, humbly suggesting to Administration, as well as another public body well known to the constitution of this country, I mean *Opposition*, that there is a caution which is not safety, a popularity which is hurtful to the people, an economy which lessens those means it is so anxious to save. Economy, in some instances, more especially when the question is as to the propriety of encouraging and fostering productive industry, by liberal assistance from the public, appears to me to resemble the imprudent saving of that seed corn, which would return sevenfold to the sower."

this Society, the Earl of Dalhousie; and to express the readiness of the Highland Society to contribute to its success, agreeably to the request made in his Lordship's letter, addressed to the Society's late excellent President, the Duke of Buccleuch and Queensberry. Among the individuals who favour the Society with communications, it appears proper to distinguish the Right Honourable Sir John Sinclair, Bart., who, since the publication of last volume, has presented to the Society the Memoirs of the Agricultural Society of the department of the Seine, also copies of the 1st and 2d editions of his own very valuable Treatise, entitled, 'A Code of Agriculture.'

Measures connected with the Public Service.

The Highland Society of Scotland, desirous of marking its sense of the distinguished valour and heroism displayed by their countrymen during the late war, more especially in their recent conflicts in Flanders, which had been attended with such glorious and important results; at a General Meeting on 3d July 1815, passed certain Resolutions to this effect, which were communicated to the Commanding Officers of the Scotch and Highland Regiments engaged in these memorable exploits. The Society, at same time, elected Field-Marshal His Grace the Duke of Wellington, and Marshal Prince Blucher, *Honorary Members.* The Resolutions adopted by the Society on the occasion, having been communicated to these distinguished Commanders, by his Grace the Duke of Buccleuch and Queensberry, then President of the Society, the following were the answers received.

Cambray, *May 6th*, 1816.

My Lord Duke,

I had the honour of receiving yesterday your Grace's letter of the 28th December last, in which you enclosed the Resolutions of a General Meeting of the Highland Society, electing me an Honorary Member of the same; and I beg that your Grace will do me the favour to present my acknowledgments to the Society for the honour which they have thus conferred upon me.

I have long and frequently had occasion to applaud the distinguished valour, and other good qualities, as soldiers, of their countrymen, and am much flattered at being admitted a Member of their Society.

I have the honour to be, &c.

Wellington.

His Grace the Duke of Buccleugh and of Queensberry, &c. &c. &c. President of the Highland Society, Edinburgh.

(Translation.)

My Lord Duke,

Your Grace's respected letter, with the Resolutions of the Highland Society of Scotland, of 3d July of last year, electing me an Honorary Member of that celebrated and esteemed Society, has been received by me with emotions, and great pleasure.

I acknowledge sincerely, and am very grateful for the flattering proof of regard which so numerous a Society of distinguished men has been pleased to confer upon me by their choice; and I feel myself so much the more honoured by this union with them, that I have ever esteemed and loved the Highlanders as one of the noblest nations, especially since I have been an eyewitness of the perseverance with which they fight, and of the bravery, not to be surpassed, with which they maintain their ancient reputation.

While I beg your Grace to have the goodness to communicate my feelings and gratitude toward the very honourable Highland Society, I assure you at the same time of the very high regard with which I have the honour to remain,

Your Grace's
very devoted and humble servant,

G. Blucher,
Wohlstadt.

Carsbad, 13*th July* 1816. *To the President of the Highland Society of Scotland, His Grace the Duke of Buccleugh and Queensberry.*

The proceedings towards obtaining a National Monument, to be erected in the metropolis of Scotland, in honour of these splendid achievements, originated at the Anniversary Meeting of the Society in January 1816, when, on the motion of Mr Linning of Colzium, seconded by the late Lord Chief Baron Dundas, certain resolutions were adopted upon the subject. An application was afterwards made, in name of the Society, for obtaining a portion of the money voted by Parliament for a National Monument, to be appropriated towards the erection of the projected one at Edinburgh; but it not having been deemed expedient to accede to this request, and the Society having no power to appropriate its own funds to such a purpose, the matter was left to the patriotism and liberality of the Noblemen and Gentlemen of Scotland; and it is understood a considerable subscription has already been obtained for accomplishing this object.

The Society further, at the Anniversary Meeting in January 1819, on the motion of the Earl of Elgin and Kincardine, passed a resolution, recommending to its Members a subscription for erecting a Monument to the memory of our illustrious countryman, King Robert Bruce, whose remains had been recently discovered in the Abbey Church of Dunfermline.

ADDRESSES TO THE THRONE, &C.

Though, as stated in the Introductions to former Volumes, political matters are foreign to the ordinary business and objects of the Society; yet it has not failed, on all proper occasions, to testify its loyalty to the Throne, and its attachment to the principles of the Constitution. Short as the period is which the present account embraces, several occasions have unfortunately presented themselves, where the Society felt itself called upon to approach the Throne with the expression of its condolence. The first was, upon the very melancholy and universally lamented demise of her Royal Highness the Princess Charlotte of Wales and Saxe Cobourg. The following Addresses, prepared by Henry Mackenzie, Esq., under the sanction of the Directors, were submitted by him to the Anniversary General Meeting of the Society, held on the 13th January, 1818, and unanimously adopted.

To His Royal Highness GEORGE, Prince of Wales, Regent of the United Kingdom of Great Britain and Ireland.

May it please your Royal Highness,

The Highland Society of Scotland, incorporated by Royal Charter, assembled in a General

Meeting, beg leave to approach your Royal Highness with their most sincere condolence for the severe affliction which has recently visited your Royal Highness's Family. As men, and as citizens, they deeply deplore an event which, while it has struck the heart of every individual parent and husband, has, at the same time, blighted the hopes of the whole nation—hopes fondly cherished in their affection and attachment to the Illustrious House of Brunswick. In the assurance of these sentiments of universal sympathy and attachment, they trust your Royal Highness will find the best consolation, of which so severe a calamity is susceptible.

Sealed with the Seal of the Society, and signed by its appoinment, by his Grace Charles William, Duke of Buccleugh and Queensberry, President of the Society.

(SEAL.) BUCCLEUGH, &c.
President.

Edinburgh, 13*th January*, 1818.

To His Serene Highness Prince LEOPOLD of Saxe Cobourg.

May it please your Serene Highness,

The Highland Society of Scotland, incorporated by Royal Charter, assembled in a General

Meeting, beg leave to lay before your Serene Highness their sincere sympathy and condolence in the late most severe and heartrending affliction with which your Serene Highness has been visited. They would not intrude on the sacredness of your sorrow with commonplace topics of consolation; but they cannot fail to contemplate, with satisfaction, that best source of comfort which your Serene Highness possesses in the piety and virtue which eminently distinguish your character; and in the assurance of that esteem, respect, and attachment, which those excellent qualities have impressed on the nation ever since your Serene Highness has resided among us.

Sealed with the Seal of the Society, and signed in its name, by his Grace Charles William, Duke of Buccleugh and Queensberry, President of the Society.

(SEAL.) BUCCLEUGH, &c.
President.

Edinburgh, 13*th January*, 1820.

The Society, at its Anniversary General Meeting on 12th January 1819, resolved to present an Address to the Prince Regent, upon the lamented death of her late Majesty.—The following Address having been on this occasion previously drawn up by Mr Mackenzie, was, on the motion of the Earl of Elgin and Kincardine, seconded by Sir Michael Shaw Stewart, unanimously adopted.

To his Royal Highness GEORGE, Prince of Wales, Regent of the United Kingdom of Great Britain and Ireland;

May it please your Royal Highness,

The Highland Society of Scotland, incorporated by Royal Charter, assembled in a General Meeting, humbly offers to your Royal Highness its sincere condolence on the late afflicting event of the death of her Majesty—a Princess endeared to the country, not only by those qualities important to her public situation, but by her constant exercise of those private and domestic virtues which shed much useful lustre on the Throne, as their example has so beneficial an influence on the corresponding manners and morals of the people.

Amidst the affliction of this event, it must be consolatory and gratifying to your Royal Highness to know how much the country has felt the excellence of your Royal Highness's filial attention to your august Parent through a long-protracted illness—attentions not less soothing in their recollection, than amiable in their performance. It has been the privilege of your Illustrious House to receive from the People the tribute of the affections, as well as the homage of loyalty; a feeling which affords the best pledge for the security of the Throne, and the surest proof of the freedom and happiness of its subjects.

Signed in presence, and at desire of the Meeting,

(SEAL.) CHARTERIS WEMYSS and MARCH,
Vice President.

Edinburgh, 12*th January* 1819.

The last occasion was upon the death of his late revered Majesty, King George the Third, and the accession to the Throne of his present Majesty; when the following Address, likewise prepared by Mr Mackenzie, and brought forward by him at an Extraordinary General Meeting of the Society, held on the 28th February 1820, was, on the motion of the Earl of Moray, seconded by the Earl of Elgin, unanimously adopted.

TO THE KING.

Most Gracious Sovereign,

We your Majesty's most dutiful and loyal subjects, the Highland Society of Scotland, incorporated by Royal Charter, assembled in a special General Meeting, beg leave humbly to lay before your Majesty our sincere and heartfelt condolence on the death of our late beloved and revered Sovereign, whose memory will long be cherished in the remembrance of his subjects, whose loyalty and affection he conciliated, by the possession and the exercise of those qualities which most adorn the Monarch, and those virtues which most exalt the character of the Man.

We take this occasion humbly to express our sincere sympathy with your Majesty's feelings, for the loss of your illustrious brother, his Royal Highness the Duke of Kent; a Prince whose active benevolence exalted him in the opinion, and endeared him to the hearts of the country.

We desire at same time to lay at your Majesty's feet, our most cordial congratulations on your accession to the Throne of these Kingdoms. Your people have been prepared, from the exercise of the Royal Functions which had previously devolved upon your Majesty, to look for that imitation of the example of our late revered Sovereign, in the graciousness of the Regal sway, and attention to the interests of the subjects, which have distinguished, and we are confident will continue to distinguish, the Reigns of your Majesty's illustrious House. It is our earnest prayer, that it may long continue to wield the Sceptre of the United Kingdom, with those dispositions which equally tend to the security of the Crown, the preservation of the Constitution, and to the freedom and prosperity of the People.

Sealed with the seal of the Society, and signed by the Right Honourable Francis Charteris Douglas, Earl of Wemyss and March, one of the Vice-Presidents in Office, in presence, and at desire of the Meeting.

(SEAL.) CHARTERIS WEMYSS and MARCH, *V. P.*

Edinburgh, 28th February 1820.

SECOND REPORT

BY THE COMMITTEE OF

THE HIGHLAND SOCIETY OF SCOTLAND,

UPON THE

MANUFACTURE OF KELP.

Approved by a General Meeting of the Society, held on 14*th January* 1817, *and directed to be Printed and Circulated.*

In the former Report * (8th December 1814), the Committee stated their intention of making a further communication, in consequence of the inquiries then set on foot. And they are now enabled to fulfil that intention, in a manner which, they hope, will be satisfactory to the Society, and beneficial to the public.

* This Report does not appear in the Society's volumes; but it is referred to in the Introduction to vol. IV. page xv, and was printed separately, and circulated among kelp proprietors and others interested. Its object was to suggest inquiries, the results of which appear from the Essays by Dr Fyfe and Mr Parkes.—Edit.

In January 1815, the Society offered premiums for two Essays, as proposed by the Committee; one, upon the proper construction of kilns for burning; the other, upon the comparative value of kelp and barilla, with their component parts and uses. These premiums were again offered in January 1816; the premium upon the construction of kilns being limited to such as had been found in practice to be effectual; but no Essay has yet been received which answers that description. The Committee, however, are now enabled to lay before the Society two Essays; one by Dr Andrew Fyfe, junior, of Edinburgh, and the other by Mr Samuel Parkes, Goswell-Street, London; pointing out the comparative value of kelp and barilla, and stating several other matters from which the great advantages to be derived from improvements in the manufacture of kelp may easily be deduced, and by which these improvements may, with no great difficulty, be accomplished.

From these communications, it appears, that the alkali contained in a given quantity of kelp, prepared in situations not materially dissimilar, varies from 1 to 6 per cent. This difference is understood to proceed, not only from the circumstance, that different kinds of weed yield different proportions of alkali, but also, in a great measure, from the difference of care bestowed in collecting, drying, and burning the weed. It is presumed that, by proper attention in these respects, the whole kelp prepared from the better kinds of weed, might be brought to yield the highest produce mentioned, and perhaps the produce might be carried still further. But even with a produce of 6 per cent., kelp can enter fairly into competition with barilla of the usual quality, yielding 11 or 12 per cent. of alkali, while the price of such barilla is nearly triple that of the best kelp usually brought to market at present. It appears also, that, besides alkali, the other component parts of kelp, when carefully prepared, are of considerable value, as materials in different useful manufactures; that some of them are in greater proportion in kelp than they are in barilla; and that there are some ingredients in kelp which do not at all exist in barilla.

This statement clearly evinces the advantage of improving the manufacture of kelp; because, if the alkali and other component parts of kelp be properly prepared, the proportional value will be increased, and the manufacturers who employ kelp as one of their materials, will proceed in its use with certainty and confidence, in place of resorting to other materials which are sometimes substituted, owing to the bad quality of kelp. The use of kelp, too, may be extended as a material to other arts and manufactures, when its real qualities are fully known; and even the Iodine (one of its component parts) may perhaps become useful, and enhance its value.

To obtain the full advantages from the information contained in the Essays before referred to, it seems to the Committee, that it might be advisable for the kelp proprietors and their factors to form local associations, similar to farming societies, the benefits of which are so well known. By these associations proper regulations might be drawn up for carrying on the business; and regular examinations might take place respecting the quality of the kelp produced.

One of the first objects of such associations would be, by firm and decided measures, to prevent the practice which has been too prevalent of late years, of adulterating the kelp, by mixing with it stones, gravel, sand, or other substances; a practice which is no less injurious to the proprietor of the kelp shores, than to the manufacturer who uses kelp as one of his materials, and which so often occasions the rejection of cargoes, to the great loss of the owners. These associations may also have in view the best means of increasing the growth of the kelp, by blowing rocks, or placing stones in proper situations, or other expedients; and might further improve the manufacture of kelp, by the distribution of small premiums to the best kelp-makers on the shores of the district.

These associations, too, would open a ready communication with the Highland Society, who, no doubt, will at all times be disposed to do every thing in their power to promote the views of the associations, and who, in particular, might be of much use, by obtaining accurate examinations of the kelp produced in different situations, so that the peculiar qualities of the kelp of every spot may be clearly ascertained, as has been done already with respect to many places; and the Society might even, for a time, give premiums in aid of those to be given by the associations. In this way, the qualities of the kelp of every particular place being distinctly known, the kelp, thus distinguished, would be applied to the manufacture to which it is particularly adapted: improvements in the manufacture of kelp would of course take place in every situation, and thus become general; and the value of the article would be thereby raised far beyond what could be accomplished by any other means. But even although the associations proposed should not become general, yet the districts where associations shall be formed will receive great advantages from them, as the consumers of kelp will naturally turn their attention to such districts: And though there should be no associations, individuals will profit by attending to the improvements now recommended.

Several circumstances respecting kelp and its manufacture still remain to be more perfectly ascertained. The Committee are of opinion, that, at present, it would be of great importance to determine the highest possible value to which kelp can be brought; and for this purpose, they strongly recommend to the kelp proprietors,

1st, To select and weigh a quantity of their best ware, which has been gathered and dried under the most favourable circumstances;—the species of the plant, or plants, to be remarked, and mentioned, with the proportions, if different plants are mixed.

2d, To have this ware carefully burnt under the superintendance of some trusty person, and the produce of kelp accurately ascertained.

3d, To send a specimen (not less than 8 or 10 lib.) of the kelp to the Society, with a small portion of the weed or weeds from which it was burned, with a memorandum of all the circumstances of its manufacture.

And the Committee presume, that the Society will have no objection to undertake to get the specimens carefully analyzed, and to communicate the result, either to the public, or to the parties concerned.

The Committee deem it also of much importance to ascertain the value of the kelp made from weed of different ages; and therefore recommend, that a quantity of kelp should be made from weed of

One year's growth,
Two years' growth, and
Three years' growth,

with all the attentions above noted, and sent to the Society; stating, in this case, whether the weed grew in a strong tide-way, or in a bay.

The Committee would further recommend, that a quantity of kelp should be made from drift-ware, after being well washed with sea-water, to remove all the sand that may adhere to it, with the attentions above indicated; and a specimen sent to the Society for analysis.

One of the Essays before referred to, proposes a very simple test for ascertaining the quantity of alkali contained in kelp; and by the use of that test, kelp-makers may acquire much useful knowledge: In particular, they may be enabled thereby to ascertain the proper degree of heat to be used in burning, as doubts have been suggested, whether part of the alkali is not dissipated and lost by the application of a very violent heat. But although this test may be useful for determining the proportion of alkali, yet to ascertain the other valuable ingredients in kelp, it will be requisite to have an intricate and diversified analysis, which may not easily be accomplished in the country.

Some of the experiments mentioned in the Essays show, very clearly, the great injury the weed sustains by exposure to fresh water, during the process of drying; and the Committee have no doubt that due attention will be paid to that circumstance in future. Great care ought also to be taken to keep the manufactured kelp perfectly dry when carried from place to place, and indeed in all situations. Cargoes are frequently rejected, owing to inattention in this respect.

It is certainly very desirable, that correct information should be obtained, on the proper construction of kilns, founded upon actual practice: And in order to draw attention to this point, it occurs to the Committee, that it may be proper to continue the premium for an Experimental Essay upon the subject; but not to be determined till November 1819. * This will afford oppor-

* The Premium has been continued, and advertised by the Society as follows:—

"A Piece of Plate, of Fifty Guineas value, will be award-
"ed for the best and approved Experimental Essay, upon
"the Construction and Management of a Kiln, or set of Kilns,
"which shall have been found to be effectual in burning sea-
"ware, both fresh and dried, into Kelp of good quality, hav-
"ing in view economy in the construction, and economy of
"fuel; with a comparative view of the quantity and quality
"of the Kelp, when produced in the kilns, and when obtain-
"ed in the common mode. The Essays to be accompanied
"with correct models or drawings of the Kilns recommend-
"ed, and with specimens of the Kelp produced. The Pre-
"mium not to be decided until 10th November 1819."

N. B.—Essays on the subject above specified, must be lodged with the Depute Secretary of the Society, on or before the 10th November 1819. A sealed note, containing the author's name, and inscribed on the back with the motto or device of his Essay, must be lodged therewith; and when the motto or device on the Essay, or sealed note, is neglected by the author, such Essay will not be allowed to compete for any premium. None of the sealed notes, except those which bear the distinguishing motto or device of the Essays found entitled to the whole or a part of the premium, will be opened; and the Society are to be at liberty to publish the Essays, or extracts from them, for which a premium, or any part of it, shall be adjudged; and such Essays as are not found entitled to any premium, will be returned to the authors when called for.

tunities to kelp-makers, as well as others, to make repeated trials, which may lead to material improvements in drying the weed, as well as in burning it.

The enlargement of the manufacture of kelp by the cultivation of sea-weeds, before alluded to, is a matter of much importance to the kelp proprietors. This point is very distinctly treated of in Essays on Kelp, by the Rev. Dr Walker, Professor Jameson, and Mr Angus Beaton, which will be found in the first Volume of the Society's Transactions.

Edinburgh, 9th January, 1817.

ESSAY

UPON

THE COMPARATIVE VALUE OF KELP AND BARILLA,

FOUNDED UPON ACCURATE EXPERIMENTS.

By ANDREW FYFE, junior, M. D. Edinburgh, 1816.

In considering the subject proposed by the Highland Society as a Prize Essay, *viz.* 'Upon the 'Comparative Value of Kelp and Barilla, found-'ed upon actual experiment, stating accurately 'the component parts of each, and showing to 'what uses those component parts may be pro-'fitably applied; to be accompanied with an ac-'curate account of the process of analyzing, and 'specimens of the different articles produced,' it is intended, in the following Paper, *first*, To state the constituent parts of kelp and barilla, and the mode of analysis employed for ascertaining them: *Secondly*, To point out the quantity of alkali, free, or combined with carbonic acid or sulphur, in the different kinds of kelp, and to compare this with the quantity of the same article contained in the barillas generally imported: *Lastly*, To show to what uses the component parts of kelp and barilla may be put. To which will be added, a few observations on the origin of the alkali in kelp, and on the mode of manufacturing it, with the view of perhaps increasing its value.

KELP.

Kelp forms a heterogeneous mass, of different colours. Sometimes it is of a light grey, at others, of a bluish black colour, intermixed with stony matter and charcoal; having a sulphureous smell, an alkaline taste, and being in general deliquescent.

Analysis of Kelp.

From the very heterogeneous nature of kelp, it is impossible that an analysis of any sample can give a fair view of the composition and proportion of the ingredients of any other sample; for this reason, a minute determination of the exact proportion of all the ingredients is of little consequence.

The principal object is, to discover the quantity of valuable matter the kelp contains. This is the soluble substance, principally the alkali, either free, or combined with carbonic acid or sulphur, and perhaps also with sulphuric acid.

Of the Effects of Water on Kelp.

By boiling kelp in water, a certain part of it is dissolved. The solution, when filtered, is in general of a pale green colour; occasionally, howhowever, it is quite colourless. Its taste is alkaline, and almost always sulphureous; its smell also is sulphureous. It affects the vegetable colours, as a solution of alkali does, rendering most of them green, but turmeric brown.

By evaporating this solution to dryness, a whitish deliquescent saline mass is obtained, which possesses all the sensible qualities of the solution.

Component parts of the Saline Matter.

In ascertaining the component parts of the Saline Matter, two methods have been pursued. The one was, by employing the different chemical tests; the other, by the slow evaporation and successive crystallization of the solution.

By the former method, the following results were obtained.

1st, The effects produced on the vegetable colours proclaim the existence of an alkali, free, or combined with carbonic acid.

The use of the alkali in making soap, renders it unnecessary to give any chemical proof that the alkali is soda, and soda free from any mixture of potassa, as the presence of the latter is incompatible with that of muriate of soda, which it will be seen the saline matter contains.

2d, The redundance of alkali proves, that the saline matter could contain no salt with an earthy or metallic base.

3d, Tartaric acid caused a precipitate, which was soluble in muriatic acid, indicating the presence of potassa.

To discover the matter with which these fixed alkalies are in combination,

4th, Nitric acid was added to the solution. This caused effervescence, accompanied with the odour of sulphuretted hydrogen, and the deposition of sulphur.

5th, Muriate of baryta caused a precipitate, which was not soluble in muriatic acid, indicating the presence of sulphuric acid.

6th, No. 1, after being boiled and filtered, gave, with nitrate of silver, a white precipitate, pointing out the presence of muriatic acid.

7th, Oxalate of ammonia produced no precipitate.

8th, There was no precipitate on the addition of prussiate of potassa.

9th, Sulphuric acid, poured on the dry salt, gave out the vapour of iodine.

The salt, therefore, besides the alkali, contains sulphuretted hydrogen, carbonic acid, sulphur, sulphuric acid, muriatic acid, and iodine. *

To ascertain the proportion of these ingredients, the following experiments were performed.

1st, 100 grains of the saline matter were dissolved in water. This left a residue weighing .5 grains.

2d, To the above solution, in a long-necked vessel, nitric acid was cautiously added. An effervescence took place, and the loss of weight amounted to 5 grains.

3d, The sulphur precipitated by the addition of the acid, weighed .1 grain.

4th, Nitrate of baryta added, gave a precipitate of sulphate of baryta, weighing 6 grains, equivalent to 2.04 of sulphuric acid.

5th, Nitrate of silver added, gave a precipitate of muriate of silver, weighing 100.3, equivalent to 19.1 of muriatic acid.

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* This substance, lately discovered as a component part of kelp, is most easily procured, by evaporating the solution of kelp to dryness, and pouring sulphuric acid on it, and applying heat; violet-coloured vapours are given off, which condense in dark, shining, needle-formed crystals, on the cool part of the apparatus. I have endeavoured to procure this substance from other marine plants, and from sea-water, but without success. The only other body I have been able to obtain it from, is sponge.

These experiments, then, indicate—

Carbonic acid and Sulphuretted hydrogen	.5
Sulphur	.1
Sulphuric acid	2.04
Muriatic acid	19.1
Insoluble matter	.5

These ingredients are in union with the alkaline bases of soda and potassa.

The saline matter of another specimen of kelp, was analyzed by the above method. The ingredients were found to be exactly the same, though the proportions varied a little.

To ascertain the state of combination of the different ingredients of the saline matter, a quantity of the solution of kelp was evaporated to a pellicle, and then allowed to cool slowly. Crystals were obtained, transparent, of an irregular, flat, tetrahedral form.

These, when dissolved in water, gave a precipitate with muriate of baryta, and with tartaric acid. On the addition of sulphuric acid, a disengagement of sulphurous acid gas took place, accompanied with a slight deposition of sulphur. These crystals, then, were sulphate of potassa, with some sulphite and sulphuret.

The second crop of crystals, obtained by a second evaporation of the solution till a pellicle was formed, indicated, by the above tests, the same composition.

The third crop was more of a cubical form, contained the same ingredients as above, along with muriatic acid, the salt giving a precipitate with nitrate of silver. This seems to have been a mixture of sulphate of potassa and muriate of potassa.

By the further evaporation of the solution, cubical crystals were obtained. These gave no precipitate with muriate of baryta: they gave a precipitate with nitrate of silver, and with tartaric acid. These, then, were muriate of potassa.

The solution being still further evaporated, deposited cubical crystals, which gave a precipitate on the addition of tartaric acid, and nitrate of silver, but more sparingly than before. The solution was now slowly evaporated; and cubical crystals were obtained which gave a precipitate with nitrate of silver, but did not give a precipitate on the addition of tartaric acid. These, therefore, were muriate of soda. By the spontaneous evaporation of the solution, a crystalline mass, having an alkaline taste, was obtained, which effervesced on the addition of sulphuric acid, and did not give a precipitate with tartaric acid; showing, that this was soda combined with carbonic acid. From the exposure of the solution to the air, carbonic acid had been absorbed, so as to make the soda pass into the state of carbonate.

I have also procured from one specimen of kelp, crystals of sulphate of soda. This salt can only be contained in kelp, when there is no muriate of potassa present, as these salts decompose each other, forming sulphate of potassa and muriate of soda.

To obtain the neutral salts, perhaps the best way is to employ the spent lees of the soap-maker. This is the solution of kelp, from which the carbonic acid and sulphur have been separated by the lime, and the free alkali by the oleaginous matter, in the manufacture of the soap.

When the spent lee is evaporated, it yields crystals of a colour more or less brown.

If a solution of these crystals in water be evaporated, till a pellicle begins to appear, and allowed to cool, it affords sulphate of potassa, and some muriate of potassa.

A second evaporation and cooling, gives muriate of potassa; a third, muriate of potassa, and some muriate of soda; and the remaining liquor, by continued evaporation, affords muriate of soda, with some muriate of potassa. *

Of the Proportion of Soluble Matter in Kelp.

To ascertain the proportion the soluble bears to the insoluble matter, we have only to boil a

* In this way, the specimens of muriate of potassa, and of muriate of soda, sent, were procured.

certain quantity of the kelp in water, filter the solution, and wash the residuum with water till this come through tasteless: What remains on the filter is then to be dried and weighed.

The following Table shows the proportion of the Soluble Matter, in several specimens of Kelp, ascertained by the above method.

Kelp.	Grains.	Insoluble Matter.	Soluble Matter.	Per cent. Sol. Matter.
Orkney -	480	276	204	42.5
Ditto -	480	185	295	61.02
Ditto -	480	228	252	52.5
Collonsay	480	162	318	66.2
Mull - -	480	302	178	37
Irish - -	480	337	143	27

From the foregoing Table, it appears that the soluble matter in kelp varies from about one-third to two thirds of the whole.

Of the Quantity of Soda, free or combined with Carbonic Acid, or Sulphur, which the different kinds of Kelp contain.

Kelp is composed, as has already been shown, of soluble and insoluble matter. To the soap-maker and the bleacher, it is the former alone that is useful. The soluble matter of kelp, we have shown, consists of sulphate of potassa, muriate of potassa, muriate of soda, carbonate of soda, soda, and, in general, a little sulphuret of soda. The soda, the carbonate of soda, and the sulphuret, are principally of use to these manufacturers; though kelp is by some also prized, according to the quantity of sulphate it contains.

In general, manufacturers, when purchasing kelp, are guided in a great measure by the sensible qualities; as the taste, smell, colour, or compactness. These, however, prove but fallacious tests; as the merchant often purchases for a good, what is in reality an inferior kelp. It is therefore of the utmost importance, that an easy method be pointed out, by which the quantity of alkali contained in kelp may be ascertained. In the test that is to be made use of, it is of no consequence to point out the proportion the pure soda bears to that of the carbonate or sulphuret; as the soapmaker and bleacher, before mixing the alkali with the oleaginous matter, always reduce it to its caustic state.

Kirwan was perhaps the first, who endeavoured to ascertain, with any degree of precision, the quantity of alkali in kelp. In a paper, in the Irish Transactions of 1789, he has given the result of his experiments on the different kinds of kelp. The method employed by him, was to precipitate alumina from the sulphate of alumina, by a solution of a certain quantity of kelp. The weight of the alumina precipitated, being proportionate to the quantity of alkali in the alkaline solution, served to denote the quantity of alkali. This, however, is a tedious process, and particularly to those not accustomed to chemical experiments.

By the above method, Kirwan has shown, that Cunnamara kelp contains................3.437 per cent. of soda.†

Do. do. desulphureted by fixed air.........	4.457	Do.
Strangford kelp.........	1.25	Do.

Mr Jameson, in his Mineralogy of the Scottish Isles, has likewise given an account of the quantity of alkali in the different kinds of kelp; at one time employing the method of Kirwan; at another, that first pointed out by Dr Black, *viz.* the saturation of an acid of known strength. According to him, the quantity of alkali in each is as follows—

	in 100 lib. lib.	oz.
Kelp, Norway..........................	2	11
Do. Shetland, indiff^t..............	2	6

† By soda, is always meant the alkali in its pure, or, as it is often called, caustic state.

		in 100 lib. lib.	oz.
Kelp,	Lewis, indiffᵗ.	2	11
Do.	do. do.	2	6
Do.	West Highlands, much damaged	$\frac{1}{2}$ of a lib.	
Do.	Arran	$3\frac{1}{2}$	
Do.	Isla, good	4	
Do.	Mull, do.	4	
Do.	Morven, do	$4\frac{1}{2}$	
Do.	Skye	5	
Do.	Leith	4	

In the various trials which I have made, to ascertain the quantity of alkali in kelp, recourse has always been had to the method proposed by Dr Black. This consists in determining the quantity of an acid necessary to neutralize the free alkali, as well as that in combination with carbonic acid and sulphur. For this purpose, I have used sulphuric acid, diluted with seven times its volume of water, making it, at temperature 60 (F), of specific gravity 1133, compared to water as 1000. By saturating a portion of this acid with carbonate of soda, and ascertaining the quantity of sulphate of soda which it yielded, it was found that 100 grains, water measure, saturated 12.9 of pure soda.

In all the trials, 4 ounces of the kelp, reduced to powder, were mixed with 12 ounces of boiling water, and allowed to remain for several days, occasionally shaking the vessel. Six ounces of the clear solution were then poured off, and this was saturated with the acid; litmus paper being employed, as the test of the point of saturation.

In ascertaining the quantity of acid employed in the various trials, I always used a water measure, divided into grains. This is much easier than weighing, and is at the same time sufficiently accurate.

It has been objected to this method, that, as the sulphuric acid can decompose the neutral salts of the kelp, a portion of the acid may go to decompose them. This, however, is by no means a valid objection; for, as soon as all the alkali, whether free, or in union with carbonic acid, or sulphur, has been saturated, if any of the neutral salts be decomposed, their acid will immediately act upon the litmus, and show, that just the proper quantity of sulphuric acid has been used.

It is necessary to attend to one circumstance, in using the litmus paper. This is often reddened, before the alkali is completely saturated, owing to the disengagement of sulphuretted hydrogen, or of carbonic acid; the red produced by these, however, soon vanishes, and the blue colour of the litmus is restored; the red produced by the sulphuric acid, on the contrary, is permanent.

For the sake of brevity, I have arranged the experiments, to ascertain the quantity of alkali contained in the different kelps, in a Tabular form.

TABLE, showing the Quantity of ALKALI, free, or combined with Carbonic Acid, or Sulphur, in different KELPS.

KELPS.	REMARKS.	Acid required. Grs. water measure.	Alkali per cent.	Specific Gravity of the Solution.
Orkney -	Made in autumn 1814. Of bluish white colour, with charcoal intermixed; not very hard. Solution colourless; slight deposition of sulphur, with the disengagement of sulphuretted hydrogen, on the addition of sulphuric acid	305	4.10	1111
Orkney -	Of dark grey colour; hardness as No. 1. Solution colourless. Deposition of sulphur rather more copious; with disengagement of sulphuretted hydrogen - - - - -	185	2.67	1117
Orkney -	Sent by Mr Laing, per Commercial Packet, Andrew Smith. In some places bluish green; in others dark gray. Hardness as No. 1. Solution colourless. Slight turbidity towards the end of the experiment - - - - -	162	2.28	1115
Orkney -	Mr Balfour's Orkney kelp. Black, intermixed with white matter. Solution colourless; with slight deposition of sulphur -	90	1.21	1095

KELPS.	REMARKS.	Acid required Grs. water measure.	Alkali per cent.	Specific Gravity of the Solution.
Orkney -	Lord Dundas's kelp. Grey, intermixed with black. Solution colourless; with slight turbidity towards the end of the experiment	280	3.77	1081
Collonsay -	Dark coloured. Solution colourless; with slight turbidity - - - - -	135	1.81	1134
Collonsay -	Bluish gray, not hard. Solution colourless; copious effervescence, with slight deposition of sulphur, and disengagement of sulphuretted hydrogen -	460	6.19	—
Collonsay -	Black; with white saline matter intermixed. Solution colourless; copious effervescence - - - -	360	4.84	—
Mull - -	Greenish colour; very hard. Solution colourless; deposition of sulphur - -	60	.808	—
Mull - -	Bluish grey; very hard. Solution colourless; slight deposition of sulphur -	310	4.17	1121
Mull - -	Externally, after exposure to air, black; internally, when recently broken, pale red; very compact, without the least admixture of charcoal; very deliquescent. Solution colourless; deposition of sulphur, and disengagement of sulphuretted hydrogen. (This kelp was			

KELPS.	REMARKS.	Acid required. Grs. water measure.	Alkali per cent.	Specific Gravity of the Solution.
Barra - -	Grey; much intermixed with charcoal; rather soft. Solution of greenish colour; copious effervescence, and deposition of sulphur - - - -	455	6.24	—
Barra - -	Dark grey; very hard. Solution colourless; copious effervescence, deposition of sulphur - - - -	450	6.03	—
Loch-Maddy	Dark green, intermixed with black; not hard. Solution colourless - -	90	1.21	1101
Loch-Maddy	As above - - - - -	113	1.42	1055
Loch-Maddy	Black. Solution pale green. Deposition of sulphur -	204	3.01	—
Shetland, near Lerwick.	Light green, with black intermixed. Solution colourless. Deposition of sulphur, and disengagement of sulphuretted hydrogen - - - - -	230	3.09	1129
Shetland, North.	Grey; with black intermixed. Solution colourless; copious effervescence; slight turbidity - - -	345	4.64	1117

KELPS.	REMARKS.	Acid required. Grs. water measure.	Alkali per cent.	Specific Gravity of the Solution.
Shetland, Simbester.	Grey; with black intermixed. Solution colourless; slight turbidity - - -	185	2.49	1107
Lewis. Lochroag.	Dark green. Solution light green. Slight deposition of sulphur - - - -	310	4.17	1107
Lewis. Stornaway	Dark green. Solution light green. Deposition of sulphur - - - - -	385	5.18	1115
Lewis. Fraserburgh.	Black. Solution light green.	125	1.67	1089
Fifeshire. Kinghorn.	Bluish grey; very hard. Solution colourless; copious effervescence, slight turbidity - - - - -	312	4.202	—
Leith - -	Dark grey. Solution pale green. Deposition of sulphur - - - - -	238	3.2	—
Ross-shire, Applecross.	Dark grey; solution pale green - - -	334	4.4	—
Benbecula -	Light green, not hard; solution pale green; copious effervescence, with deposition of sulphur -	380	5.11	—
Harris -	Dark grey; solution colourless; no deposition	220	2.96	—

KELPS.	REMARKS.	Acid required. Grs. water measure.	Alkali per cent.	Specific Gravity of the Solution.
Tiree -	Dark grey, admixture of charcoal, rather soft; solution colourless; deposition of sulphur - -	360	4.84	—
Tiree -	Pale green; little admixture of charcoal; solution colourless; no deposition	280	2.69	—
Airds - -	Light grey; little admixture of charcoal; hard; solution colourless; no deposition - -	120	1.61	—
Airdincapple	Dark green; admixture of charcoal; hard; solution pale green; deposition of sulphur - -	340	4.57	—
Canna -	Dark grey; very hard; solution colourless; slight deposition of sulphur. -	90	1.31	—
Canna -	Pale green and black, rather soft; solution colourless; slight deposition -	450	6.03	—
Coll - -	Dark grey; little admixture of charcoal; solution colourless; no deposition -	200	2.69	—
Bay of Galway, Ireland -	Black, with white intermixed; solution colourless; slight turbidity - -	85	1.75	—

From the foregoing experiments we find, that the alkali in kelp varies from 1 to 6 per cent.; about 3 per cent. may be considered as the average quantity. It also appears, that the quantity of alkali varies in kelp made in or near the same place; so that it is difficult, if not impossible, by any set of experiments, to ascertain the comparative value of kelps of different places. Indeed, the manufacture of kelp depends on so many circumstances, that we are not always to expect a uniformity in the quantity of alkali, even in those made in the same place. Since then there is such variety in the quantity of alkali in kelp;—In the purchasing of it, it would be of considerable importance to the buyer, to try the article to be bought by some chemical test; perhaps the easiest is the one to which I have had recourse. For this purpose, let him have an acid of known power of saturation. Let small pieces, from different masses of the matter, be taken, and let those be reduced to powder. A certain quantity of this may be boiled in water, and then the solution filtered, and water passed through, till it come off tasteless; or, the method which I have followed may be adopted. Perhaps, for one who is purchasing a cargo of kelp, the former is preferable; as, in these instances, it is of importance to have the experiment performed as quickly as possible. If litmus paper be employed as the test for the point of saturation, care must be taken, not to be misled, by the reddening produced by carbonic acid, or sulphuretted hydrogen: This is known by allowing it to remain for a little time. If it be from these sources, the red will disappear, and the blue colour will be restored.

That the above, or some other method, should be had recourse to, by those who are purchasing this article, is sufficiently obvious, from the high prices which are often given for kelp of inferior quality, as is shown by the prices of the following specimens.

	Price per Ton.			Alkali per cent.
Collonsay - - - -	L.12	12	0	6.19
Ditto - - - - -	12	0	0	4.84
Mull - - - - -	11	11	0	.808
Barra - - - - -	11	0	0	6.94
Barra (driven ware) -	8	0	0	1.107
Loch-Maddy - - -	8	10	0	1.21
Ditto - - - - -	9	0	0	1.42
Shetland - - - -	8	5	0	3.09
Ditto - - - - -	8	5	0	2.89
Ditto - - - - -	8	0	0	4.64
Uncertain - - - -	12	0	0	3.77
Mull (said to be worth, could a ton of it have been procured) - -	50	0	0	3.07

To the soap maker, the value of kelp principally depends upon the quantity of alkali, free, or combined with carbonic acid; and in part also upon the quantity of neutral salts, especially the sulphate, which is decomposed by him in the course of his operations, so as to yield the alkali.

But the value rises in a greater ratio than in that of the quantity of alkali, as the same quantity of alkali is obtained from a rich kelp, at a much smaller expense of labour and utensils, than from a poor one. The glass maker values kelp differently. The quantity of alkali is of less moment. The admixture of the different neutral salts, and earthy matter, free from iron, which enable it to act as a powerful flux, constitute its value to him.

Analysis of the Insoluble Matter of Kelp.

The insoluble residue of the kelp, the analysis of whose saline matter has been given, was employed.

1*st*, Muriatic acid, poured upon the residue, caused an effervescence, accompanied with the odour of sulphuretted hydrogen, and a considerable portion of it was dissolved. The elastic fluid disengaged, was made to pass through lime water, which it rendered turbid; consequently, it consisted of sulphuretted hydrogen and carbonic acid.

2*d*, The solution gave a precipitate of oxalate of lime, on the addition of oxalate of ammonia indicating the presence of lime.

3d, Aqua ammoniæ caused a precipitate, which was soluble in sulphuric acid, indicating the presence of alumina.

4th, On the addition of carbonate of ammonia, and then of phosphoric acid to the solution, No. 3, after the alumina had been separated by filtration, a precipitate of phosphate of ammonia and magnesia took place, indicating the presence of magnesia.

5th, With prussiate of potassa, the solution gave a blue precipitate, indicating iron.

6th, The matter left undissolved by the muriatic acid was black, and, on being exposed to a high heat, underwent combustion; the part that still remained was soluble in fused potassa. These last experiments indicate the presence of carbon and silica.

To ascertain the proportion of these ingredients,

1st, 100 grains, cautiously added to muriatic acid, in an appropriated vessel, lost 14 grains.

2d, The solution gave a residue weighing 16.4.

3d, Which, after exposure to heat, lost 4.1.

4th, To the solution, No. 1, muriate of baryta added gave a precipitate, which, after being dried, weighed 1.4, equivalent to .47 of sulphuric acid.

5th, Oxalate of ammonia, now added, gave a precipitate, which, when cautiously dried, weighed 93.4, equivalent to 32.6 of lime.

6th, Aqua potassæ was added in excess and boiled; a precipitate took place: This, after filtration, was dissolved in muriatic acid, and prussiate of potassa was then added: The precipitate, after being cautiously dried, weighed 3.3, equivalent to 1.12 oxid of iron, or .77 iron.

7th, Aqua potassæ was now added to the solution from which the iron had been precipitated; the precipitate, after exposure to high heat, weighed 18.5 of magnesia.

8th, To the filtered liquor (No. 6.) muriatic acid was added, and then subcarbonate of potassa; the precipitate, after exposure to a high heat, weighed 15.4 of alumina.

The above experiments show, that the insoluble matter of the kelp was composed of

Sulphuretted hydrogen and Carbonic acid	14
Carbon	4.1
Sulphuric acid	.47
Silica	12.3
Lime	32.6
Magnesia	18.5
Alumina	15.4
Iron	.77
	98.14
Error	1.86
	100.0

A portion of the insoluble matter of another specimen of kelp, was analyzed by the above method: the ingredients, though varying a little in their proportions, were the same.

Barilla.

Barilla also forms a heterogeneous mass, though much less so than kelp. Its colour is, in general, of a light grey, with slight admixture of charcoal; having a sulphureous smell, an alkaline taste, and being in general deliquescent.

Of the Analysis of Barilla.

In the analysis of Barilla, the same method has invariably been pursued, as that described when treating of kelp. It is unnecessary, therefore, to enter into a minute account of the different processes that have been followed, as this would be a mere repetition of what has already been detailed.

Of the Effects of Water on Barilla.

Water has the same effect on barilla as on kelp; the solution, also, has the same sensible qualities; and affords, on evaporation, a saline mass, similar to that of kelp.

Of the Component Parts of the Saline Matter of Barilla.

Experiments, similar to those made on kelp, demonstrated, that this saline matter consisted of some free alkali and of neutral salts, containing both the fixed alkalies. By the application of the various reagents, it was found that the alkalies were combined with the same substances as in kelp: the saline matter, however, afforded no iodine.

These substances, in 100 grains of the saline matter, obtained from Teneriffe barilla, were as follow—

Carbonic acid - - -	27
Sulphuric acid - - -	5.4
Muriatic acid - - -	13.4
Insoluble matter - - -	.5

Another quantity of saline matter, from a different specimen of barilla, was also analyzed, and found to contain the same ingredients, though in different proportions.

To ascertain the state of combination of the different substances, the solution was treated in the same way as that of kelp. The same salts were obtained, *viz.* sulphate of potassa, muriate of potassa, soda, and carbonate of soda.

Of the Proportion of the Soluble Matter in Barilla.

To ascertain the proportion the soluble bears to the insoluble matter, quantities of the different kinds of barilla were treated in the same way as those of kelp. The following Table points out the result of the experiments.

Barilla.	Grains.	Insoluble Matter.	Soluble Matter.	Sol. Matter, per cent.
Sicily - -	480	215	265	55.2
Teneriffe -	480	180	300	66.2
Carthagena -	480	140	340	70.8
Ditto - - -	480	215	265	55.

From the above Table it appears, that the soluble matter in barilla is from about one half to two thirds of the whole.

Of the Quantity of Soda, free, or combined with Carbonic Acid or Sulphur, which the different kinds of Barilla contain.

The same remarks may be made with respect to the purchase of barilla, as have already been done with respect to kelp, when treating of that article. It is of importance, therefore, that some method be employed, to ascertain the quantity of alkali in barilla, and not to trust, as the merchant does, to its sensible qualities. Kirwan † has, by his method already described, shown, that sweet barilla contains 24 per cent. of alkali. Mr Jameson, ‡ likewise, by the method recommended by Kirwan, as also by that of Dr Black, ascertained, that

	lib.		lib.
Barilla, Alicant, contained -	23	in	100
Do. Teneriffe, (bad) -	8	in	do.

In ascertaining the quantity of alkali, free or combined with carbonic acid, I have invariably had recourse to the method already pointed out, *viz.* the saturation of the alkali, by means of the

† Irish Transactions, 1789.

‡ Mineralogy of Scottish Isles.

sulphuric acid. The result of the experiments are exhibited in the following Table.

BARILLA.	REMARKS.	Acid required. Grs. water measure.	Alkali per cent.	Specific Gravity of the Solution.
Sicily - -	Bluish grey. Solution colourless. Deposition of sulphur; disengagement of sulphuretted hydrogen.	915	12.33	—
Teneriffe, East-Quay	Bluish grey. Solution colourless. Copious effervescence; slight turbidity - - - - - - - -	950	12.87	—
Teneriffe -	Bluish grey. Solution colourless. Deposition of sulphur - - - - - -	810	11.71	1095
Carthagena	Light grey; very hard. Solution pale green. Copious effervescence; deposition of sulphur - -	960	12.94	—
Carthagena	Bluish black. Solution, &c. as No. 3. - - - -	865	11.44	—
Carthagena	Black. Solution, &c. as No. 3. - - - - - - -	615	8.31	—

The foregoing Table shows, that the quantity of alkali in barilla, is more uniform than in kelp: About 11 per cent. we may consider as the average.

Analysis of the Insoluble Residue of Barilla.

The method of ascertaining the composition of the insoluble residue of barilla, being exactly the same as that employed for kelp, it is unnecessary to state the particulars. The ingredients were found to be the same, and in the following proportions.

Carbonic acid and Sulph. hydr. - -	28
Carbon - - - -	4
Silica - - - -	4.5
Lime - - - -	42.4
Magnesia - - -	7.3
Alumina - - - -	12.7
Iron - - - -	1.1
	100

In another specimen, the ingredients, though in different proportions, were the same.

In the paper in the Irish Transactions for 1789, before alluded to, Kirwan has given the analysis of the sweet barilla; The method he has followed, and the result obtained, are different from those already pointed out: According to him, one pound (5760 grains) contains—

Carbonic acid	- -	960
Charcoal	- -	861.82
Lime	- -	542.86
Magnesia	- -	127
Alumina	- -	131.23
Silica	- -	249.58
Pure soda	- -	842
Impure ditto	- -	250
Soda mixed with muriate of soda	-	127
Sulphate of soda	-	125
Muriate of soda	-	70
Earth deposited	-	20
		4306.49
Water	- -	1453.51
Total	-	5760

From what has been said, we observe, that the ingredients in kelp and barilla are the same, with the exception of iodine, which does not exist in barilla. Though the quantity of soluble matter, in some kelps, be as great as that of some of the barillas, yet the average quantity is about 15 per cent. less.

The material difference we find to exist, is in the quantity of alkali, free, or combined with carbonic acid. In kelp, this varies from about 1 to 6 per cent.; about 3 per cent. we may consider as the average.

The quantity of alkali in barilla we find to be more uniform, being in general about 11 or 12 per cent.

From the statement that has been given, of the composition of kelp and barilla, we may institute a comparison between the actual values of these substances, so far as chemical experiments alone can determine them. In this estimate, of course, all reference to the different expenditure of labour and utensils, in putting them to use, must be left out of view.

Since barilla is principally employed by the soap-maker, the comparison between it and kelp must rest on the relative quantities of alkali which they contain: Taking the average of these in the kelp, we find the alkali about 3 per cent.; that in barilla about 11.

It is, however, to be observed, that kelp, in general, contains more of the sulphates than barilla; and that this gives some additional value to kelp, beyond what is indicated by the quantity of alkali, as the sulphate in the spent lees may be decomposed, and made to furnish its alkali.

Of the Uses to which Kelp and Barilla may be applied.

As kelp and barilla contain the same ingredients, and as they are both applied to the same purposes, I will confine my remarks entirely to the former.

Kelp is principally employed by the soap-maker, the bleacher, and the glass-maker: By the two former, it is only the soluble part that is used; and this is chiefly prized on account of the alkali, free, or combined with carbonic acid, or sulphur, that it contains.

In the making of glass, sometimes the entire kelp, at other times the insoluble residue, or rather the residue of the soap-maker, is employed, as perhaps some of the other ingredients besides the alkali, are useful in the formation of that substance.

Kelp is used in the manufacture of crown glass: For this purpose, the entire kelp is employed.

The kelp is broken into small pieces, and the stony matter picked out; it is then reduced to fine powder, by a large stone roller; the sand and kelp are now mixed, and thrown into a kind of oven or furnace, and heat applied, to consume the carbon and sulphur. In this part of the operation, care must be taken not to give too much heat, and to keep constantly stirring the mixture, so as to expose the whole to the air, and to prevent it running into hard lumps, which remain with the carbon unburnt. The matter is now removed from the furnace, and allowed to cool; in this state it is called Frit. When again to be melted, for the purpose of making the glass, it is put into large conical vessels of baked clay, which hold each about 20 cwt., and exposed to an intense heat for about two days, by which the whole becomes fused, and passes into the state of glass. A quantity of saline matter gathers at the top, which is called Sandiver or Glass Gall; it contains principally the muriates. In the purchase of kelp, the glass-maker is not guided by the quantity of alkali. To him the presence of saline and earthy matter, that render it a powerful flux, and the absence of iron, are of more moment. The sulphates certainly aid very much in the formation of glass; and Gehlin has lately informed us, that he has manufactured this article with sulphate of soda as the only flux.† Glassmakers have imagined, that the kelp most beneficial to them, is that whose earthy matter is principally siliceous.

From the examination of Orkney kelp, much esteemed in the manufacture of glass, I am disposed to call this opinion in question. I found the residual earthy matter to abound principally in lime, which is well known to promote the fusion of earthy bodies in a remarkable degree.

The circumstance of most moment in the manufacture of glass, is the absence of iron. This metallic body injures very much the colour of the crown glass, and consequently reduces its value.

Hence it is of importance to the glassmaker to know a ready way of trying whether or not kelp contains much iron. For this purpose, let him take an ounce of kelp, reduced to fine powder, and gradually pour upon it, in a long necked flask, about two ounces of muriatic acid; put the

† Thomson's Annals of Philosophy—May 1816.

flask into a kettle with boiling water, and allow it to remain for an hour or two; then add 3 or 4 ounces of water, and, when the liquor is clear, pour it off. Drop into this a solution of prussiate of potassa; if a blue colour appear, the presence of iron is indicated; if the iron be in any quantity, a precipitate of a rich blue colour is formed. It would be well to ascertain the result of this experiment with some kelp of known good quality, which the manufacturer may possess, and to employ it as a standard of comparison.

Of the Uses of the Soluble Part of Kelp.

The soluble part of kelp is employed only by the soapmaker and bleacher. For their purposes, the kelp is reduced to powder by a large stone roller; it is then disolved in water, and a quantity of quicklime mixed with it; the whole is well stirred, and put on a filter; what passes through is a solution of the soda, with the other saline ingredients, the lime having seized the carbonic acid of the carbonate of soda, and thus reduced it to its caustic state. In this form it is ready to be mixed with the oily matter for making soap, or for the immersion of the cloth which is to be bleached.

Though kelp is chiefly prized on account of its free or carbonated alkali, it is also valuable for the other saline ingredients it contains: these are

Muriates and Sulphates. It is perhaps the latter principally that are of use to the soapmaker; for from these he obtains a matter equally valuable as the kelp itself.

For this purpose, the spent lees, or the solution after the soda has been extracted, are evaporated to dryness, and then mixed with sawdust, or waste tanner's bark, and with lime; these are put into a reverberatory furnace, and exposed to a high heat; what remains is employed in the same way as the kelp itself, for making soap.

The spent lees are composed of muriate of potassa, muriate of soda, and sulphate of potassa: By mixing these with the lime and charcoal, and exposing them to heat, the sulphuric acid of the sulphate of potassa is decomposed, and the potassa set free: This then unites with the muriatic acid of the muriate of soda; and the soda is disengaged. This either remains in its caustic state, or unites with the carbonic acid, formed by the combustion of the charcoal. The sulphur of the sulphuric acid unites with the lime.

One specimen of the spent lees, thus decomposed, I have tested with the sulphuric acid: It was of a dark green externally; internally, when recently broken, it was of a light red colour; its texture was compact, and without any admixture of charcoal or stony matter. This, treated with the diluted acid, in the same way as the kelps, required for saturation 375 grains, indicating 5.05 per cent. of alkali.

For the purpose of decomposing the spent lees, it is unnecessary to be at the expense of lime and carbonaceous matter. What remains on the filter, after the soluble matter of the kelp has been extracted, answers equally well.

To prove this, some of the spent lees, evaporated to dryness, was mixed with about an equal bulk of the insoluble matter of kelp, and exposed to a high heat in a covered crucible for two hours; it was then dissolved in boiling water.

By means of the diluted acid, it was found to contain 3.23 per cent. of alkali; during the addition of the acid, there was a considerable deposition of sulphur; so that, perhaps, the percentage of the alkali may be slightly overrated: The experiment, however, is sufficient to prove, that some of the neutral salts had been decomposed.

What remains, after the solution of the decomposed spent lees has been mixed with the oily matter, is a solution of muriate of potassa and muriate of soda. These salts may be easily obtained separately by evaporation, the muriate of potassa being first deposited. The only use to which this salt is applicable, is in the manufacture of alum; and the alum-makers purchase it from the soap-boiler.

The muriate of soda remaining in the mother-water, may be considered of little value; added to the soaper's waste, it may improve it for agricultural purposes.

The spent lees also contain iodine, and may be employed for procuring this article; hence it is often purchased from the soap-maker for this purpose.

Kelp, then, we find, is not only valuable on account of the alkali, free, or combined with carbonic acid, but also in proportion to the soluble matter, principally the sulphate of potassa and muriate of soda, which it contains. It is of importance, therefore, in trying the value of kelp, to be able, by an easy method, to ascertain the proportion of the soluble ingredients. This may be done, by boiling a certain quantity of kelp in water, till all the soluble matter be taken up, then throwing the residuum on a filter, and washing and drying it. This, however, is a tedious process; and it is difficult, without a particular apparatus, always to reduce the different residua, to the same dryness. An easier method, therefore, is desirable; perhaps the specific gravity of the solution affords the readiest.

When any one species of saline matter is dissolved in water, the specific gravity of the solution is a certain indication of the quantity of salt in it; but as different salts affect the specific gravity of the water somewhat differently, the quantity of mixed salts is not indicated with the same precision; the difference, however, is not great, as appears from the following trials.

1*st*, 50 grains of sulphate of potassa, and 50 grains of muriate of soda, were mixed and dissolved in water: the specific gravity of the solution, at temperature 58, was 1043.

2*d*, 30 grains of muriate of soda and 70 of sulphate of potassa, were mixed and dissolved in the same quantity of water: The specific gravity of the solution, at 58, was 1045.

3*d*, 30 grains of sulphate of potassa and 70 of muriate of soda, were mixed and dissolved in the same quantity of water: The solution was, of specific gravity, 1041, at temperature 58.

As the saline ingredients of kelp are always of the same nature, though they differ somewhat in their proportions, the specific gravity of their solution will be a sufficiently accurate indication of the quantity of soluble matter contained in them, as is seen by the following experiments.

1*st*, 90 grains of the saline matter obtained from kelp (Lochroag) were dissolved in water; at temperature 68, the specific gravity was 1035.

2*d*, 90 grains of saline matter from kelp (Stornoway), as above, specific gravity was 1037.

3*d*, 90 grains of saline matter from kelp (Fraserburgh), as above, specific gravity was 1037.

Conceiving that this mode might prove very serviceable in judging of the value of any parcel of kelp, I extracted a quantity of the saline matter from kelp, using a mixture of different sorts, to procure the matter of an average character. I then dissolved different quantities in water, and ascertained the specific gravity of each solution. From these experiments I drew up the following Table, showing the quantity of saline matter contained in solutions of different specific gravity.

Specific Gravity	1008.1	Indicates 1	per cent. of soluble matter in the solution.
	1015.9	2	
	1023.4	3	
	1030.6	4	
	1037.5	5	
	1044.4	6	
	1051.6	7	
	1059.1	8	
	1066.9	9	
	1075.	10	
	1082.3	11	
	1089.5	12	
	1096.6	13	
	1103.5	14	
	1110.4	15	
	1116.9	16	
	1123.	17	
	1128.6	18	
	1133.8	19	
	1138.1	20	

If the quantity of kelp employed be equal to the quantity of water, then the above Table indicates the per centage of soluble matter in the kelp; if, however, the quantity of water be greater, then it will be necessary to multiply the number denoting the quantity of soluble matter, by the number of times the water is greater than the kelp. Thus, in the different trials which I have made, 4 ounces of kelp and 12 of water were employed, that is, 1 of kelp to 3 of water. I therefore multiply the number denoting the quantity of soluble matter in the different solutions by 3; and this gives me the per centage of soluble matter in the kelp.

KELP.	Specific Gravity of the Solution.	per cent. of Soluble matter in the Solution.	per cent. of Soluble matter in the Kelp.
Orkney	1111	15.004	45.012
Do.	1117	16.	48.
Do.	1115	15.9	47.7
Collonsay	1134	19.003	57.009
Mull	1121	16.9	50.7
Irish	1081	10.05	30.15
Loch Maddy	1101	13.05	39.15
Do.	1055	7.9	23.7
Shetland	1129	18.004	54.012
Do.	1117	16.	48.
Do.	1107	14.04	42.12
Uncertain	1121	16.9	50.7
Lewis	1107	14.04	42.12
Do.	1115	15.9	47.7
Do.	1089	11.9	35.7
Castle Hill	1114	15.05	45.15
Do.	1129	18.004	54.012
Do.	1122	16.9	50.7
Do.	1150	20.2	60.6
Do.	1133	18.9	56.7
Orkney	1095	12.1	36.3
Do.	1081	10.05	30.15
Mull (L. 50 p. ton)	1183	23.66	71.6

I have already mentioned the plan which I followed, to procure the solution, by which I estimated the quantity of the saline ingredients of kelp, but shall now state it more minutely, for the sake of those who may wish to follow the same method.

Select a number of pieces from different parts of the same cargo of kelp, and bruise them into small fragments: Take two ounces of these, and reduce them to fine powder, and put them into a phial, and pour six ounces of boiling water on them: Then cork the vessel, and allow it to remain for several days; shaking it often each day.

When the liquor is clear, pour off some of it, and try its specific gravity. See by the Table what quantity of saline matter this denotes, and multiply the number by 3. This will give the per centage of soluble matter in the kelp: Say the specific gravity is 1075, this denotes 10 of soluble matter in the solution: This, multiplied by 3, gives 30, the per centage of saline matter in the kelp; the water being to the kelp as 3 to 1.

This trial may be made much more expeditiously in the following way.—Put the two ounces of finely ground kelp into a strong-ale glass, and pour on it six ounces of boiling water. After stirring well, mark the height of the liquor; transfer the whole into a small pan, and boil it in the gentlest manner for about an hour; return the whole into the glass, and add boiling water till it come to the mark. After stirring well, allow it to stand till a sufficient quantity of the liquor can be drawn off clear, for trying its specific gravity.

The same liquor will answer equally well for the experiment formerly described, for ascertaining the quantity of alkali by means of the sulphuric acid; and for this purpose, take three ounces of the liquor, and find how much acid of known power of saturation they require.

It has been proposed to ascertain the exact proportion of neutral salts, by subtracting the quantity of alkali from the whole of the soluble matter. This, however, is a very erroneous proceeding; as the quantity of alkali indicated by the sulphuric acid, is the quantity of pure soda which exists in the kelp, in a great measure united with carbonic acid and sulphur, which of course augment its weight greatly.

For the above experiments, should the water employed bear any other proportion to the kelp than 3 to 1, then the number denoting the quantity of soluble matter, must be multiplied by the number denoting the proportion of the water. Perhaps 3 to 1 is the best; as, in most instances, the number indicating the specific gravity will be included in the above Table. The specific gravity may be ascertained in the common way, by weighing the solution in a bottle which holds a known weight of pure water. An easier, and at the same time a sufficiently accurate method, is to make use of Lovi's beads, following the directions given along with the beads.

Of the Uses to which the Insoluble Matter of Kelp may be applied.

The insoluble residue of kelp, or rather the residue of the operations of the soap-boiler, is used by the glass-maker for preparing the coarser kinds of glass. In this state, it contains, along with the insoluble ingredients of the kelp, a large quantity of lime, which has a considerable share in the formation of the glass. It is also employed by the farmer as an excellent manure.

I have already shown, that this may also be employed, for the decomposition of the spent lees by heat: After this operation, it is still applicable to the purposes of the glassmaker, and of the agriculturist.

On the Manufacture of Kelp and Barilla, and of the Origin of the Alkali, free, or combined with Carbonic Acid, contained in them.

Kelp is prepared by burning different kinds of sea weed, principally the Fucus Nodosus, F. Vesiculosus, F. Serratus, and F. Digitatus. The weeds are cut in May, June and July, and exposed to the air on the ground, till they be nearly dried, care being taken to prevent them, as much as possible, being exposed to the rain. They are then burned, either in pits dug in the sand, or on the surface of the ground, surrounded by loose stones, forming in both ways a rude sort of kiln. A peat fire is kindled on the ground, and the weed gradually added, till the fire extend over the whole floor of the kiln: the weed is then spread lightly on the top, and added in successive portions. As it burns, it leaves ashes, which accumulating towards evening, become semifused, and are then well stirred. Another day's burning increases the mass; and this is continued till the kiln is nearly filled. On some occasions the kiln consists of a cavity in the ground, over which bars of iron are placed; and on this the ware is burned, the ashes fall into the cavity, where they are well worked by the proper instruments.

Of the different weeds which are employed for the manufacture of kelp, the Fucus Vesiculosus is considered by kelpmakers, as the most productive; and the kelp obtained is, in general, supposed to be of the best quality.

The Fucus Nodosus is considered to afford a kelp of equal value to that of the above species, though perhaps it is not quite so productive.

The Fucus Serratus, or Black Weed, as it is commonly called, is neither so productive, nor is the kelp procured from it so valuable as that obtained from the other two. This weed is seldom employed alone for the manufacture of kelp; it is in general mixed with some of the other kinds.

The Fucus Digitatus is said to afford a kelp inferior in quality to any of the others; it forms the principal part of the drift weed.

Kelp is generally divided into two kinds; the cut weed kelp, and the drift weed kelp:—the former made from the weed which has been recently cut from the rocks, the latter from that which has been drifted ashore. The latter is supposed to yield a kelp of inferior quality. Some specimens of kelp, however, made from sea weed which had been drifted ashore, tend to prove that this is not always the case.

KELP.	REMARKS.	Acid required. Grs. water measure.	Alkali per cent.	Specific Gravity of the Solution.
Sanday, Orkney.	April 1815.—From drifted weed, *fucus digitatus.* Black; with saline matter intermixed. Solution pale green. Deposition of sulphur - - - -	180	2.42	—
Castle-Hill -	May 1815.—*F. digit.* in a state of decay from over maturity; 6864 lib. of the weed taken up immediately after being drifted ashore, and dried under favourable circumstances, produce, 314 lib. of kelp; grey, mixed with black; hard; solution green; deposition of sulphur, and disengagement of sulphuretted hydrogen -	72	1.01	—

KELP.	REMARKS.	Acid required. Grs. water measure.	Alkali per cent.	Specific Gravity of the Solution.
Castle-Hill -	1816.—Red drifted weed. One ton produced 4 cwt. 4 stone; greenish; solution colourless; copious effervescence; deposition of sulphur - -	402	5.41	1150
Castle-Hill -	From ware taken up in a putrid state, half a ton produced 2 cwt. 3 stone; solution colourless - -	385	5.18	1133
Barra - -	Dark green; very hard; solution colourless - -	80	1.107	—

The foregoing Table shows, that drift weed occasionally affords a kelp, equally valuable as that which has been cut.

On the contrary, weed which has been exposed to rain during the process of drying, affords a kelp of inferior quality.

KELP.	REMARKS.	Acid required. Grs. water measure.	Alkali per cent.	Specific Gravity of the Solution.
Castle-hill -	July, 1815.—From *F. digitat.* 6860 lib. yielded 224 lib. of kelp. In this case the weed had been exposed to rain during the drying. Of grey colour, mixed with black; solution green; deposition of sulphur - - - - - -	134	1.77	—

Some experiments also, made with the view of discovering the origin of the alkali, immediately to be related, tend to prove the above assertion.

It is of the utmost importance, therefore, to the manufacturer of kelp, to keep his weed as much as possible free from rain. For this purpose, many employ sheds: when these are not at hand, the weed, which has been laid out to dry, should be collected into one heap, during the rain; when this ceases, it should again be immediately spread out.

It has often been matter of dispute, how old the plants should be before they be cut. In general, three years is the time allotted; this, however, from some trials which I have made, to ascertain this point, seems to be too long.

Kelp.	Remarks.	Growth.	Product.	Acid required gr. water measure.	Alkali p. cent	Specific Gravity of the Solution.
Castle-hill	Made from sea-weed not in strong tide-way. Blackish grey; with white intermixed; solution colourless; deposition of sulphur - -	3 years.	2 tons gave 5 cwt. 4 st.	325	4.37	1114
Castle-hill	From weed not in strong tide-way. Blackish grey, with white intermixed; solution colourless; copious effervescence; deposition of sulphur - - - -	2 years.	1 ton gave 2 cwt. 5 st.	460	6.19	1129
Castle-hill	From weed in strong tide way. Black; with slight admixture of white; solution green; deposition of sulphur; with copious effervescence - - - - -	2 years.	1 ton gave 2 cwt. 5 st.	420	5.65	1122

The above experiments show that the produce of kelp, from one ton of three years old weed, is only 8 lib. more than that from the same quantity of two years old: From this we would conclude, that the weed ought to be cut every two years. Though perhaps less weed may be procured from the same extent of ground occupied by weed of two, than of three years growth, yet the difference may not be so great as to render it worth while to allow the weed to remain for three years.

Barilla is principally procured from different species of salsola and salicornia, more particularly along the shores of the Mediterranean. The plants are pulled in autumn, and laid on the ground to dry. Spherical cavities, capable of containing each about 20 cwt., are then dug in the ground, and two bars of iron put across them, upon which the plants, mixed with reeds and straw, are burnt. During the burning, the matter, after some time, undergoes a kind of fusion; it is then well stirred. When the pits are full, which generally requires a whole night, they are covered with earth, and allowed to cool for 10 or 12 days; it is then taken out, and broken into small pieces.

Of the Origin of the Alkali in Kelp and Barilla.

The origin of the alkali, in the substance procured by the combustion of marine plants, is a subject of considerable importance, and has long engaged the attention of chemists.

With respect to the origin of the alkali in barilla, some, as Vauquelin, have asserted, that the alkali, free, or combined with carbonic acid, preexists already formed in the plant, and that the combustion merely serves to get quit of the vegetable matter; hence, he says, he found soda in union with carbonic acid, in the infusion of the salsola soda, the plant from which barilla is prepared. †

Others, on the contrary, imagine, that the alkali exists in combination in the plant, and that it is in some way developed during the combustion.

I have had no opportunity of satisfying myself, whether or not the alkali preexists in the plants from which barilla is prepared, free, or combined with carbonic acid; but the well-known accuracy of Vauquelin, precludes all doubt on the subject.

The same variety of opinion is entertained respecting the source of the alkali in kelp. With the view of investigating this important question, the following experiments were instituted.

1*st*, I boiled in water, on different occasions, parcels of the sea-weeds, using sometimes those fresh gathered at Leith, and sometimes dry weed,

† Annal. de Chimie, tom. xviii.

that had come from the kelp shores of the Long Island: The decoction, thick and mucilaginous, showed no alkaline quality: it did not give the brown colour to turmeric. I was indeed much surprised to find, that, so far from manifesting any predominance of alkali, it actually exhibited acid qualities, and tinged litmus paper of a red colour.

By the proper tests, I found that the liquors contained compound salts, having soda and potassa for their bases, in union with sulphuric and muriatic acids.

2d, I evaporated the liquor to dryness, mixed it with charcoal, and gave it a strong heat in an open crucible. The residuum being lixiviated, gave a liquor which manifested alkaline properties.

From these experiments it appears that the alkali does not exist in the fuci, either pure or in combination with carbonic acid. As the alkali, in both of these states, exists in the kelp, it is plain that, somehow or other, it is developed by the operation of kelp-making.

In this process the weed undergoes a smothered combustion.

It is a question which has been a good deal agitated, whether this combustion acts merely by the temperature which accompanies it, or whether the concurrence of the air be necessary for the inflammation, and in some way assist, by its oxygenating powers. In general, I believe, the latter view has been adopted; but the result of the following experiments is hostile to that notion.

1*st*, Eight ounces of kelp-weed were burned in an open crucible; the lixivium of the ashes was alkaline, rendering turmeric paper brown; it required 270 grains of a diluted sulphuric acid for saturation.

2*d*, Eight ounces of the same weed were heated very strongly in a crucible, well luted up, so as to allow the escape of the elastic fluids, but preclude the access of air. The weed retained perfectly its form, and was completely charred: When reduced to powder and lixiviated, the liquor exhibited alkaline qualities, and required 480 grains of the same acid for saturation; during the addition of the acid, a deposition of sulphur took place.

From these experiments, it is obvious, that the alkaline quality may be induced, by the operation of a due intensity of heat, independent of any action of the air; and from the greater degree of alkalescent condition, in the latter case, it is possible that the combustion, with contact of air, may cause the dissipation of some part of the alkali, as soon as it is developed. Concerning the source of the alkali, it cannot in reason be imagined, that it is actually generated, or is a product of the operation. Every thing leads to the opinion, that the alkali exists in the weed, in a state of combination with some acid, and that part of the acid is destroyed, or expelled in the process.

In many terrestrial plants, alkali exists, in union with some vegetable acid; or with sulphuric acid. It is most probable, that the alkali exists in sea-weeds in a similar condition.

To ascertain the state of combination of the saline ingredients of sea-weed, I made an infusion of this, and evaporated it to dryness. Alcohol was then poured on it, and digested for 24 hours; the solution was again evaporated to dryness, and the saline matter obtained, dissolved in water. By the usual tests, I found this to contain muriate of soda.

Water was now poured on the matter left undissolved by the alcohol. The solution, after filtration, I found contained sulphate of potassa. The saline ingredients of sea-weed are therefore sulphate of potassa and muriate of soda; the latter evidently derived from the sea water; the former, perhaps, formed by the combination of the potassa, which plants in general contain, with the sulphuric acid of some of the sulphates contained in sea water.

After the weed has been burned, so as to afford kelp, the saline ingredients, we have already seen, are sulphate of potassa, muriate of potassa, muriate of soda, soda, and soda in union with carbonic acid and sulphur.

Hence we may reasonably infer, that the vegetable matter is destroyed by the heat, furnishing, by its destruction, carbonic acid; and that the sulphuric acid of the sulphate of potassa is decomposed by the carbonaceous matter, part of the sulphur being dissipated, and part retained to form the sulphuret.

Though the sulphate of potassa is decomposed, no potassa will be found, in a free or carbonated state, in the kelp; for, as the weed also contains muriate of soda, the potassa must, from its greater attraction for muriatic acid, decompose the muriate, dislodge the soda, and take its place.

This is probably the source of the muriate of potassa. The soda set free, partly remains so, and partly unites with the carbonic acid formed by the combustion of the vegetable matter, and with the sulphur.

During the process of kelp making, every possible means should be taken to defend the ware from rain; that which has been much drenched in water, certainly yielding but a small proportion of alkali.

To illustrate this important truth by experiment, I took,

1*st*, Three ounces of recently gathered weed, and burned it in a crucible; the ashes, after lixiviation and filtration, took, of a diluted sulphuric acid, 135 grains for saturation.

2*d*, I then took an equal quantity of the same weed, washed it well with water, and, after drying it, burned it, and treated it as above. The solution required, of the same acid, for saturation, 30 grains. A deposition of sulphur at the same time took place. I found, however, that soaking in sea-water restored to the weed its power of yielding the usual proportion of alkali.

Three ounces of the same weed, after having been washed, were soaked in sea-water for 20 hours; it was then burned, and treated as above; the solution required, for saturation, 180 grains of the same acid; a deposition of sulphur took place during the addition of the acid.

A repetition of these experiments, gave the following results, which correspond with the preceding very nearly.

1*st*, Some fresh cut weed was boiled in water, the liquor did not make turmeric paper brown.

2*d*, Sixteen ounces of the same weed were burned, and the residuum duly lixiviated; the lixivium required, for saturation, 930 grains of the same acid.

3*d*, Sixteen ounces of the same weed were washed with water, and then burned and lixiviated; the lixivium required, of the same acid, 540 grains.

4*th*, Sixteen ounces of the weed, well washed, and then soaked in sea-water, were treated in the same manner as the preceding; it required 900 grains of the acid.

In all these instances, there was a deposition of sulphur on the addition of the acid.

Having thus found the effect of the sea-water, it occurred, that the addition of salt brine, or the saline matter of sea-water, might contribute to increase the quantity of alkali in kelp; and the following experiments go to confirm that idea.

1*st*, I have already shown that three ounces of weed, when burned, took, of a diluted acid, 135 grains for saturation.

2*d*, I took an equal quantity of the same weed, and mixed it with 3 drachms of the saline matter obtained from sea-water, and burned it in a crucible; towards the end of the burning, the matter became fluid; when cold, it was dissolved in water, and filtered; the solution required, for saturation, 345 grains of the same diluted acid; during the addition of the acid, a deposition of sulphur took place.

This experiment, then, sufficiently shows, that, by proper means, the alkali in kelp may be increased; at least, as it has succeeded in the small way of experiment, we have every reason to believe it will succeed on the large scale. Were furnaces established for burning kelp, they might be so constructed as to dry the ware; and, during the drying, it would probably be found very beneficial to sprinkle the weed, from time to time, with sea-water.

AN ESSAY

UPON

THE COMPARATIVE VALUE OF KELP AND BARILLA,

FOUNDED UPON ACTUAL EXPERIMENTS,

AND ADDRESSED TO

THE HIGHLAND SOCIETY OF SCOTLAND.

By SAMUEL PARKES Esq., F. L. S.
Member of the Geological Society of London, and of the Caledonian Horticultural Society of Edinburgh, &c. &c.
1816.

MY LORDS AND GENTLEMEN,

HAVING seen your printed proposal of awarding a prize to the Author of the best Essay upon the Comparative Value of Kelp and Barilla, founded upon actual experiments; and conceiving, from my long acquaintance with most subjects of chemical inquiry, particularly those Preliminary Observations.

Prel. Obs. which relate to the analysis of Kelp, Barilla, Natron, Potash, &c. and to which my immediate pursuits, during many years of my life, led me more especially to attend, that it might be in my power to prepare an Essay which would be acceptable to your very respectable Society—I entered upon the task with a considerable portion of zeal, and have bestowed the utmost of my own personal care and attention upon all the experiments which were necessary for the purpose. I am, therefore, not without hope that my labours may be deemed to be deserving of your reward.

In order to institute a series of experiments which would be the best adapted to show the comparative value of Kelp and Barilla, the kinds which should be chosen for the experiments were thought not to be quite unimportant.

With respect to kelp, I had some reasons for wishing to make choice of a cargo from one of the Western Isles of Scotland, such as should be thought a good parçel by those who are in the habit of consuming this article. Accordingly, a lot of kelp from the Isle of Lewis was fixed upon; and from this several lumps were taken promiscuously, so as to obtain as true a sample as possible.

With regard to the barilla, it has been thought advisable to make experiments on that kind which is made in the island of Teneriffe. Formerly, most of the barilla consumed in this country was imported from Spain; but, when the price became exorbitant, the Spaniards resorted to such means of adulteration, that the large British consumers found it to be their interest to procure barilla from Teneriffe, and from sundry islands in the Mediterranean; so that a considerable quantity of such barilla is now consumed in London, Bristol, and elsewhere, in preference to the Spanish; the former being generally found to be more uniform in quality, than the latter. The Teneriffe barilla on which these experiments were made, was imported from that island by the Neptune, about the month of November 1815.

My first experiments were upon the Barilla; and these I shall endeavour to detail with as much brevity as is consistent with perspicuity and utility. To those Members of the Society who are familiarly conversant with chemical subjects, it might have been more acceptable had I entirely confined myself to a mere outline of the experiments which form the basis of the following conclusions; but when I considered the importance of the subject, and that, if this Essay should be approved, it might probably be thought advisable to print it, for the use of those persons who are interested in the improvement of the manufacture of kelp, and who often know but little of the science of chemistry, I thought it my duty to affix the rationale of every experiment, together with a minute account of the methods which I pursued, for the instruction of those who may not have been ac-

Prel. Obs. customed to such investigations; and when, in addition to these motives, the importance of the manufacture of kelp, in a national point of view, is considered, I do flatter myself, that the Society will be inclined to bear with me, and make every candid allowance for the length to which these observations may be extended.

Analysis A.

Analysis of a Parcel of Teneriffe Barilla A.

1. Two pounds of this barilla, taken from several parts of the parcel, were pulverized in an iron mortar; the barilla was then well mixed by passing it through a fine hair sieve, in order to ensure, in all the subsequent experiments, uniform results. It was then put into a stoppered glass bottle, to preserve it from the atmosphere, and keep it in the same state of carbonization and dryness.

Water. 2. Of this pulverized barilla, 500 grains were submitted to the temperature of 180° of Fahrenheit, for the purpose of ascertaining the quantity of water contained in it. At this heat it lost 25 grains, or 5 per centum of its weight;—but when the same was weighed, after it had been for a considerable time upon a sand-heat, it was found to weigh only 469 grains, having lost 31 grains of water in drying. This denotes, that the sample of barilla contains, in its usual state, 6.2 per cent. of water.

Analysis A. — Experiment with Muriate of Barytes.

8. These 469 grains were then repeatedly washed with distilled water, until all the soluble matter was extracted. When the several waters were mixed and filtrated, the whole was treated with muriate of barytes, which produced a considerable precipitate. When this precipitate had been well washed and dried, it weighed 186 grains. Subsequent experiments with other portions of this barilla, show that this must be a mixture of sulphate and carbonate of barytes. The precipitate, when dried and weighed, was laid by for the Society.

I formerly imagined, that this would be an accurate mode of ascertaining, not only the sulphuric, but also the quantity of the carbonic acid in any solution of carbonated alkalies; and that from thence might be deduced the real quantity of alkali present. For, if the barytic precipitate were treated with nitric acid, this acid would dissolve the carbonate of barytes, without acting upon the sulphate of that earth;—then, if the sulphate were washed, dried and weighed, its quantity would give the exact proportion of the carbonate of barytes which had been taken up by the nitric acid. Several experiments have, however, convinced me that this method cannot be relied upon, because much of the carbonic acid escapes without combining with the barytic earth. Other methods, therefore, must be resorted to for ascertaining that question with accuracy.

Analysis A.

Insoluble Matter.

4. The insoluble matter collected from these 500 grains of barilla, after having been thoroughly washed, was dried upon a sand-heat, and found to be 208 grains. In drying this residuum, care was taken that the heat should not be sufficient to burn off any of the charcoal. This experiment denotes, that the barilla contains 41.6 of insoluble matter; consequently, it may be expected, when the alkaline and neutral salts are examined, that they, with the water, will unitedly amount to 58.4 per cent.

Remaining Earths.

5. The 208 grains of insoluble matter were then burnt in a crucible at a red-heat. This reduced them to 172 grains, which shows, that 36 grains were lost in the fire, and denotes, that of the 41.6 of insoluble matter, 7.2 are combustible. The residuum, in burning, acquired a light brown colour, very similar to that of unburnt umber. These ashes were also laid by for the Society.

Analysis B.

Analysis B.

Quantity of Soda.

1. 200 grains more of this Barilla were digested in distilled water, and afterwards washed with successive portions of water, as in the former experiment, until all the soluble matter was obtained. The filtrated solution was then made hot, and crystallized oxalic acid added gradually to it,

until the point of saturation was attained. For this purpose, 66 grains of the acid were required; a quantity which saturates 56.24 of dry sub-carbonate of soda, or 32.8 of real soda. This gives 28.12 of sub-carbonate of soda, containing 16.4 of dry soda, as the quantity contained in 100 parts of the barilla. Analysis B.

It will be obvious, to those who are but little accustomed to such experiments, that in all cases it is necessary to filtrate the solutions, before the quantity of alkali be attempted to be ascertained by the addition of an acid; for otherwise, the lime and magnesia which are generally contained in barilla and kelp, would combine with a part of the acid, and occasion deception.

2. The insoluble matter from this experiment, when thoroughly dried, weighed 82.5 grains; which agrees very nearly with No. 4. in Analysis A, where the quantity obtained from 500 grains indicated the proportion of 83.5 grains. Insoluble Matter.

3. This insoluble matter, when treated with diluted sulphuric acid, gave out 15 grains, or 7.5 per cent. of carbonic acid. Some care, however, is necessary in performing this experiment on earthy residua, as it requires a considerable time to extricate all the carbonic acid; sometimes, with perpetual agitation of the mass, more than an hour, even though a large excess of sulphuric acid be employed:—because it is necessary that the whole be *cold* before the acid is added, or a partial evaporation of the water Carbonic Acid.

would occasion an error in the result, when the mass is submitted to the test of weighing.

Analysis C.

Analysis C.

Water.

1. 200 grains more of Barilla were exposed to a considerable heat, and lost 12 grains in drying. This nearly agrees with Experiment 2, Analysis A, where 500 grains indicated a loss of 31 grains.

Salts.

2. The soluble matter was then separated from the above; and when the solution was filtrated, it was boiled to dryness. The salts which were obtained, when thoroughly dried, weighed 102 grains.

Results.

From these two experiments, compared with the foregoing, it appears that 100 grains of this barilla consist of—

Alkaline and neutral salts	(C 2.) -	51.0
Insoluble matter - -	(A 4.) -	41.6
Water dissipated in drying	{A 2. / C 1.}	6.2
Loss in boiling and drying	- -	1.2
		100.0

The saline mass, and the insoluble matters, were then examined, by methods to be described hereafter.

3. The salts obtained by the last experiment were then dissolved in distilled water, and the solution divided by weight into two equal portions. Analysis C. Salts divided.

4. One of these portions was treated with pure nitric acid, until the alkali was completely neutralized. Nitrate of silver was then added; which occasioned an abundant precipitate of muriate of silver. The design of previously adding nitric acid was to decompose the carbonate of soda, because alkaline carbonates will also precipitate silver; and hence a deceptive result would have been produced. In ascertaining the proportion of muriatic salts in kelp, by means of nitrate of silver, an error is likewise often occasioned by the circumstance of the alkali being in the state of a hydro-sulphuret; because hydro-sulphurets, as well as muriatic acid, precipitate silver. This may, however, at any time, be ascertained by a single drop of acetate of lead, which will become blackened, if sulphuretted hydrogen, or a hydro-sulphuret, be present. In that case, it is advisable to add a little pulverized sulphate of lead, which will immediately precipitate the sulphur, and render the lixivium nearly colourless. The alkaline solution should then be filtrated, to render it fit for the addition of the nitrate of silver. In the experiment last mentioned, the sulphate of lead was not employed; as a previous trial, with acetate of lead, had convinced me that this alkaline lixivium contained no sulphur in solution. Experiment with Nitrate of Silver.

Analysis C.

This was further corroborated by the precipitate of muriate of silver preserving its colour unchanged. It is, moreover, necessary to remark, that the alkaline solution was heated to about 100° of Fahrenheit, before the nitrate of silver was added; having always observed, that when the solutions are warm, the muriate of silver forms itself into flakes more readily, and precipitates sooner.

Muriatic Acid.

5. After the precipitated muriate of silver had been well washed, and properly dried, it was submitted to a red-heat in a silver crucible; and, in that state, it weighed 36 grains. This gives 6.8 grains of real muriatic acid in every 100 grains of the soluble part of this barilla. The blackness of the muriate of silver, which the Society will receive with this Essay, was not occasioned by the presence of sulphuretted hydrogen, as might be suspected, for when it was precipitated it was perfectly white, its present colour being occasioned by the well known action which light has upon this metallic salt.

Sulphate of Soda.

6. For the purpose of ascertaining the quantity of sulphuric salt in the barilla, the other half of the solution, mentioned at No. 3. of this analysis, was saturated with diluted nitric acid. The solution was then treated with nitrate of barytes, and a precipitate of sulphate of barytes was obtained;—which, when washed and dried, weighed 4.5 grains, which are equivalent to 2.7 grains of dry sulphate of soda. This sulphate of soda

is doubtless produced in the barilla by the decomposition of the sulphate of magnesia usually found in sea-water.

Analysis D.

Analysis D.

Salts. 1. To 1000 grains of this barilla successive portions of water were added, until all the soluble matter was dissolved. The mixed solutions being evaporated to dryness, a saline mass was obtained weighing 506 grains, which corresponds very nearly with Experiment 2, Analysis C, in which 200 grains of barilla produced 102 grains of saline matter.

Residuum. 2. The insoluble residuum of these 1000 grains, when properly dried, weighed 384 grains. This being 3 per cent. less than the product of the residuum in Experiment 4, Analysis A, I conclude that, in the former experiment, I had not separated all the water which might have been expelled by a sand-heat. These 384 grains, however, when burnt in a crucible at a full red-heat, were reduced to 340 grains—a quantity which agrees very nearly with the weight of the burnt residuum produced in the other experiment.

Carbonic Acid. 3. Fifty parts of the saline mass, equal to what was produced from 100 parts of the barilla, were dissolved in hot water. When the solution had become cold, it was accurately balanced in a pair of scales, together with a phial of diluted

Analysis D.

sulphuric acid, and their united weights were noted down. By the gradual addition of the acid to the alkaline solution, the latter became saturated, and the carbonic acid was expelled which had been previously contained in it. On reweighing the vessels with their contents, they were found to have lost 12 parts, that being the quantity of carbonic acid contained in the alkali procured from 100 parts of this barilla. There could have been no deception from the escape of sulphuretted hydrogen with the carbonic acid, as a previous experiment with acetate of lead had convinced me that the solution contained no sulphur.

Twelve parts of carbonic acid, denote 29 of subcarbonate of soda, which very nearly coincides with Experiment 1, Analysis B, where the test of oxalic acid shows the existence of 28.12 of subcarbonate of soda. The average of the two experiments is 28.56.

Muriate of Potash.

4. Weighed 50 grains more of these salts, equal to 100 grains of barilla, and dissolved them as before. To the lixivium some solution of muriate of platina was gradually added, so long as any precipitate was produced. The solution having been suffered to remain a sufficient time at rest, it was again filtrated, and the precipitate dried gradually. When thoroughly dry, it weighed 9 grains, which, added to 4¼ grains which adhered to the filter, make 13¼ grains. This quantity indicates nearly 5.7 grains of potash, which

gives about 9 grains of muriate of potash in the 100 of the barilla. Analysis D.

5. This calculation is made from the following data. One hundred grains of potash, purified by alcohol, were dissolved in pure water, and precipitated by muriate of platina. When the precipitate was dried, it was found to weigh exactly 200 grains. Now, as this purified potash is not mere potash as it was formerly considered, but a hydrat of potash, consisting of 83.925 of real potash and 16.075 of water, we may assume, for the sake of round numbers, that 84 parts of potash form 200 of the dried triple muriate of platina and potash. Consequently, the 13.5 grains of precipitate procured in Experiment 4, are equivalent to 6.75 of hydrat of potash, or 5.7 of real potash; and when this is combined with 3.3 of muriatic acid, their union will form 9 parts of muriate of potash, as mentioned above. Potash.

6. Now, it will be recollected, that, by Experiment 5, Analysis C, we had 6.8 of muriatic acid; and as 9 parts of the muriate of potash contain only 3.3 of muriatic acid, there will remain 3.5 which must be combined with soda, forming 7.5 of muriate of soda. On this principle it is that we conclude that 7.5 per cent. is the real quantity of muriate of soda, independent of the muriate of potash which is contained in this barilla. Muriate of Soda.

Analysis E.

Analysis E.

Carbonic acid.

1. One thousand parts of barilla, and a small quantity of water, were put into one bottle, and some diluted muriatic acid into another; and these were placed in a scale, and counterpoised. Then, upon adding the muriatic acid to the barilla, and suffering it to remain, with occasional agitation, until all effervescence had ceased, the loss of weight was noted; and amounted to 197 parts, or 19.7 per cent., consisting of carbonic acid. This experiment was made for the purpose of comparing the result with those of the former experiments. See Experiment 3, Analysis B, where the insoluble matter alone gave 7.5 per cent.; and Exp. 3. Analys. D, where the saline matter, when separated from the residuum, gave out 12 per cent., amounting together to 19.5 per cent.

Mixed salts.

2. Being desirous of sending some of the saline matter to the Society, and not having enough left from the Experiment 1, Analysis D,—1000 grains more of this barilla were treated as before; and, when the saline mass had been slowly boiled down, it produced 512 grains. These were put into a phial, and will be sent to the Society.

Objections answered.

It may be said, why did not the Author of this Essay separate the neutral salts from the alkali, and also the several neutral salts from each other, and exhibit them to us in a state of separation? Having anticipated this question, it will be necessary to reply to it. Formerly, it was no uncommon thing for an analytical chemist to attempt to separate salts by priority of crystallization; and in some processes, the manufacturing chemist does still effect this, sufficiently accurate for his purposes. The refining of saltpetre, where the muriate of soda is separated from the nitrate of potash, may be adduced as an instance; but, for the purposes of philosophical or analytical chemistry, where accuracy is always absolutely necessary, it would be a vain attempt—the thing is impossible. There is, indeed, no method that I know of, whereby a saline mass, consisting of the sulphate and carbonate of soda, and the muriates of potash and soda, can ever be analyzed with correctness, except by means of reagents, or chemical tests. This is the method, therefore, which I have adopted; and I hope it will be acceptable to the Society. Analysis E.

There is another mode, which is sometimes practised, *viz.* that of making the alkali caustic by means of lime; then boiling the salts down to dryness, and treating the dry salts with alcohol, which has the property of dissolving the pure alkalies, without acting upon the neutral salts. The alcoholic solution of the alkali, when poured from the neutral salts, is to be boiled in a vessel of silver, to dissipate the ardent spirits; and Analysis by alcohol.

Analysis E. then the alkali may be exhibited in a state of separation. For the purpose of preparing pure soda, or pure potash, this is the only method which can be adopted; but whenever it is necessary to ascertain proportions, this mode will be as fallacious as the other; for, however caustic the alkali may be made, it will acquire some carbonic acid from the atmosphere, while it filtrates from the lime, and still more while boiling, for the purpose of being brought into a state free from water, for the action of the alcohol; and whatever portion becomes carbonated, that portion will not be dissolved by the spirit, but will be precipitated along with the neutral salts;—and this will render an accurate analysis impossible. There is also another source of error in the boiling down of the pure alkali; but which, after what I have said, it will now be needless for me to explain. These various difficulties, however, have induced me to make choice of the method which I have adopted, and which is the only unexceptionable one with which I am acquainted.

On the application of the Platina. One other remark I am desirous of making in this part of the Essay. It respects the precipitation of the potash by means of muriate of platina, as referred to in No. 4, Analysis D, but which did not occur to me to mention while describing that experiment. The observation which I wish to make is this, that in analyzing kelp or barilla, it will always be advisable to precipitate the sulphur by sulphate of lead, or by some other means, before the solution of platina be added; or there will be a danger of the sulphur being sometimes precipitated with the triple salt of platina, which would occasion a false result. Analysis E.

Having thus finished the analysis of the saline part of the barilla, we have now only to look to the earthy residua, in order to complete the analysis.

Analysis F.

Analysis F.

Residua treated with Muriatic Acid.

1. In order to ascertain the nature of the residuum, 69 grains, part of the 340 grains which had been submitted to a red heat in the Experiment 2, Analysis D, and which is an average product of 200 grains of the barilla, were treated with diluted muriatic acid. When the muriatic acid had taken up all that was soluble therein, the whole was put upon a double filter, and the liquor preserved which ran from it. The remaining insoluble matter was washed with successive portions of distilled water, which, when filtrated, were added to the former liquor. This fluid, it is presumed, contains magnesia and lime, which are to be separated by subsequent processes.

Alumine and Siliex.

2. The matter which remained upon the filter, consisting of alumina and silex, was then washed and dried, and found to weigh 33 grains, or 16½ per cent.

Analysis F.

Caustic Ammonia employed.

3. The liquors which passed through the filter, in Experiment 1, were then treated with pure ammonia, which was added to the muriatic solution by degrees, until the ammonia became a little in excess. This occasioned a precipitate which was allowed to subside in a glass bottle closely stoppered, so as to exclude the air. The supernatant liquor was then poured from the precipitate, and preserved in another stoppered bottle. Water was then added to supply the place of the fluid which had been poured off; and when this had been well agitated with the precipitate, the whole was left, well closed, to subside as before. Several portions of distilled water were thus added, until the last water which was poured off, no longer tinged turmeric paper, so as to indicate the presence of an alkali.

Magnesia in state of a Hydrat.

4. The precipitate which had been carefully preserved, was then redissolved in muriatic acid; and from its colour I was induced to test a very small portion of it (mixed with some distilled water) with prussiate of potash, and it gave a very slight trace of iron. The muriatic solution was then made hot, and treated with a solution of subcarbonate of soda, which produced a magnesian precipitate. When the precipitate was washed and slowly dried, it had the appearance of a semi-transparent, gelatinous substance, and was doubtless a true hydrat of magnesia, * con-

* It is well known that sea-water contains magnesia, dissolved by the sulphuric and the muriatic acids. These having a stronger affinity to the alkalies contained in the barilla,

sisting of about 75 parts magnesia, and 25 water. When the hydrat of magnesia had been thus carefully and slowly dried, it was put into a silver crucible and submitted to a gentle heat.† This expelled the water, and reduced it to a pulverulent substance. Before it be put into the crucible, it is advisable to rub it in a glass mortar for the purpose of breaking the lumps: it is then to be heated in the crucible no longer than is necessary to dry it completely. Under this operation it immediately acquires the appearance of an uniform powder, similar in outward resemblance to the carbonate of magnesia known in commerce. When weighed, it was found to be 27 grains. This gives 13.5 of carbonate of magnesia, in every 100 parts of the barilla. Analysis F.

5. The clear ammoniacal solution which had been poured off from the magnesian precipitate, was then treated with a solution of carbonate of ammonia, until no further precipitate was produced. The precipitate, now formed, is carbonate of lime; and this, when thoroughly washed and dried, weighed 13.50 or 6.75 grains in 100 of barilla. In this experiment, the solution was brought to a boiling heat, to expel any excess of Carbonate of Lime.

than to the magnesia, the latter of course is precipitated, and is found in the barilla in the state of carbonate of magnesia.

† Although carbonate of magnesia, when procured by precipitation from acids by means of subcarbonate of soda or potash, always precipitates in combination with one-third of its weight of water, it holds this water by so feeble an attraction, that it may be separated from it by a very moderate heat.

Analysis F. carbonic acid, which would have prevented the whole of the lime * from being precipitated; it being well known that a certain portion of carbonic acid precipitates lime, and a larger quantity redissolves it.

Rationale. 6. The principle on which this separation of the two earths is founded, may be explained in a few words. Caustic ammonia precipitates magnesia from its acid solutions, but does not precipitate lime.

Results. 7. On referring back to the different experiments, and the results obtained from them, it will be seen, that 100 parts of this barilla consist of various substances, as under, *viz.*

Water dissipated by drying	(A 2)	6.20
Carbonaceous matter	(A 5)	7.20
Sulphate of soda	(C 6)	2.70
Subcarbonate of soda	{B 1 & D 3}	28.56
Muriate of potash	(D 4)	9.
Muriate of soda	(D 6)	7.50
Alumina and silica	(F 2)	16.50
Carbonate of magnesia	(F 4)	13.50
Carbonate of lime	(F 5)	6.75
Water not dissipated by the first drying, and loss		2.09
		100.00

* A proportion of lime is usually found in barilla. It is the product of the marine shells which inevitably become entangled with the sea-weed, and are burnt with it.

The observations which naturally arise from the results of this analysis, will be reserved for the end of the Essay.

AN ANALYSIS OF A PARCEL OF KELP FROM THE ISLE OF LEWIS.

Analysis A.

Analysis A.

Water. 1. A parcel of this kelp having been pulverized and sifted in the same manner as the Teneriffe barilla had been treated, 200 grains of it were dried upon a very hot sand-heat, in order to ascertain the amount of the water which it had imbibed since its manufacture. By this operation, it lost in weight 20½ grains, or 10¼ *per cent.*

Salts. 2. Water was then poured upon the same in successive portions, until all the saline matter was extracted. The mixed liquors were then placed in a sand-bath, to evaporate the water. The saline mass, reduced to complete dryness, weighed 94 grains.

Insoluble matter. 3. The insoluble matter was then dried, and found to weigh 85 grains. Thus, the 200 grains appear to consist of—

Analysis A.

Alkaline and neutral salts - -	94.0
Insoluble matter - - - -	85.0
Water in a state of mixture - -	20.5
Loss - - - - - -	.5
	200.0

Combustible Matter.

4. The insoluble matter, when burnt at a red heat, was reduced to 73 grains; so that the combustible matter, which had been dissipated, amounted to 12 grains. The remaining ashes were nearly white.

Analysis B.

Analysis B.

Carbonate of Soda.

1. Another parcel of this kelp, amounting to 100 grains, was macerated in distilled water for 12 hours, and afterwards washed with successive portions of pure water, to insure the solution of all the soluble matter. These liquors were then mixed, and made very hot in a glass vessel; and oxalic acid in crystals was gradually added, until the whole of the uncombined alkali was completely saturated. This required exactly 7 grains of the acid, which indicates the presence of 3.48 grains of real soda, and is equivalent to 5.96 grains of subcarbonate of soda,—previous experiments having convinced me, that 100 parts of crystallized oxalic acid combine with 49.71 of real soda, or with the alkaline part of 85.21 of the subcarbonate of soda.

2. When the Society shall have examined this Kelp, a piece of which I purpose sending with the several precipitates, some of the Members may perhaps be surprised to find, that it should contain not more than 3¾ per cent. of real soda, they having frequently heard of good kelp, containing from 5 to 6 per cent. of that alkali. This difference is owing, as I suspect, to an error in the calculation of every old analysis, from the circumstance mentioned already at No. 5, Analysis D. Mr Kirwan, and other eminent chemists, in order to ascertain the power of the respective acids in saturating soda and potash, had recourse to those alkalies purified by alcohol, and by subsequent fusion; taking it for granted that these alkalies were then in a state of absolute purity; not suspecting that the one holds 16, and the other 22 per cent. of water, after having been submitted to a red heat.* Thus, when a sample of barilla was analyzed, and, on this principle, said to contain 25 per cent. of pure soda, it in fact held only 19.37 per cent.; 100 of hydrat of soda being equal only to 77.50 of real soda. I was desirous of again adverting to this source of error, in order that those persons who may hereafter be engaged in such analysis, may not lose sight of so important a circumstance; for Analysis B.

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* See Annales de Chimie, tom. 62. p. 96; and Sir H. Davy's "Elements of Chemical Philosophy," Oct. 1812, page 324 and 333; where these facts are explained.

Analysis B. though an intense heat will not separate the water from soda, yet if 100 parts of the hydrat of soda be dissolved in diluted muriatic acid, the acid will expel the water, and the 77.5 of real soda will combine with 67.5 of muriatic acid; and if the muriate which results from the combination be dried at a proper heat, no more than 145 of salt will be produced.

Oxalic acid, the advantage of using it.

3. Formerly I employed diluted sulphuric acid in the analysis of alkaline ashes; but the oxalic acid in crystals has lately been found more convenient; because, in all nice experiments, where great accuracy is required, the saturation may be obtained with more precision. The minute size of the crystals of oxalic acid, renders them more suitable for the purpose than any other; for, by adding a single needle crystal at a time, on the point of a penknife, and examining the fluid by means of test papers, between each addition of the acid, there can be but little danger of supersaturation; and experiments with it are generally more accurate than when a fluid acid is made use of.

Carbonic acid.

4. The insoluble matter from the 100 grains which were lixiviated in Experiment No. 1, was well washed upon the filter, and, when it was thoroughly dried, weighed 42 grains. These 42 grains were then treated with diluted muriatic acid, and lost 14 grains in the state of gas.

Analysis C.

Analysis C.

1. I took the 94 grains of saline matter procured from 200 grains of this kelp, by Experiment 2, Analysis A, and dissolved them in distilled water. The solution was then divided into two equal portions, by weight. To one of these, diluted nitric acid was added, to neutralize the uncombined alkali, and decompose the carbonated alkali, for the purpose mentioned under Experiment 4, Analysis C, of the Teneriffe barilla. It was then treated with nitrate of silver, which produced an abundant precipitate of muriate of silver. Nitrate of silver employed.

2. The muriate of silver, being well washed and gradually dried, was heated to redness. In this state it weighed 66 grains. Now, as 66 grains of fused muriate of silver contain 12.55 grains of real muriatic acid, this denotes 27 grains, within a small fraction, of dry muriate of soda; but as 1.2 of muriatic acid is required to combine with the potash, indicated by the next experiment, there will be only 11.35 of muriatic acid left to form the muriate of soda; and this I find, from calculation, to give 24.36 of that salt. Muriatic acid.

3. The other half of the saline solution was treated with muriate of platina, which produced the usual precipitate that occurs whenever that Muriate of Potash.

Analysis C. reagent is added to a solution containing potash, or any of its salts. When this precipitate was dried, it weighed 5 grains, which (according to my Table, already referred to in Exper. D 5, on the Teneriffe barilla) indicate 2.10 grains of real potash, or 3.3 grains of muriate of potash, in every 100 grains of the kelp.

Analysis D.

Analysis D.

Carbonic acid.

1. The salts from another 100 grains of this kelp having been dissolved, the solution was concentrated by evaporation, and then divided into two equal portions. One of these was treated with sulphate of lead, to separate the sulphur, in case any existed, and, when it had been filtrated, was supersaturated with diluted sulphuric acid. This operation drove off 2.5 grains of carbonic acid.

Sulphuric acid.

2. The other half of the solution was neutralized by nitric acid, and then treated with nitrate of barytes, for the purpose of ascertaining the quantity of sulphuric salts contained in this kelp. The precipitate of sulphate of barytes, in a state of complete dryness, weighed 11¼ grains; consequently, had the whole of the saline solution obtained from the 100 grains of kelp been acted upon, we should have had 22.5 grains. Now, as 22.5 grains of the sulphate of barytes contain

7.65 grains of dry sulphuric acid, this quantity of that acid must have been combined with the soluble part of the kelp, and would form 13.6 of dry sulphate of soda. Analysis D.

3. The insoluble residuum from the washings of the last 100 grs. of kelp, when thoroughly dry, weighed 41½ grs. When treated with diluted sulphuric acid, this residuum lost 14.5 grs. of carbonic acid. Carbonic acid in the combined earths.

Having thus far proceeded, it may not be amiss to notice, that the preceding experiments show, that 100 parts of this kelp contain of Quantity of salts in this kelp.

Real soda, perfectly dry -	3.48
Carbonic acid, combined with it - - - -	2.48
Neutral salts, consisting of muriates of soda and potash, and sulphate of soda	41.26
	47.22

Analysis E. Analysis E.

1. It is now necessary to examine the nature of the earthy residua. For this purpose, 85 grs. (produced from 200 grs. of this kelp) were put into an earthen crucible, and submitted to a red heat. When the matter was reweighed, it was Charcoal.

Analysis E. found to have lost very nearly 12 grs. Hence I conclude, that this kelp contains 6 per cent. of charcoal.

Carbonate of magnesia. 2. The remaining matter was then treated with diluted muriatic acid, and afterwards with caustic ammonia, exactly in the same manner as was pursued with the barilla. Subcarbonate of soda was then added to the solution, and a hydrat of magnesia was precipitated as before. When this had been slowly dried, it was put into a silver crucible, to separate the water which was chemically combined with it to produce a hydrat; but care was taken not to give it heat enough to expel the carbonic acid. When this operation was finished, the carbonate of magnesia, a little tinged by iron, weighed 35 grains, giving a proportion of 17.5 per cent. of that earth originally in the kelp.

Carbonate of lime. 3. The ammoniacal solution was then treated with liquid carbonate of ammonia, and this precipitated the carbonate of lime, as in Exp. 5. Analys. F. *of the Barilla*; and proved, when properly dry, to be 28 grains.

Silica and alumina. 4. The remaining earths, consisting of silica and alumina, weighed 8 grs.

5. The whole of the products from 100 parts of this kelp may therefore be stated thus—

Analysis E.

Saline Substances, consisting of

Subcarbonate of soda	(B 1)	-	5.96	
Muriate of soda -	(C 2)	-	24.36	
Muriate of potash -	(C 3)	-	3.30	
Sulphate of soda - -	(D 2)	-	13.60	
				47.22

Insoluble Matter, consisting of

Charcoal - -	(E 1)	-	6.0	
Carbonate of magnesia	(E 2)	-	17.50	
Carbonate of lime -	(E 3)	-	14.00	
Silica and alumina -	(E 4)	-	4.00	
				41.50
Water - - -	(A 1)	- - -		10.25
Loss	-	- -		1.03
				100.00

When I had finished the analysis of the kelp from the Isle of Lewis, it occurred to me, that it might be acceptable to the Society to obtain some information respecting the component parts of some other kelps. Accordingly, I procured a box of good kelp, which had been prepared in the Island of Skye, and another box of Irish kelp; and though I shall not have time sufficient for making a complete analysis of each before the 10th of November, the day appointed by the So-

Analysis E. ciety for the reception of papers on this subject, I trust I shall be able to show the proportions of alkali and of neutral salts in each, and some other of their component parts, sufficient to enable me to reason upon their relative value.

ANALYSIS OF SOME KELP FROM THE ISLE OF SKYE.

1. Weighed 400 grains of this kelp, dried it as in the former experiments, and found it lose 46 grains. Consequently, in its usual merchantable state, it holds 11.5 of water.

2. I treated this parcel with distilled water as before, and divided the solution into four equal portions.

3. One of these portions was treated with crystallized oxalic acid, and required 10 grains for its saturation. Agreeably to my former experiments, the 10 grains of oxalic acid are equivalent to 4.97 of pure dry soda, or to 8.52 of subcarbonate of soda.

4. Saturated another portion with nitric acid, and then precipitated the sulphuric acid with muriate of barytes. There was a trifling precipitate of sulphur, which was separated before the addition of the muriate of barytes. The precipitated barytic salt weighed 37½ grains.

5. Saturated a third portion with diluted sul-

phuric acid, for the purpose of driving off its carbonic acid. In this way it lost 3 grains.

6. The dried residuum weighed 134 grains; making 33.50 of insoluble matter in every 100 grains of the kelp.

7. The above 134 grains of the insoluble matter were then heated in a crucible as before, and, being weighed, produced only 107 grains. This gives a proportion of 6.75 per centum of charcoal.

8. 400 grains of this kelp were divested of the salts by solution in the usual way; and the solution being boiled to dryness, gave 217 grains of dry salts.

9. The general results of this examination may be stated thus. Results.

Salts, consisting of			
Subcarbonate of soda	(3.)	8.52	
Sulphate of soda -	(4.)	22.72	
Muriates of soda and potash		23.01	
		——	54.25
The insoluble matter; viz.			
Charcoal - - -	(7.)	6.75	
Earths - - - -		26.75	
		——	33.50
Water - - -	(1.)		11.50
Loss in the analysis - -			75
			——
			100.00

ANALYSIS OF IRISH KELP.

1. A fair sample from a parcel of kelp made in the county of Galway, was pulverized and sifted in the usual way.

2. I weighed 1000 grains, and drove off the water by means of hot sand, as in the previous experiments. The whole quantity lost 125 grains, or 12.5 per cent.

3. I treated these 1000 grains with water, to dissolve out the salts. When these were procured and dried, they weighed 503 grains; which indicate the proportion of 50.3 per cent. of soluble matter in this species of Irish kelp.

4. The insoluble substance, when dried, weighed 372 grains, giving a proportion of 37.2 per cent. of charcoal and earths.

5. I repeated the above experiments on 500 grains of this kelp. These lost 60 grains of moisture in drying. The salts found in this quantity were 254 grains. The dried residuum weighed 186 grains.

6. I then dissolved one-fifth of these salts in pure water. I saturated the uncombined alkali with nitric acid, and then added some nitrate of barytes, for the purpose of ascertaining the amount of the sulphuric salts.

7. 51 grains, another fifth of these salts, were

dissolved in pure water; the solution was made hot, and then treated with crystals of oxalic acid until the exact point of saturation was obtained. It required 8 grains of the acid; which indicate the presence of 3.97 of real soda, or 6.81 per cent. of subcarbonate of soda.

8. Having washed the sulphate of barytes obtained in Experiment 6, and made it quite dry, it was found to weigh 16 grains; indicating the presence of 9.7 per cent. of sulphate of soda.

9. The 372 grains of insoluble matter procured in Experiment 4. were put into an earthen crucible, and continued a considerable time in a red heat. By this operation, the 372 grains were reduced to 320 grains, which gives a proportion of about 5 per cent. of combustible matter.

10. It appears by Experiment 7, that this kelp contains 6.81 per cent. of subcarbonate of soda; and, by Experiment 8, 9.70 per cent. of sulphate of soda; and as the whole of the salts, according to Experiment 3, were 50.30 per cent., the remainder, consisting of muriate of potash, and muriate of soda, must be 33.79 per cent.

11. The general results of this examination, may therefore be stated thus. Results.

Salts consisting of

Subcarbonate of Soda	(7) -	6.81
Sulphate of Soda -	(8) -	9.70
Muriate of Soda and Potash - -	(10) -	33.79
Carry over	——	50.30

		Brought over -	50.30
The insoluble Matter contains			
Charcoal - -	(9)	- 5.00	
Earths - -	(9)	- 32.00	
			37.00
Water - - - - -			12.50
Loss in the analysis - - -			.20
			100.00

Relative Value.

With regard to the relative value of these different kelps, when compared with barilla, the most convenient method of estimating this will be, to convert the different quantities into pounds avoirdupois, and then to show how many hundred weights, quarters of the hundred weight, and pounds, there are of each merchantable article in one ton weight of the respective kelps, or barilla, and calculate accordingly.

Such barilla as that upon which I have been operating, is now worth £.30 per ton in the London and Bristol markets; but, in London, taking 50 or 100 tons together in one lot, it may be bought for £.28 per ton. Upon this latter price, therefore, it will be proper to calculate the relative value of the different kinds of kelp.

The price of the kelp from the Island of Lewis, would be now about 9 or £.10 per ton, delivered at the principal English ports, where kelp is usually imported. The kelp from the Isle of Skye, is of the last year's manufacture. I procured it from a friend of mine at Newcastle, who says, in a letter which I received from him, 'It cost £.11 per ton, delivered at Newcastle; 'but was burnt for me expressly, at an extra 'price of 20s. per ton, on condition of being 'purely and well burnt; and I consider,' (adds he) 'the bargain to have been honourably kept, 'and the article to be of singular purity, in re-'spect of foreign adulterations.' The analysis which I have made, justifies every thing which my friend has said; and I copy so much of his letter, for the purpose of showing what may be done for the improvement of this manufacture, by care and attention.

Irish Kelp, its prices.

I have not been informed of the price of the sample of *Irish* kelp; but I know that this species of kelp is usually sold, delivered at any of the ports, at £.5, and from that to £.7 per ton, according to quality. I do not think that the Irish burners pay any rent to the proprietors of the shores, the kelp not selling at a price more than adequate to remunerate them for the expenses of manufacture; for, if they do, it is very trivial indeed; as I am credibly informed, that many of the makers pay none. In consequence of this, I understand that the kelp is not bought of the proprietors of the shores, but of the farmers who manufacture it, by merchants in their respective neighbourhoods, who have the care of sending it to market. They pay for it, as I understand, from 50s. to 80s. per ton of 22 cwt., according to its quality.

Barilla made the Standard.

In order to make an accurate estimation of the comparative value of the different productions, barilla may be made the standard; and, therefore, in estimating its value, I have taken the neutral salts at the prices which I know them to be severally worth in the market; and have put the soda at such a value that, when added to the prices of the neutral salts, will bring the whole collective produce of the barilla as near as possible to that of its original cost. In valuing, I shall therefore begin with the barilla.

The only merchantable articles which this barilla contains, are, the Subcarbonate of Soda, the Sulphate of Soda, the Muriate of Soda, and the Muriate of Potash. In reducing the respective weights of these to a mercantile form, we must proceed thus.

	lb.		lb.		lb. oz.		lb.		cwt. qr. lb.	
Subcarb. Soda,	28.56	=	$28\frac{1}{2}$	in 100	= 32 0	in	112	=	5 2 24	in 1 ton.
Sulphate Soda,	2.7	=	$2\frac{7}{10}$	in 100	= 3 1	in	112	=	0 2 $7\frac{3}{4}$	in do.
Muriate Soda,	7.5	=	$7\frac{1}{2}$	in 100	= 8 6	in	112	=	1 2 0	in do.
Muriate Potash,	9.0	=	9	in 100	= 10 2	in	112	=	1 3 $6\frac{1}{2}$	in do.

Value of each of the Above.

	cwt.	qrs.	lb.		l.	s.	d.
Subcarb. Soda, - -	5	2	24	- at 90s. -	25	14	0
Sulphate Soda, -	0	2	8	- at 20s. -	0	11	6
Muriate Soda - -	1	2	0	- at 10s. -	0	15	0
Muriate Potash -	1	3	6	- at 14s. -	1	5	3
	9	2	10		£.28	5	9

A Valuation of the Articles contained in the Kelp from the Isle of Lewis.

	lb.		lb.				cwt.	qr.	lb.	
S. carb. Soda, *dry*,	5.96 =	6	in 100 =	6.12	in 112 =		1	0	23	in 1 ton.
Sulphate of Soda,	13.60 =	13.9	in 100 =	.15	in 112 =		2	2	20	in do.
Muriate of Soda,	24.36 =	24⅓	in 100 =	27.8	in 112 =		4	3	18	in do.
Mur. of Potash,	3.20 =	3⅕	in 100 =	3.10	in 112 =		0	2	16	in do.

Value of each Article, at the Prices put upon the same Articles in the Barilla.

	cwt.	qr.	lb.			L.	s.	d.
Subcarb. Soda, *dry*,	1	0	23	- at 90s.	-	5	8	5
Sulphate Soda, do.	2	2	20	- at 20s.	-	2	13	8
Muriate of Soda, -	4	3	18	- at 10s.	-	2	9	1
Muriate Potash, - -	0	2	16	- at 14s.	-	0	9	0
	9	1	21			£.11	0	2

A Valuation of the Articles contained in the Kelp from the Isle of Skye.

	lb. oz.		lb.			cwt.	qr.	lb.	
Subcarb. Soda,	8.52 =	8½	in 100 =	9.8	in 112 =	1	2	22	in 1 ton.
Sulphate Soda,	22.72 =	22.11	in 100 =	25.8	in 112 =	4	2	6	in do.
Mur. Soda & Potash -	23.01 =	23.0	in 100 =	25.14	in 112 =	4	2	13½	in do.

Value of each Article

	cwt.	qr.	lb.			L.	s.	d.
Subcarb. Soda, dry,	1	2	22	- at 90s.	-	7	12	8
Sulphate Soda, - - -	4	2	6	- at 20s.	-	4	11	0
Mur. do. and Potash,	4	2	13½	at 12s.	-	2	15	6
	10	3	13½			£14	19	2

A Valuation of the Articles contained in the Kelp from the County of Galway.

		lb.	oz.		lb.		cwt.	qr.	lb.	
Subcarb. Soda,	6.81 =	6	12	in 100 =	7.9	in 112 =	1	1	11¼	in 1 ton.
Sulphate Soda,	9.70 =	9	$_{10}$	in 100 =	10.14	in 112 =	1	3	21½	in do.
Mur. Soda & Potash -	33.79 =	33	¾	in 100 =	37.15	in 112 =	6	3	3	in do.

Value of each Article.

	cwt.	qr.	lb.			L.	s.	d.
Subcarb. Soda, -	1	1	11¼	- at 90s.	-	6	1	6
Sulphate of Soda,	1	3	21½	- at 20s.	-	1	18	10
Mur. Potash and Soda,	6	3	3	- at 12s.	-	4	1	[illegible]
	10	0	7¾			£12	1	[illegible]

Having thus made a very circumstantial and care-ful valuation of the several articles, useful in manfactures, that were found in the four parcels of alkaline ashes which I have been analyzing, it now behoves me to say a word or two upon the principle on which these valuations are founded.

Subcarbonate of soda, in a perfectly pure state, has, I believe, never yet been sold as an article of trade; consequently, it has no price in the market. I had, therefore, no method of setting a value upon it, but by calculating what some fixed portion of this pure alkaline salt, as it exists in the articles of commerce, does actually cost the consumer. Accordingly, I have fixed upon barilla as the standard, and have already explained (in page 100) how I made the calculation. Carbonate of Soda.

As to the neutral salts, the valuation which has been put upon them has been made with a view only to those persons who separate the soluble matters from kelp and barilla, before they consume them; such as bleachers, soapmakers, and some manufacturers of glass, who may all avail themselves of the several amounts set against those respective articles. Neutral Salts.

With regard to the manufacturers of soap, most of the large makers have now reverberatory furnaces upon their premises, where they work over their waste lyes a second, and often a third time, for the production of alkali; and these people well know the value of the neutral salts; I mean those among them who are in any degree become scientific. Soapmakers.

Thus the sulphate of soda, which I have valued Sulphate of Soda.

at 20s. per cent. when properly heated in a reverberatory furnace, with carbonaceous matter, will become converted into a sulphuret of soda; an article very suitable for making that kind of soap which is consumed by the poor, and is coloured with resin and palm oil. And if the manufacturer be not a maker of *yellow* soap, he has only to separate the sulphur by some cheap and easy method, which any good chemist could point out, and then the resulting alkali would be as fit for the best *white* soap, as any which they can procure from barilla. In this case, every hundred weight of uncrystallized, perfectly dry sulphate of soda, and which I have valued at 20s., would produce, when completely decomposed, 0 cwt. 3 qr. 1 lb. of subcarbonate of soda, which, at 90s. would be worth 3*l.* 8s. 3d.; but from this he would have to deduct the expense of charcoal, fire, and labour.

Muriate of Soda.

The muriate of soda (common salt) will not be thought to be overrated at 10s. per cwt., as it is an article which the soapmaker cannot dispense with in his manufacture; and this is equally good with the best common salt, which cannot be purchased for less than 33s. or 34s. per cwt.

Muriate of Potash.

The muriate of potash I have valued at 14s. per cwt., as I find upon inquiry, that the soapmaker has no difficulty in procuring that price, and even more for it, in any quantities, for a purpose to be explained hereafter. For, as it appears from the printed proposals of the Highland Society, that they expect not only an analysis of kelp and barilla, but also "an Essay, stating the component parts, and showing to what uses these component parts may be applied," I shall endeavour to comply with their requisition, and would not willingly have intermixed what I had to say on the *uses* of the several articles, with any other matter, if I could have avoided it. Conceiving that any observations which may be calculated to throw light upon the relative value of these productions, or which may tend to the improvement of their manufacture, will be acceptable to the Society, I hope I may be excused should I go more into detail than was expected; and it is with these views the following remarks are offered.

As there is one manufacture in which the kelp is employed in its native state, without any previous lixiviation, I shall at first confine my observations to that important and staple business; I mean the manufacture of glass.

Manufacture of Glass.

By frequent intercourse with some very intelligent glassmakers, connected with my own observations, I have been enabled to collect the following facts, all tending, as I trust, to further the patriotic objects of the Highland Society.

Use of Barilla lately diminished.

Formerly barilla was employed for all kinds of glass; but of late years, the use of these foreign ashes in glass-making, has been almost entirely discontinued; potash being now chiefly employed for flint-glass,—the soda which is procured from muriate of soda, (common salt), for plate-glass,—and kelp for crown, or best window-glass; it having been generally determined that in this last branch of the business, barilla is in no respect superior to kelp, except in the circumstance of its containing more alkali; and this is more than counterbalanced by its high price.

Remarks on the Quality of Kelp.

Notwithstanding the preference which is thus given to kelp at the crown houses, some kinds of kelp disappoint the expectation of the manufacturer, and will not make clear glass. This is probably owing to iron, as I understand that the kelp which is made on some shores, always contains a considerable portion of this metal in the state of oxide. This, I believe, is always the case where the shore is in a great measure composed of sand which has been abraded from the soft-red sandstone. In such situations, great care should be taken that no sand gets into the oven with the weed.

Sand in Kelp.

I am not apprehensive that the addition of sand to the kelp is injurious in abstracting a part of the alkali, because I conceive that the temperature at which kelp is made, is not often high enough to enable the sand to form glass by its union with the alkali. In this opinion I am confirmed by the statement of a very respectable glass manufacturer, who informs me that the Orkney kelp is generally more adulterated with sand than that which is made in the Western

Isles, containing sometimes 20 per cent. of sand, and yet that this makes much better glass than most other species of kelp.

Common Salt in Kelp.

Kelp generally contains a large portion of common salt, particularly the Irish kelp; but this is not injurious to the manufacture of window glass, for it is thought to be rather of service in the operation of forming the frit; and when it comes into the glasshouse pots, or crucibles, it is either driven entirely off by the intense heat, or rises to the surface, and forms a part of the sandiver. This is effected by the increased density of the melted metal; for, as the glass gets perfect, it always becomes of greater specific gravity; therefore, as the particles of the glass come closer together, the common salt which has not been dissipated, is squeezed out as it were, and then forced up to the surface.

Salt in Kelp for Glass.

There is only one inconvenience that I know of, which accrues to the glass-maker from the superabundance of salt in kelp, and that is by increasing the quantity of sandiver; for whenever the coat of sandiver lies thick upon the surface of the glass in the crucible, it protects the glass from the action of the heat, and thereby the process is often very much lengthened, which enhances the expense of the manufacture. In no other way is the excess of salt in kelp prejudicial, because the glass-maker can always sell the sandiver which it produces for 8 or 10*l.* per ton, a price nearly equal to that which these manufacturers generally pay for the kelp in the first instance.

Lime in kelp.

Another substance which generally occurs in kelp, is lime. On the effect of this earth in glass, there are various opinions; some manufacturers considering it to be beneficial, and others injurious. Loysel has a Chapter, * expressly on the effects of lime in the composition of glass, which I beg leave to recommend to the perusal of those Members of the Society, who take a peculiar interest in the improvement of the manufacture of kelp. The few facts which have come within my own knowledge, I shall take the liberty of mentioning.

Crown and Plate-glass generally contain from one fifteenth to one twenty-fifth of their weight of lime; but notwithstanding this, most glass-makers select that sort of kelp which contains little or no lime, preferring the adding that earth themselves, to the materials as they see occasion, † because a small portion more than is re-

* Essai sur L'Art de la Verrerie. Par Le C. Loysel. Paris, An. VIII.

† A small portion of lime is sometimes added to the materials for flint-glass, for the purpose of rendering the glass less liable to break by a sudden change of temperature. In window and plate-glass, it has the effect of making the glass tougher, and hence easier to cut with the diamond.

quisite very much injures the quality of the glass.

The kelp made in the Islands of Uist often contains so much lime, that the glass made with it has an appearance in some parts of the sheet very similar to porcelain, though this in some measure depends upon the manner of cooling. The glass-maker, moreover, sustains a loss by using kelp which contains much lime, from the circumstance of the great affinity which lime, when mixed with silex, has for alumine; because it has been found, that such kelp corrodes the pots or crucibles much faster than any other. That this is a fact, I have no doubt; because it is well known, that in the Black-bottle houses, where the alkaline material is soapers-waste ashes, consisting of a mixture of refuse kelp and lime, the crucibles do not endure half the time which they do in other glass-houses. Hence it appears to me, that the proprietors of kelp-shores would do well to instruct the work-people to be careful at all times not to admit sea-shells or limestone into the kilns in which the ware * is burnt.

Another manufactory, one to which I have already referred, and in which large quantities of kelp are used, is that of soap. Here the kelp, Soap-making.

* This is the name which the Highlanders give to the sea-weed which is burnt for the production of kelp.

previously mixed with quicklime, for the purpose of abstracting the carbonic acid, is lixiviated with water, to dissolve the alkaline and other salts contained in it; and it is the lixivium only which is employed to make soap.

In speaking of this business, I am desirous of remarking, that there are many parcels of kelp, which would be quite unfit for glass-making, that would be very suitable for, and might be employed to great advantage in, the manufacture of soap. Here, I more particularly refer to those kelps which contain a large portion of muriate of soda, and yet are not much deficient in the quantity of alkali. A little explanation will render this very evident. Soap cannot be made with *pure* alkali alone, however strong it be; it must have an addition of common salt to keep the pan open, as the boilers term it; for without salt, the water would unite with the oil and alkali, as it does in *soft* soap; and a firm consistent article could not be made. Again, whenever potashes are cheap, the manufacturer can employ a large portion of potash; and then, by the use of lyes, made with a kelp which contains a great deal of salt, a double decomposition takes place, and *muriate of potash* results, which the soap-maker can sell to the maker of alum to great advantage.

Uses of the component parts.

I shall not have completed my original design, unless I make some further observations on the *uses* of the several substances which may be obtained from kelp and barilla.

Respecting the muriate of potash, which is found in kelp, and which the large soap-boilers now collect for sale, it has already been observed, that this article is sold to the makers of alum in Yorkshire, and is used by them in considerable quantities. Uses of the Muriate of Potash.

It is a well-known fact, that it is absolutely necessary to add either potash or ammonia, in some form or other, to the aluminous liquor; because, sulphate of alumine alone will not crystallize so as to form alum. Until lately, an article furnished by the makers of nitric acid, called Sal-Enixum, and which is a true sulphate of potash, has been employed for this purpose; but when the price of this residuum became enormous, some of the alum-makers made trial of the muriate of potash, which they found not only to answer equally well with the sulphate of that alkali, but was more valuable to them, inasmuch as that the muriatic acid of the muriate of potash, has the property of separating the iron from the aluminous solution, and consequently of rendering the alum much fitter for the dyer, and for every other manufactory where this earthy salt is employed, and in which the iron would often prove injurious. Hence it is, that this circumstance bears upon the question of the improvement of kelp; and means should, I conceive, be adopted, for increasing the quantity of muriate of potash, and lessening the quantity of insoluble matter in all kelp which is designed for those manufactures, where the neutral salts and the alkali are separated by a previous operation; because, however large may be the quantity of muriate of potash which may thus be collected, it can all be consumed in the manufacture of alum.

Another purpose to which the muriate of potash may be applied, is, in the preparation of saltpetre. In France, the muriate of potash has been used for this purpose to a very considerable extent: and if ever the situation of these kingdoms should be such as to render it expedient to form nitre-beds in every district, as was the case in England a century and a half ago, the muriate of potash which can be obtained from kelp, might prove a resource of great national importance. The presence of lime, or carbonate of lime, is necessary for the formation of nitre-beds; consequently, large portions of nitrate of lime are always found in connexion with native saltpetre; and there is no way of converting this earthy nitrate into true nitre, but by the addition of potash, or some of the salts of potash; and the muriate of potash will effect the decomposition in the most complete manner, and convert what would otherwise be a useless substance, into true saltpetre.

Use of the Sulphate of Soda.

Respecting the sulphate of soda, I have already spoken of its value to the soap-maker who prepares his own alkalies; but I am desirous of remarking, that wherever a large quantity of this salt occurs, as in the specimen of kelp which I have analyzed from the Isle of Skye, where there appears to be more than 4½ *cwt.* in one ton of the kelp, it is a sign that the kelp has not been properly burnt. When I say, not properly burnt, I mean, that the temperature was not raised sufficiently high, or the materials were not properly stirred in the kiln, so as to produce that decomposition which the carbonaceous matter of the kelp, and proper management, would have effected. Thus, a salt, which might otherwise be useless, would be converted to good carbonate of soda, fit for the manufacture of glass or soap. Were the attention, which I am recommending, actually paid to the manufacture of kelp, it would doubtless produce double the quantity of alkali, which is now usually found in it.

There is another purpose for which kelp might be employed, if its manufacture were thus improved, which has not yet been adverted to; that is, for the preparation of *crystallized soda.* This is an article of such universal demand in the arts, that it appears to me to be an object of considerable national importance to increase its quantity, and to enable the makers to furnish it at a lower price than that at which it has hitherto been sold. At present, the whole of that which is brought to market, is produced either from the natron of the East, from foreign barilla, or from the decomposition of common salt. In this country, there is a large consumption of Russian and American potash by dyers and colour-makers; but, of

Further use of Kelp.

late years, owing to a deficiency of wood in those provinces where potash has usually been made, the produce has decreased, and the article has every year become more and more adulterated. Besides this, a practice has of late been introduced, of opening the barrels after their arrival in this country, and of mixing inferior English ashes with the foreign ashes, so that the consumer has now the greatest difficulty to procure a parcel of genuine pearl ash, at any price. These difficulties have induced many of the consumers to substitute crystals of soda for potash,* in their respective manufactures; and I have no doubt, that if kelp were to be had of as good a quality as might be made, that it would be employed for making soda; and that thus, the consumption of kelp in these kingdoms, might be very considerably increased.

Having undertaken to speak of the uses to which kelp and barilla, or their component parts, may be applied, it might be deemed an omission were I to neglect to advert to the insoluble residuum of kelp and barilla, which is thrown out

* Here it may be proper to remark, that the foreign potash cannot be purified by crystallization, like the soda of kelp and barilla; because potash cannot be made to crystallize, unless it be further impregnated, by an *expensive* process, with carbonic acid. The subcarbonate of soda crystallizes readily; but potash must be brought to the state of a bicarbonate, or what was formerly called a supercarbonate, before it can be obtained in crystals.

of the vats of the soap-boiler, and sold under the name of soap ashes. The use of these ashes as a manure, and also their employment in the manufacture of black bottles, must be well known to the Society. But I am inclined to think, that there is a use to which it is applied in London, and in some other parts of these kingdoms, that is not generally known to the public. In London and its neighbourhood, soaper's-waste ashes are much used in making mortar for building; and, when mixed in equal portions with common lime-mortar, the mixture produces a very hard and durable cement; and as waste kelp and barilla ashes are not worth more than two or three shillings the cartload in London, there is a great economy in employing it in this way. This method of making a cheap mortar will be particularly worth notice in every district where either lime or sharp sand is sold at a high price.

The only other material derived from kelp, worthy attention, is Iodine, a very extraordinary substance of modern discovery, which has the property of taking both the form of a crystalline salt, and that of a brilliant purple-coloured gas. At some future time, this singular product may probably be used in colour-making, or in calico-printing, or for some other purpose in the Arts; but, as it has hitherto been employed in very small quantities only, it would be needless to occupy the time of the Society in enumerating any of its known properties.

Nothing now remains, but to offer a few remarks which have occurred to me on the *burning* of kelp; and, although this is a branch of the subject, the consideration of which the Society has not enjoined upon the writers of the Essays on the comparative value of kelp and barilla, it is so intimately connected with the subjects of this Essay, that I presume a few observations, which I conceive may conduce to the improvement of the manufacture, will not be thought to be improper or intrusive. A slight review of the products of the barilla, and the different kelps which I have analyzed, will furnish some remarks which may not be quite unimportant.

In looking at the products of the barilla, the first thing which strikes me is the large excess of soda, when compared with the quantity usually found in kelp. This is owing to two circumstances. The one is, that the plant which produces barilla is of a peculiar kind, and cultivated for this particular purpose. The other is, the extra care which is taken in burning it,—a fact which may, I think, be easily proved to the satisfaction of the Society. With regard to the first, it might be worth the consideration of the Society, whether they ought not to recommend to the proprietors of the kelp-shores to import a quantity of the seed of the *Salsola Soda*, and cultivate it at a small distance from the shore, with the design of mixing this plant with the sea-ware, for the improvement of the kelp. It was formerly imagined, that the barilla plant would not produce any quantity of alkali worth its cultivation, if planted in France; but, in the year 1782, some spirited individuals procured a quantity of barilla seed, and made a plantation of it near the coast of the Mediterranean, in the province of Languedoc, and had the satisfaction, for several years, to find, that the barilla which they produced from these plants, was of a quality equal to that which they usually procured from Alicant. Why, then, may not a similar attempt in our own country be equally successful?

As to the superior management of the Spaniards in burning the barilla, to that of the Highlanders in the incineration of kelp, the truth of this fact will evidently appear from a comparison of some of the products of barilla with the quantities of the similar articles found in kelp. The *sulphate* of soda, which can only arise from the decomposition of the sulphate of magnesia, was found, in the Lewis kelp, to be more than 13 per cent., and, in that from the Isle of Skye, nearly 23 per cent.; whereas, in the barilla, it does not amount to 3 per cent.; and yet, from the quantity of disengaged magnesia which is found in the barilla, it is evident that there was an abundance of magnesian sulphate originally with the materials of which the barilla was formed. Hence it appears to me, that if the proprietors of the kelp-shores were to improve their furnaces, so that a higher temperature might be given to the melted materials, and, at the same time, to bestow more labour on stirring the mass while in fusion, most of the sulphate of soda would be decomposed, and the quantity of carbonate of soda, which is the article of most value in kelp, would be much augmented.

This is not mere chemical theory, or a matter of simple speculation only, but is founded on absolute fact and experience. I say this with confidence; because, some years ago, I caused a reverberatory furnace to be erected upon my own premises, for the express purpose of putting this matter to the test; and at various times I have superintended the remelting of several parcels of kelp, with fresh carbonaceous matter, and always found the value of the kelp to be much increased by the operation. *

The alumina and silica in the sample of barilla which has been examined, are full as much as are usually found in good kelp; and, so far, the ba-

* This remelting of kelp, with an additional quantity of charcoal, improves its quality, in consequence of the decomposition of the sulphate of soda, and which is effected by virtue of the carbon. The carbon attracts the oxygen of the sulphuric acid; and the carbonic acid which is thus formed, unites with the base of the salt, and produces subcarbonate of soda. It is necessary, however, to stir the mass very frequently with an iron rake while in fusion, in order to promote and hasten the decomposition.

rilla is imperfect. But it will be observed, that the carbonate of lime therein, is much less than that which usually occurs in kelp; and this is certainly an excellence, and bespeaks great care in the collecting of the materials.

Another important difference which this analysis of the barilla and kelp exhibits, is the quantity of muriate of soda contained in them. In the barilla, I found only 7½ per cent. of sea-salt; whereas the kelp from the island of Lewis has more than 24 per cent., and the Irish and French kelp have generally a still larger quantity of that salt. This difference arises from the ware not having been allowed to grow to sufficient maturity, or from the very free use which the burners of kelp make of the sea-water; and I suspect that it is sometimes absolutely necessary for them to throw in a large quantity of sea-salt, in order to occasion the mass to melt more readily; common salt acting, at a certain temperature, as a powerful flux. In many instances in which kelp is employed, this large proportion of common salt is no detriment whatever, as I have already explained; and if, during the present exorbitant tax on salt, it were generally known how large a proportion of that useful commodity might be obtained from kelp, I do think that the number of the buyers of kelp would be very much increased; because the common salt might easily be extracted for culinary purposes, or for use in a variety of the arts, and the carbonate of soda still used as an alkali. Thus, when the *gabelle* existed in France, the manufacturers of green-glass derived great advantage, as Chaptal informs us, from the salt in kelp; for the salt when melted, rising to the surface of the glasshouse pots, they carefully collected it, and made it an article of commerce.†

Moreover, if the growers of kelp could contrive to make some considerable plantations of the most productive of the kali, or of fumitory, wormwood, and other inland plants, which yield large quantities of potash, and collect the crop to burn with the other materials, the carbonate of potash resulting from their incineration would decompose the sea-salt, and a great accumulation of carbonate of soda would be produced. This latter suggestion I am extremely anxious to impress upon the several Members of the Society, in the hope that they may perceive its importance, and make this one of the subjects of their general recommendation. To prevent misconception, it may be necessary to add, that this idea is founded upon a well known chemical axiom—that carbonate of potash will decompose muriate of soda, and that the salts resulting from the mutual decomposition will be carbonate of soda and muriate of potash.

While upon this subject, if it be allowable to travel so far out of the prescribed path, I am

† See Chaptal's Chemistry applied to the Arts. 8vo. London, 1807, vol. II. page 116.

anxious to suggest for their consideration, whether or not it might be advisable for the Society to offer a premium to the person who shall plant, at a convenient distance from a kelp shore, the greatest number of acres with wormwood, or any other plant suitable for the production of potash. It was proved long ago by Du Hamel, that the marine plants produced soda merely in consequence of their situation; for, when they have been cultivated for some years in an inland spot, they yield only potash.*

Another improvement which might be made in the manufacture of kelp, occurs to me as worth noticing. This respects the sulphur which is often found in kelp, in considerable quantity. I have often observed, that the better the kelp is burnt, the more sulphur there is in it. This is the natural consequence of the complete decomposition of the sulphuric salts; and it often stains the alkali so much, as to render it unfit for the manufacture of *white* soap. I have found by experiment, that a little of the parings and scraps of what is called tin-plate, or any other waste iron, if thrown into the furnace when the kelp is in fusion, and well stirred with it, will attach all the sulphur to itself, and prevent the injurious effect just mentioned. In all the large towns,

* See Memoires de l'Acad. des Sciences, 1782, p. 146.; and Murray's System of Chemistry, second edition, Vol. II. page 210.

an abundance of these tin scraps may be had for little or nothing; and their operation in sweetening kelp is very efficacious.

Should the Society require further explanation respecting any part of this Essay, I shall be glad to furnish it, or to enter upon such experiments as may be thought likely to promote any object which the Society may have in view.

SAMUEL PARKES.

London, November 6th, 1816.

REPORT

BY A COMMITTEE OF

THE HIGHLAND SOCIETY OF SCOTLAND,

ON

DRILLED WHEAT.

Approved by the Society, and recommended to be Published.

The Committee have examined the certificate by the Earl of Dalhousie, Robert Hay Esq. of Spott, and other members of the Society, with other documents transmitted to the Secretary, in behalf of Mr John Brodie of Scoughall, who has been found entitled to the first premium advertised by the Society, as having had the greatest extent of ground within the county of Haddington, properly sown down in drilled wheat, crop 1815.

The documents are of importance, as they show the advantages of drilling wheat crops, upon soils adapted to that species of husbandry, the object the Society had in view when the premium was proposed.—On the farm of Scoughall (the soil being a soft sandy loam, which produced great quantities of annual weeds), the difference of produce in favour of the drilled crop, compared with the crop sown broadcast, upon ground of the same extent and quality, was as 41 to 34. The seed was at the rate of 8 or 9 pecks per Scots acre for the drilled crop, and 12 pecks per Scots acre for the broadcast; and the saving of seed for the drilled crop was equal to the additional expense occasioned by hoeing, which is stated at 7s. or 8s. per acre.—The weight of the grain produced was similar; being about 65 lib. per firlot, in both cases.—Another experiment was made on the farm of Thorntonloch, where the soil was a hard gravel loam, which threw up few or no annual weeds, and got little or no hoeing; and there the produce of the drilled and broadcast fields was very nearly equal; but still the difference was in favour of the drilled crop, being as 51 to 50; to which fell to be added, the difference of seed, as there was little or no hoeing.—The ground upon both farms, under drilled wheat, amounted to about 150 Scots acres.—The drill machine used, was wrought by two horses, and sowed at the rate of 10 acres per day; and the seed was deposited to an inch and a half in depth.—Mr Brodie states that, on both farms, the ground was under turnips the preceding year, and got one furrow in the common way of ploughing (but does not exactly recollect the depth), that both places were drilled across the ridges; and that he sometimes gives one, and sometimes two double harrowings before sowing: The wheat, in both cases, was sown about the middle of February.—Mr Brodie has one machine which sows seven drills at a time, at a foot asunder; and one that sows *eight* drills, at *ten* inches asunder (he prefers the first).—These machines cost about *ten* guineas each.—Mr Brodie states, that grass seeds were sown with his drilled and broadcast crops; and that the grass was best among the drilled crops; but he is afraid this may not always be the case, because the grass seeds cannot be sown in the drilled crop till it is hoed, and, if very dry weather has then set in, the seed might be lost; whereas the grass seeds in the broadcast crop, may be sown at any time when the weather is favourable; and he adds, that if it were not for the risk of dry weather, 'there is not a doubt that 'grass seeds would always succeed best with a 'drilled crop.'

In consequence of the recommendation of the Directors, the Committee inspected some of the drilled crops in the neighbourhood of Edinburgh, particularly the crops upon the farms of Warriston and Bangholm, possessed by Mr Robert Dickson, where they found several fields of drilled wheat, sown at different times, and one small field of drilled oats, all in excellent order: But, to enable the Committee to fulfil the purposes of the remit to them, they made some inquiries at Mr Dickson, with respect to his crop of last year, and his mode of drilling.—Mr Dickson stated to the Committee, that his farms consist of different soils. Warriston is a light sandy loam, upon a dry bottom; and Bangholm a black loamy sand, upon a retentive bottom. The difference of produce between the drilled crop, and broadcast crop of wheat on these farms, in favour of the former system, was as 60 to 45. The seed was at the rate of 14 pecks per acre for the drilled crops, and the same for the broadcast. The expense of hoeing the grain twice, was 5s. per Scots acre. Warriston was in early potatoes, and Bangholm in late potatoes the preceding year. The early potatoes were taken up in the month of August, and the ground ploughed across with a furrow of 9 inches. The late potatoes were taken up in October, and the ground ploughed thrice with a *nine* inch furrow. The drills were lengthwise; and, in both cases, the lands got a double time across with the common harrow, immediately before drilling. The average weight of the drilled wheat was 64 lib., and of the broadcast 63 lib. per Winchester bushel. The seed was drilled at the depth of 4 or 5 inches, upon the dry-bottomed land, and 3 inches upon the wet-bottomed. One row was sown in each furrow, as the plough goes along, taking a furrow slice of 10 inches broad upon the dry-bottomed land, and 12 upon the wet. The drill-box attached to the plough, costs 1*l.* 11s. 6d.; and the drill-barrow which follows the plough costs 2*l.* 15s.; but Mr Dickson rarely makes use of the latter. The work can be performed either with one or two horses, and one Scots acre sown per day. In stoney land it may be proper to use the barrow; and then one horse may be sufficient to draw the plough. The grass among the drilled wheat was all equally good; but where the broadcast wheat was strong, the grass failed much.—Mr Dickson mentioned that winter wheat drilled, ought to be sown before the end of October; but that in light soils, with early exposure, it may be sown as late as the month of December.

From what has been stated, the advantage of drill husbandry, as to the quantity and quality of the grain, is evident. There is another circumstance, too, which the Committee may notice.—It frequently happens, that in severe winters a great deal of wheat, sown broadcast, is thrown out of the ground; and this they understand has happened to a great extent this season. The drill husbandry secures against this, by the depth at which the seed is deposited; and, in this respect, Mr Dickson's mode must be preferable to the shallow drills. It must also be preferable, as it tends to obviate a danger stated by Mr Brodie with respect to sowing grass seeds in dry seasons; because, from the depth at which the wheat seed is deposited, the farmer is enabled to give the ground a complete hoeing, or deep harrowing, which will open it up, and produce moisture on the surface, to nourish the grass seeds, without doing any injury to the grain.

The Committee had no opportunity of making a regular inquiry as to the advantage of drilled barley and oats, compared with broadcast: But from the information they have received in regard to some trials made on a small scale, the results appeared favourable to the drilled system.

Edinburgh, 3d May 1816.

ACCOUNT

OF

CERTAIN EXPERIMENTS MADE DURING THE YEARS 1812, 1813, 1814, and 1815,

ON

THE ECONOMY OF FEEDING HORSES.

By WILLIAM FRASER TYTLER, Esq. of Belnain.

THE science of rural economy presents no subject of investigation more important, than that to which the Highland Society have so laudably directed the attention of practical men—the economical feeding of horses. If, as is generally understood, there be not less than three millions and a half of horses of various descriptions in Great Britain, which divert from the food of man the produce of nearly 16 millions of acres, it requires no argument to show that a more important consideration cannot come under the view of the political economist than the means of narrowing so vast a consumption.

Various causes contribute to increase this consumption, greatly beyond what necessity demands.

The vanity of the wealthy, and the carelessness or knavery of their servants, lead to extravagance and waste in the maintenance of pleasure horses. A similar vanity on the part of farmers (fortunately less known in Scotland than in our sister kingdom), prompts to a preposterous excess in pampering an unwieldy breed of work horses, whose numbers must necessarily be increased in proportion to their inefficiency.* And even where no such extravagance or weak emulation is found, the inattention of servants, and supineness of masters, produce both a waste of the various articles of food in use in their stables, and a neglect of the means within their power of substituting less expensive articles of consumption.

The quantity of corn which a horse will consume, when given, as it often is, without limita-

* In many parts of England, four horses, and sometimes five, are employed to do the work of two; and, to the eye of a Scotch Farmer, nothing can appear more ridiculous than this extraordinary misapplication and waste of so expensive a power. On the road between Glasgow and Edinburgh, a single horse draws from 1 ton to 22 cwt.; while four horses, equal, if not superior in size, strength and symmetry, are, in many counties of England, (even where the land is extremely light), to be seen yoked to the plough one before the other. The writer of this Essay, has seen in Worcestershire, five powerful horses in the highest condition, yoked *at length* to a plough, in land so light that any one of them could have made as good a furrow as that effected by the whole five; and this, in a field or paddock so small, that the first horse was turning at the head of the ridge, when the plough was but very little past the middle of the field.

tion, is amazing. Two pecks of oats per day, and a stone of hay, is the quantity stated to be given to post-horses, by two eminent coach-masters mentioned by Sir John Sinclair (in the Appendix to his account of Scots Husbandry, vol. 2. App. No. 23.): and a charge for a similar consumption has not been unheard of, for horses which had no heavier duty to perform, than that of carrying their owner a round or two of Rotten Row. Thus is expended, in the maintenance of one, often useless, quadruped, what would amply maintain six human beings.

The practice of farmers in the most improved districts of the country, although it comes far short of such extravagance in feeding their horses as that before instanced, is nevertheless sufficient to show, that too little attention is paid to economy in this important branch. Three feeds of oats, and 1¼ stone of hay, is the usual allowance to horses working nine hours a-day; and, consequently, when oats are 25s. per boll, and hay at 1s. per stone, the daily expense of each horse, for corn and hay alone, is 2s. 5d.; and though this expense is considerably diminished at certain seasons, still the annual charge of maintaining a work horse, is computed by farmers at from 30*l.* to 40*l.* †

† See Estimates of the Expense of Maintaining Work Horses, by Mr Brown of Markle; Mr Cuthbertson of Seton Mains; Mr Walker of Mellendean; Mr Walker of Wooden, and others.—*Acct. of Husb. of Scotland, vol.* 1. *p.* 134, *et seq.*

The object of the present paper is to show, from actual experience, that this branch of farm expenditure may be greatly diminished; that the daily food of a horse, working the usual hours, may be reduced to an expense, at no season exceeding half of the amount above mentioned, and, at certain seasons, not exceeding one sixth of it; and this, while the best condition of the working stock, both in appearance and in aptitude for labour, is maintained.

To this subject, the author of these observations has, for the last 10 years, been led to pay particular attention. The circumstances of his farm demanded no ordinary regard to this important branch of farm management; for, from the exhausted state in which a soil, naturally thin and poor, had been left by the former tenant, it was some years before the produce was even adequate to support the stock necessary for the management of the farm. Distant carriages of dung and lime, and of all the materials wanted in the construction of extensive farm buildings, required an extra number of work horses for some years; while miserably scanty crops, both of corn and hay, afforded but very sparingly the means of maintaining them. Under these circumstances, his attention was earnestly directed to the economical management of the slender means which he possessed, for maintaining so large a working stock; and various substitutes for the more expensive articles of food, were submitted to experiment.

The experience of many farmers has ascertained, that there are few articles of farm produce which afford a more valuable addition to the ordinary food of working stock than the Swedish turnip. The common turnip is no doubt useful in the same light; but it is a weak and watery food when compared with the Ruta baga. This root is greatly more nutritious, in proportion to its bulk, more solid in its texture, and more agreeable in its flavour, than the common turnip. Horses are exceedingly fond of it; and it now forms an important part of the food of working stock on most farms. In common with most farmers, I employ potatoes largely in the feeding of my working stock. I have made various experiments to ascertain the difference between this root in its raw state, and when prepared by boiling, or by steam; the result of which I hold to be, that potatoes, when given raw to horses, form a very nutritious and wholesome food, but keep the horses too soft for severe labour. When boiled or steamed this objection is wholly removed; and horses fed on potatoes so prepared, with a very moderate allowance of oats, are in as high condition, and capable of undergoing as severe labour, as when kept on the highest feed of oats and hay.

Swedish Turnips.

Potatoes.

The late and bad harvest of 1812, and the probability that potatoes, as well as grain, would rise extremely in value before next crop, led me to attempt some substitute for the large quantity of this root which I annually consumed with my working stock. Potatoes, indeed, had risen, even before winter, to nearly three times their usual price, in the neighbourhood of my farm; and the saving which I effected, by the means afterwards to be noticed, did, in fact, enable me to sell, in the following spring, a large quantity of potatoes, at the extraordinary price of 30s. per boll; while, the year before, I had purchased potatoes for my horses at 8s. The boll I allude to is a provincial one, and weighs 42 stones Dutch weight.

Whins. *Feeding Horses on Whins*—I had heard talked of, but rather as one of the fantastic experiments of theoretical farmers, than as a matter of real practice. The abundance of the material, supplied by every bit of waste ground on my farm, was an inducement at least to put the thing to the test of experiment; and I took care, that the scale on which it should at first be tried, should not be such as to attach much ridicule to the failure. Having collected a small quantity of the succulent shoots of the whin, which were bruised, and put into the manger of two stalls before the horses came in from their morning yoking, I was not a little pleased to see, that, instead of beginning to their hay, both horses completely finished their new mess, before they ever lifted their heads to the hay-rack. A larger quantity was provided the following day, and the experiment was repeated, giving a quantity which might weigh from 2 to 3 lib. to each of 8 work-horses. It was eaten by the whole with such avidity, as to show, that a much larger allowance would have proved highly acceptable. The day following, I varied the experiment, by not giving them the whins till their oats were put before them, a feed of whins being put in the opposite side of the manger. They preferred the oats, but certainly showed that they had some difficulty in settling their choice; occasionally snuffing at, and taking a mouthful of the whins, while they were eating their corn; which was no sooner finished, than they began with the same avidity as they did the day before, and ate up the whole whins that were before them.

So far the experiment had succeeded. It was ascertained, not merely that horses might, by necessity, be brought to eat whins, but that no food could be more acceptable to them. It remained to be seen, how far it was as wholesome and nutritious, as it appeared to be palatable; and this only time could show. There was at least every reason to believe, that a species of food, eaten with so much avidity, would not likely prove injurious; and the temptation to continue the experiment, was a very strong one. I, therefore, determined to set zealously to work; and, for the approaching winter at least, to feed my horses, as it has been sneeringly called, 'on 'Furze Faggots.' The first *desideratum* was a method of bruizing the whins, more expeditious than the imperfect means I had used in my small experiments; and it occurred to me, that some contrivance of the nature of a bark-mill, would be the cheapest and most effectual apparatus I could employ. I procured an old millstone of tolerable thickness; mounted it on a spindle or horizontal axle; one end of which was attached to an upright post, by a swivel working on a pin, on which it might revolve as a centre. To the other end of the spindle, a swingle-tree was hung by a hook, also working on a pin; the course on which the stone revolved, was paved with coarse flags. I furnished a woman with a pair of hedge gloves, a sheep-skin apron, an old reaping hook, and a short-forked stick, with which to hold the whins, while she cut them with the hook. A boy, with a small cart drawn by a mule, which had long been employed as a drudge on the farm, was added to, and completed the establishment, with which it was proposed to feed 12 horses, *viz.* 4 pairs of work horses, a saddle horse, and 3 colts.

Whin-mill.

Cutting.

On the 30th November 1812, the plan of feeding, now to be described, was begun. The woman went out to her shearing in the morning, while the boy and his mule were occupied in carting turnips home to the cattle in the courtines; or to the pastures, for the outlyers and sheep. The manner in which the whins were cut, needs little description,—the woman laying hold of the branch with the forked stick, with a cut of the hook drawn towards her, trimmed off such a part only of the ligneous substance of the plant, as connected 3 or 4, or more, of the succulent shoots of the year's growth. By the joint use of the hook and fork, these were laid into bundles or faggots, and compressed, as they were formed, by a stroke of the foot. The woman soon became very expert at the work, and cut in the course of 6 or 7 hours the whole quantity of whins then given to 12 horses. The cart then came round for the faggots, collecting the cutting of each morning and the preceding evening, which was forked in with a common pitchfork; pressed down by the boy's feet, (who was furnished with a pair of coarse leather gaiters to defend his legs); roped down like a load of hay; carted home, and deposited at the bruising-mill. This was the morning work—the business of the afternoon was to bruise them. The mule was yoked to the mill, which it drew with perfect ease, a proper quantity of the whins being previously spread round in the course of the stone. The boy followed the stone with a pitchfork in his hand, with which the whins were constantly turned as the stone passed over them; when sufficiently bruised, they were forked into a large frame wheel-barrow, such as is used for turnips, and the course filled anew with whins. About 3 hours work finished the whole; and the food, Bruising.

thus prepared, was wheeled off to the stable. The horses continued to manifest the same relish for this food as at first; and, in the course of a few weeks, I was sensible of the most material improvement in their condition. This was particularly observable in their coat. No horse sweated under body-clothes, and the steams of his own dung, ever showed a sleeker and finer coat than my work-horses did after they had been 6 weeks on their feed of whins; and although some of the severest work I had ever engaged in as a farmer, fell to their lot this winter, they not only kept, but improved their condition during the whole season. This system of feeding was regularly pursued from its commencement in November till the middle of March. The horses had, along with their whins, as much straw as they chose to eat, and 3 lib. 2 oz. of oats per day till the beginning of February, when their allowance of oats was doubled; the quantity of oats being the same as I had been in use to give, when feeding with Swedish turnip or potatoes.

Such was the experience of the first year. The result exceeded any expectation I had formed of it, even after I had fairly ascertained the practicability of the plan. In the month of March, instead of having, as usual, finished the crop of yellow turnips, and nearly half the Swedish, both of these crops, with all the yams and potatoes, remained untouched. The Yellow turnip lasted till the end of May; and the Swedish turnip, chiefly consumed by feeding stock, afforded a remainder, which carried on my horses to the second week of June; after which, the yams came in for their summer food. The potatoe crop, instead of being as hitherto inadequate to my own consumption, was sent to market at 30s. per boll. The hay stack remained untouched; and the whole hay consumed in my stable this season, was a remainder of one hundred and eleven stone.

Encouraged by this flattering result, I began the whin feeding on the 26th November of the following year. I had not yet ascertained what the quantity of whins given to the horses actually was. I now weighed the day's provision; and, repeating the trial five or six times at different intervals, I ascertained, that the quantity given to each horse was from 17½ to 19 lib. per day, the average of the trials being 18¼ lib. The same quantity of oats was given this season. The horses continued to show the same relish for the food; and their condition was equal to what could be produced by any feeding, or any mode of treatment, even in cattle less exposed to the heavy labour, and vicissitudes of weather, which attend the winter work of a farm. Quantity.

The following winter, 1814, I began whin feeding on the 4th of November; my work horses had now been reduced to three pair, and the whole number of my horses was eight. I determined, therefore, to increase the quantity of whins given to each, having it in my power to do so, without increasing the number of hands employed in the preparation of it. To each of six work horses, I gave 28 lib., and from 20 to 22 lib. to the other horses. I now wholly withdrew their oats, during the short days; and, when spring work commenced, gave only half the former allowance, or 3 lib. 2 oz. For a part of this spring, one half stone of hay was given in part of straw, not from any idea of the necessity of such change, but because my straw was more than usually scarce; and I had saved the whole hay of the former season. The condition of the horses was certainly equal, perhaps superior, to what it had been during the former winter. The quantity of corn withdrawn, appeared to be more than compensated by the additional 10 lib. of whins. This feeding was continued, as in the former seasons, till the month of March. I have always found, that the horses begin to show a distaste to the whins about the commencement of spring. The shoots probably lose something of their succulence, or become less palatable from other changes which at this season the vegetable undergoes; and I watch the first indications of this, to leave them off, and to supply their place with Swedish turnip.

Quantity increased.

Period at which whin feeding is given up.

It were unnecessary to particularize the experience of the succeeding winter 1815. It corresponded in every respect with what I have already stated. The whin feeding was commenced in the month of October, continued till the usual season, and was attended with the same satisfactory result. It is now as regular a part of the routine of the farm, as giving clover in summer, and turnips in winter. *

The expense which attends this mode of feeding, may be estimated in the following manner, taking that of 1815, when I had carried it to the full extent. Estimate of the expense.

* The only addition I made this year, 1815, to my experience in this useful branch of farm economics, consisted in trying the whins, both with fattening and young cattle. I found, that although the quantity of whins cut by the woman in the short winter day, did not much exceed 1½ cwt., yet in spring, both from the greater length of the day, and the diminished severity of the weather, she cut nearly 3 cwt.; and I now bruised and gave the remainder, after feeding my horses, (being nearly one half), to the cattle. Both those at stall, and the cattle in the courtines, ate it greedily; but I did not pay such particular attention to this application of it, as enables me to state what saving of other food might be produced. Indeed, in the feed of 30 or 40 head of cattle, it must necessarily have been quite immaterial. However, after I ceased this feeding with the horses about the usual time, (*viz.* the beginning of March), I continued to collect and bruise the same quantity; and it was wholly given to the cattle. They continued to eat it for about a fortnight after the horses, and then began to show the same distaste to it, only picking particular parts, and leaving much of it: when I saw this, it was withdrawn.

Prior to beginning February.

Wages of a woman cutting per day	L.0	0	6
Ditto of a boy employed in driving and bruising, also 6d., but one third of the day at other work - -	0	0	4
Supposed keep of the mule 6d., also deduct as above - - -	0	0	4
8 stones straw - - - -	0	2	0
or 4¾d. for each of 8 horses	L.0	3	2

After beginning February.

Wages of a woman, cutting two thirds of a day for horses * - -	L.0	0	4
Ditto of a boy, one half do. for do.	0	0	3
Keep of a mule one half day -	0	0	3
25 lib. oats - - - -	0	2	6
8 stones straw - - - -	0	2	0
or 8d. each horse	L.0	5	4
but where hay is given, add 4 stones at 1s., and deduct 4 stones straw -	0	3	0
	L.0	8	4

being 1s. 0½d. each horse.

I have thus endeavoured to detail four years' experience of a practice in husbandry, which, though not altogether new, has certainly not

* The rest of the day's work being allowed for the portion of whins given to the cattle.

hitherto met with the attention it deserves; nor am I aware that any individual has yet prosecuted it to the same extent I have done myself. It has, however, within the last two years, been adopted on a scale of great magnitude, and in a situation where its advantages were highly conspicuous. The forage used by the Regimental horses of the British army under the Duke of Wellington while in the north of Spain, and in the Pyrennees, was chiefly whins, on which they were found to thrive remarkably; the whins were collected by the men, and either bruised between two stones, or pounded in a trough. *

Whins used as Forage by Lord Wellington's Army in Spain.

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* *Extract of a Letter from Lieutenant-Colonel* MACGREGOR, *9th Foot, dated Elgin, 29th October*, 1816.

'I CANNOT answer your queries respecting the use of 'whins within the period you mention, not having been 'with the army at the time they were so much made use 'of. I can only tell you generally, that the horses of the 'army were chiefly subsisted on them when it was sta'tioned in the north of Spain and the Pyrennees; and they 'were found to thrive upon that kind of food. I presume 'it to have been confined to the bat horses, and those em'ployed with the infantry regiments and artillery. The 'cavalry probably, that is, the great body of them, were 'stationed in districts where there was no occasion of de'viating from the customary food. If I recollect right, 'the whins were made use of in the same manner by the 'army in the south of France, in the neighbourhood of Bay'onne. But as to the mode of preparation, or satisfac'tory answers to the queries you state, I am not prepared 'to speak, my information being entirely from hearsay.

I have no doubt but the rude machinery which I employ for the purpose of bruising, may admit

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'But I shall transmit the queries to a friend, who was with 'the army at the time, and who I think likely to afford the 'information you want.'

Extract of a Letter addressed to Lieutenant-Colonel MACGREOR, *9th Foot.*

'The whole of the regimental horses and mules of the 'division were fed in this way (viz. on whins); the quanti- 'ty they ate, I cannot say; it was mostly given them at 'night, when doing them up; and, I think, as much as 'they would eat during the night. They occasionally got 'a small allowance of corn; and were turned out to browse 'the whole of the day, when not wanted; but what they '*then* picked up, considering the time of the year (winter), 'and the numbers feeding nearly on the same spot, and for 'a continuance, could not have affected them much in point 'of nourishment. The period during which whins consti- 'tuted the principal part of the animals' food, was from 'October to March. During a great part of the time of 'feeding them in this way, they had but little work to do, 'and improved in condition, having fallen off much before 'by their great fatigues and privations. They had previ- 'ously been fed on the usual forage of straw, &c. &c.; but 'always uncertain as to quantity, and often without any. 'Rest, I think, must have greatly assisted in getting them into 'condition, while feeding on whins.—At the time of the year 'when forage is scarce on the frontiers both of France and Spain, 'the natives feed their horses and mules on whins; and in 'every house a trough with a heavy mallet is found, for 'preparing it. It is the green shoot of the whin that is cut, 'may be about a foot in length, or more, and placed in this 'trough (which is generally the bottom of a tree scooped 'out, and of very hard substance), and then beaten with of much improvement. Two attempts at this have fallen under my own observation; the one, an apparatus for this purpose, attached to a thrashing-mill; the other, a bruising-mill, to be driven by the hand; but, in both instances, the attempt has been unsuccessful; and the operation was found to be very imperfectly performed by either instrument. I therefore adhere to the plan of a bark-mill, originally adopted, only having substituted, in place of the old millstone, a stone of much greater weight and thickness, which is still drawn with perfect ease by the

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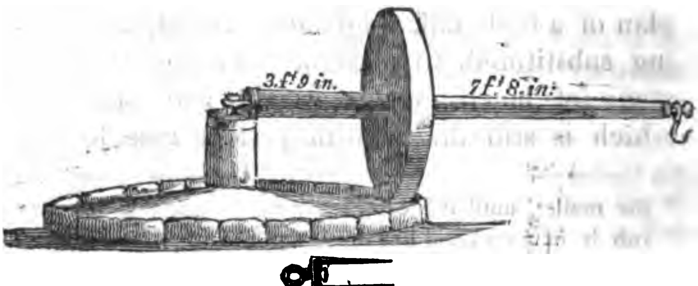
'the mallet, until it is completely mashed, so that you may 'rub it in your hand like bran, and the prickly heads quite 'pounded away. It is a very laborious employment, which 'our grooms were heartily sick of.—Feeding on whins, it 'is said, will give the horses worms or botts: Be that as it 'may, almost every one of the regiment were so affected; 'but whether from the whins, or from former bad food, and 'privations, which make animals eat any thing they can 'pick up, is hard to say;—the latter is my opinion;—and 'I consider the whins, when given mixed up with corn, or 'straw and hay, to be good food, and such as ought to 'make them do their work. On the army advancing to 'Bayonne, the animals did their work well.'

Should any such idea exist, that whins are an unwholesome food, I can add to the judicious opinion expressed by the writer of the above letter, a very satisfactory testimony. During the last five years, it has been my uncommon good fortune never to have had a sick horse in my stable. I do not infer from this, that whin-feeding affords an antidote to all diseases; but it is at least proof that it predisposes to none.

mule. The diameter of this stone is four feet two inches, and its thickness, which is uniform throughout, is 17 inches.

I annex a slight sketch, which I think sufficient to enable any farmer to erect a similar apparatus; the total expense of which, can hardly, in any situation, exceed 6*l.*;—mine did not exceed 5*l.*



Swivel for the lying Shaft.

Other modes of feeding. Having stated that it is only for a part of the year, viz. from the beginning of November to the month of March, that I practise this method of feeding working stock; it may be proper that I give some further account of the manner in which their feeding is conducted during the rest of the year, and that in the order in which it is pursued.

Swedish Turnip. The whins are succeeded by Swedish turnip, as the principal constituent of the daily food. I have tried giving this food steamed, and mixed with chaff; but I am not sensible of any advantage which attends this practice. Steaming or boiling Swedish turnip appears to be attended with an effect directly opposite to that produced by steaming or boiling potatoes. These lose their moisture by condiment, that of the turnips is apparently increased by it; but I look upon Swedish turnip given raw, to be one of the most useful articles in the food of working stock, and affording a cheap substitute for much of the hay and corn usually consumed for this purpose.

The quantity of this root consumed by a feeding ox is very considerable. A bullock, which will feed to 40 or 45 stones Dutch, will consume 1¼ cwt. per day. A work-horse, with a moderate allowance of corn, and with either straw, or a small allowance of hay, will not be found to consume more than about 30 or 35 lib. Now the bullock will, on the above feed, gain nearly at the rate of 1½ lib. beef per day; which makes the value of a hundred weight of Swedish turnip the same as a pound of beef, say 6d. Taking this as the value of Swedish turnip, the expense of feeding 8 horses would be as under.

Estimate of Expense of feeding with Swedish Turnip.

2½ cwt. Swedish turnip - -	L.0	1	3
50 lib. oats - - - -	0	5	0
Straw as before - - -	0	2	0
Or nearly 1s. ½d. per horse	L.0	8	3

The increased allowance of oats I conceive to be indispensable; because, from the hard nature of the Swedish turnip, a horse has not time to consume a sufficient quantity to make up for the want of corn. The turnips ought always to be well washed and sliced. Were they given whole, a horse would not eat more than 15 or 16 lib. in the whole night.

This feeding I continue as long as the Swedish turnip lasts; which is generally to the very end of May, sometimes longer.*

Potatoe Feeding.

When the Swedish turnips are finished, potatoe feeding commences. The potatoes are invariably given steamed. The means used for this purpose are now so universally known, that any description would here be unnecessary.†

Expense of Potatoe Feeding.

The quantity of potatoes given to each horse, is 32 lib. avoirdupois per diem; and the expense of this mode of feeding may be given as under.

The provincial boll, to which I have before alluded, weighs 42 stones Dutch, or 45 stones 15 lib. avoirdupois. When potatoes are at 10s. per

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* The Swedish turnips are kept in the usual manner; being drawn in winter, they are deposited in long rows, between two sheep flakes, supported so as to hang outwards. The turnips are drawn to a ridge at top above the flakes, and slightly covered with drawn straw.

The whole produce of 15 acres of Globe, Yellow, and Swedish turnip, crop 1816, were stored in this manner.

† The particular apparatus, which I have used for 10 years, and believe to be as simple, cheap, and efficacious, for a farm of moderate extent, as any I have seen, has been described in a Communication to the Farmer's Magazine, No. XLIII. for August 1810.

boll, the price per stone, of 16 lib. avoirdupois, is, to a very minute fraction, 2¾d.

16 stone avoirdupois potatoes, at the above rate - - -	L.0	3	8
Steaming - - - - - -	0	0	8
25 lib. oats, as before - -	0	2	6
8 stones straw - - -	0	2	0
Or 1s. 1¼d. per horse	L.0	8	10

Comparison between Potatoes and Swedish Turnip.

The above allowance of corn given with the potatoes, is more than equal to the double allowance given with the Swedish turnip; for, however valuable the latter root may be, it bears no proportion to potatoes in the quantity of nutriment which it contains. It is not necessary to resort to chemical analysis to ascertain the amount of this difference. The experience of feeding cattle will give a more accurate estimate of it than any analysis could furnish. A bullock of a good age, and moderately advanced in condition, will give three stones of beef for every ton of potatoes. Comparing this with the statement before given, of feeding on Swedish turnip, we ascertain that 46⅔ lib. weight of potatoes contains as much nourishment as 112 lib. Swedish turnip. Hence it may be very safely alleged, that 32 lib. weight of potatoes, with 3 lib. 4 oz. oats, is a more nutritious feed for a horse than 6 lib. 4 oz. of oats, and any quantity of

Swedish turnip along with it which a horse in regular work has time to eat.

Mr Curwen's Experiments.

Mr Curwen, M. P. for Carlisle, to whom the world is indebted for much valuable precept, and still more valuable example, in the department of rural economy, has given a detailed account of his experiments on feeding working stock with steamed potatoes; an account which first directed my attention to this most important branch of farm management. The object of his experiments avowedly was, to substitute potatoes for hay, rather than for corn; and he has even denounced, against any attempt to supply the use of corn by potatoes, the penalty of certain failure. I have, however, not been deterred from making this attempt. Nor do I think that failure was to be anticipated. There was, in my opinion, good ground to infer, from a consideration of the relative qualities of the two vegetables, that potatoes might, in a great degree, be advantageously substituted for oats. A working horse, if fed on potatoes alone, will consume about 42 lib. per day. Now, 42 lib. weight of potatoes will yield 12 lib. 7 oz. of dry weight or flour. A Winchester peck of oats, the largest allowance a farmer would think of giving to a horse, supposing him to have nothing but oats and straw, weighs (of good oats) about 10 lib., which will yield about 5 lib. 13 oz. meal. Now, it is no unreasonable presumption, that 12 lib. 7 oz. of potatoe flour (which would yield 6¼ lib. of starch) con-

Comparison between Potatoes and Oats.

tains at least an equal, if not a considerably greater quantity of nourishment than 5 lib. 13 oz. of oatmeal. But a farm horse working 9 hours a day, (and often ten hours during the turnip season), has not time to eat 42 lib. weight of potatoes with a proper quantity of straw. It is therefore advisable to give only 32 lib. weight of potatoes, and to substitute a small proportion of oats between yokings. Mr Curwen's practice is to give 21 lib. of potatoes and 8 lib. of oats. It appears to me, that he has thus stopt short of the full measure of advantage which was to be derived from a practice, of which he has so well illustrated the importance.

Clover and Tares.

From the time that the potatoes are done, which always last till the middle of July, often till the 1st of August, the horses are kept on the usual feed of clover and tares. I have sometimes given green buck wheat; but prefer either of the others. Along with the clover, &c. the horses generally get a feed of 3 lib. 2 oz. oats; and this mode of feeding continues till the commencement of the whin feeding. Of such land as mine, a horse will consume, during that time, the produce of about half an acre, which may be estimated at about 3*l.* 10s., or a trifle more than 8d. per day; which, with the oats as before, valued at 3¼d., is 11¼d. per day.

Expense of.

Estimate of Annual Expense.

I now conclude this account, by an estimate of the annual expense of feeding working horses according to the plan which I have detailed.

From 1st November to 1st February, at 4¾d. per day—(Whins) -	£.1	16	5
From 1st February to 15th March, at 8d. ditto - - - - -	1	8	8
From 15th March to 15th May, at 1s. 1½d.—(Swedish Turnip) -	3	2	6
From 15th May to 20th July—(Potatoe feeding)—at 1s. 1¼d. - -	3	12	10½
From 20th July to 1st November—(Clover, Tares, &c.)—at 11¾d. -	5	0	10¼
Expense of feeding 1 horse *p.ann.*	£.15	1	3½

According to this method of feeding work-horses, a saving is obtained of at least half the usual expense, calculated to be incurred in this department of farm-management, in the more improved districts of the country. I should take little credit for this saving, if obtained, as it often is by such an abridgement of the labour required from horses, as is supposed to compensate for the poverty of their fare; * a mode of management which, fairly considered, will be found more expensive than the highest and most extravagant feeding that can be given by the farmer. From the horses fed as I have described, a quan-

* In many parts of the Highlands, this is carried to so great a length, that the crowd of small and wretched animals employed on a farm do not work three months out of the twelve—the remaining nine being allowed them, for gleaning, among rocks and mosses, their scanty subsistence.

tity of labour is obtained equal to the work of any farm horses in the kingdom; † while, at the same time, their condition evinces that their food is fully adequate to the labour they have to perform.

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† The practice of my farm, in this respect, is the same which generally prevails in Berwickshire—2 yokings of 4½ hours each, while the length of day permits it; lengthened, in all press of work, at seed-time, turnip-sowing, or harvest, to 5 hours—and, during the short day, from day-break to nightfall, allowing a short halt at mid-day. The distance from which lime and coals are driven, is eight miles; and when at this work, the horses go twice a day—an exertion which no horses could make for any great length of time, and which only horses in the best condition could do at all. Each single horse takes a load of 15 cwt. of coals; thus carrying 1½ ton per day. At this work, an extra feed morning and evening is given in their mouth bags, and ate while loading.

1st March, 1817.

The foregoing Essay having been returned to me, for the purpose of preparing it for the press, I am enabled to add to it the experience of another season, but differing in no respect from that of the preceding year. The same mode of feeding has been regularly practised throughout this winter, and has been attended in every respect with the same satisfactory results.

FIORIN GRASS,

(*Agrostis Stolonifera.*)

The attention of the public having been called to the cultivation of this grass, which was stated to be very productive, while it was at the same time found to be nutritious as food for horses and live stock, the Highland Society, desirous of ascertaining the degree of success which promised to attend its introduction, and the proper mode of cultivation, offered Premiums for the greatest quantity of Fiorin, raised in Scotland, upon an extent not less than two Scots acres. The Society required from competitors, an accurate description of the manner the experiment had been made, and upon what kind of soil.

The Premiums having been advertised for several years, came to be decided in January 1816. Among the competitors were General Sir James Stewart of Coltness, Norman Lockhart Esq. of Carnwath, Mr John Baird, Manager of the Shotts

Iron Works, and Mrs Trotter of Castlelaw; all of whom communicated the result of their experiments to the Society,—which were, upon the whole, very favourable. Sir James Stewart had cultivated the Fiorin upon the most extensive scale; but Mr Baird and Mrs Trotter having raised the greatest weight upon the extent of ground required by the Society's advertisement, the premiums were awarded to them.

The certified statement in favour of Mr Baird bears, 'That the ground chosen by him for the 'raising of this plant, was nearly four acres in 'extent; of which 2 acres and 21 falls were a 'good black moss soil, and the remainder earthy 'land, upon a bank too steep to be worked by 'the plough; delved and levelled, not ridged, 'but having a furrow at every 24 feet; manured 'with coal ashes from the workmen's houses, 'at the rate of about 50 single-horse carts per 'acre.

'From the aforesaid ground, managed as above 'described, the produce of Fiorin grass has been 'this year (1815, which is its second crop on the 'moss, and the third on the earthy land) in 'weight and quantity as follows, viz. On the 'moss at the rate of 3029 stones Tron weight, 'or 29 tons 15 cwt. 3½ lib. per acre; and, on the 'earthy land, by the attestation of General Sir 'James Stewart, and of Robert Russel and Wil-'liam Stark, who cut it, a still heavier crop; 'which is now cut, but has not been weighed on 'account of the snow. The above ground was 'measured and attested by James Morton, land-'surveyor at Shotts Works; and the green Fiorin 'grass weighed by Robert Russel, Gavin Russel, 'and William Stark, according to their attesta-'tions, taken by James Stewart Esq. of Carphin, 'Justice of Peace: All which is hereby certi-'fied by Colonel George Callander and the Mi-'nister of the parish.

'GEO. CALLANDER.
'ARCH. LIVINGSTON, *Min.*'

Mrs Trotter's statement is contained in a letter from that lady addressed to the Secretary, and merits being given at length. It is as follows.

'SIR, *Bush, Dec.* 15*th*, 1815.

'As a competitor for the premium offered by 'the Highland Society for the best Fiorin Grass, 'I have the honour of enclosing, for the consi-'deration of the Members of the Society, a cer-'tificate of the quantity raised on my son's pro-'perty at Bush; and, in compliance with their 'desire, that a minute report of the manner in 'which the experiment was made might be al-'so given, I beg leave, for their information, to 'subjoin the following particulars, of the me-'thod we have adopted in the cultivation of this 'grass.

'In October 1812, we planted about one acre 'and a half after fallow; the plants were gathered partly from the fields in general, and some from the water; but we have found the land plants succeed best. The plants being laid on the ground, were covered only with the moss taken out of the furrows, thrown over them with a spade, and rolled the spring following. In the summer, the grass was twice weeded, which occasioned a very considerable expense; and the grass was materially hurt by the second weeding, as it loosened the strings of the Fiorin, which would otherwise have taken root, and have covered the ground with plants more speedily. The first crop was cut in October 1813, but was not more than 300 stones per acre. In spring 1814, a part of this grass or land was top-dressed with horse and cow-dung, and the rest with ashes from the moss. It was cut in the autumn of the same year; when the part top-dressed with dung yielded hardly any grass, but that with the ashes was a very abundant crop.

'This year, 1815, it has received no manure; the grass is very equally good over the whole, and the weight is as certified. It was from this grass the experiment was made.

'At Whitsunday 1814, we planted another acre and half in the same field after fallow, with strings of the oldest Fiorin. A piece having been left uncut to supply plants, we covered these with a compost of lime and moss;

'we considered these plants to make much more 'rapid progress than the first planted; and the 'crop cut in autumn 1814, only six months af'ter being planted, was better than that planted 'in 1812, though not cut for a year. We did 'not weed this grass of any thing but thistles 'and dockens; and the land is this year quite 'as clear as the other. It has received no 'manure since being laid down in Fiorin; and 'the crop this second year has been most abun'dant, as certified.

'Whether this acre and a half succeeding 'better than the first, is owing to the compost 'of lime covering the strings instead of only 'moss; or to the land not being so entirely moss, 'but in some degree mixed with a loamy soil, I 'am not a judge.

'In autumn 1814, we again planted about an 'acre and a half in the same field after fallow.— 'The plants or strings were again cut from the 'oldest Fiorin, and covered with ashes from the 'moss. This land is quite peat-moss. The quan'tity cut from this part, being the first year's 'crop, was 641 stones Tron, in October 1815: 'But we do not consider this to be so good a 'crop as that part was the first season, which was 'planted only at Whitsunday, and covered with 'the same compost; nor is the ground so well 'covered with plants as that was the first year.

'In autumn 1815, we have planted in the same 'field, the land having been previously trench-

'ed, pared and burnt, about an acre and a quar-'ter. The plants were mostly gathered from the 'uncultivated part of the moss in this field, and 'covered with the ashes made on the land. This 'new planting is looking remarkably well for the 'time it has had, perhaps better than any of the 'rest did at the same age. I hope the above ac-'count will be in some degree satisfactory to the 'Gentlemen Members of the Society. And I 'have the honour to be, &c.

'ANN TROTTER.'

Certificate by Sir George Clerk, Bart. M. P. John Inglis, Esq. J. P. and the Reverend Mr Torrence, Minister of Glencross, referred to in the preceding letter.

'*Bush*, *Dec.* 11, 1815.

'We, the undersigned, this day attended the 'cutting and weighing of 20 falls of Fiorin grass, 'on the property of John Trotter, Esq. of Castle-'law, the land being in his own immediate pos-'session. The grass was cut this day, which was 'perfectly fair; and the weather having been, for 'some time previous, hard frost, must have con-'siderably diminished its weight. It weighed '228 stones, Hay or Tron weight, 22 lib. to the 'stone, being at the rate of 1824 stones Tron 'per acre. Mrs Trotter has above four acres of 'Fiorin in this field; and we are of opinion, that 'this part, selected for the experiment, was a 'fair specimen, or rather below the average per 'acre. The soil is peat-moss, and has been ma-'nured with ashes from the moss.

'GEORGE CLERK.
'WILLIAM TORRENCE.
'JOHN INGLIS.'

From the above, and other experiments, the results of which have been communicated to the Highland Society; and from the correspondence of the original patron and champion of Fiorin, (Dr Richardson of Ireland), with some extensive proprietors deeply interested in the prosperity and improvement of the Highlands of Scotland, of which, with the sanction of the Doctor, the Highland Society has been possessed by Sir James Stewart, the Society has been induced to think that the cultivation of this plant might be introduced with advantage in many parts of the North and West Highlands. In this view, and in the hope that some of its public-spirited Members connected with that part of the country, may feel disposed to give the cultivation of Fiorin a fair trial in these extensive districts, where the want of a supply of provender for cattle in winter frequently proves so disastrous to the store farmer, the Society has recommended to the Editor to notice Dr Richardson's suggestions on this subject. Experiments might be made in the first instance, in different situations, on a small scale, and consequently at a moderate expense.

Dr Richardson recommends peaty and moory soils, as well adapted to Fiorin: And, as much of the wastes and unproductive tracts in the Highlands, are composed of these, this is an additional inducement for making the trial, and is at same time favourable to its success.

It appears to be fully ascertained, that bleak exposures and cold regions are peculiarly congenial to Fiorin, as it has been found to show itself spontaneously, and in more abundance in these, than in more favoured situations.

In describing mossy soils, Dr Richardson states, that these are to be found in a variety of gradations, 'from light, spungy, fibrous peat, 'until it terminates in pure earth; the interme-'diate shades being formed by a natural mixture 'of earth with peat, in proportions perpetually 'varying between the two extremes, and are ge-'nerally described by the term *Moor*.'—The Doctor prefers moory soil to either light, spungy peat, or pure earth.

Selection of a Mountain Meadow.

'In the selection of our site (says he), I pre-'fer the moor I have already described to the 'pure peat; though the latter would answer, 'should the former not easily be found. I wish 'our meadow to be in the confines of, or rather 'contiguous with, *dry*, *firm* mountain, as the 'resort of cattle about our meadow in the winter 'will be great; if soft, the ground would soon 'poach; and should the peaty soil of the mea-'dow itself be wet and spouty, it must be well 'dried by numerous shallow surface-drains.

Meadow must be enclosed.

'So soon as the ground shall be selected, 'and the size of our meadow determined, it 'must be effectually enclosed, for no beast must 'ever tread on the interior. In one part of the 'enclosure, on a side where the ground is dry, 'and separating the meadow from the mountain, 'the fence must be a stone and lime wall, 8 or '9 feet high, and of such length as shall be 'deemed sufficient, when its use is known: In 'this wall a door is to be left, and open sheds 'formed of the whole length, on *both* the inside 'and outside.

Sheds to be formed.

Kinds of Moory Soil most eligible.

'The best moory soil, I conceive to be that 'where there is a considerable admixture of 'earth, and at least 18 inches deep.

'Where the moory grounds are very wet, but, 'by a diversity of surface and declivities afford-'ing facilities of discharge to the water, by fre-'quent shallow drains, I consider the ground as 'very favourable; for here there is always a mix-'ture of alluvial matter, and the fibrous peat is 'decomposed, decayed, and converted into good 'soil.

'Where cattle have broken and abused the 'surface (soft from undischarged water), and 'thrown up little hillocks, this description is very 'favourable (where drainage is easy); for the feet 'of the cattle have destroyed the fibrous texture 'of the peat, converting it into a rich mud.'

If the soil is a dry peaty moor, of less than 15 inches deep, having but a small admixture of earth, and the peat but little decomposed, manuring with earthy composts, which may be easily had where the substratum approaches to clay, would improve it much for the production of Fiorin.

If such consolidated materials are not to be had with convenience, the ashes with which the ground is to be fertilized, must be given in greater abundance.

Of all descriptions, *cut out moss* is the most readily converted into Fiorin meadow, as much of the work is previously done by the turf-cutter.

Paring and burning are much recommended, and said to succeed well; yet Dr Richardson states, that he never adopted it. He says, 'We 'should in this practice be very sure we do not 'destroy a better soil to get at a worse; the 'very upper surface of all soils is formed by the 'decomposed vegetables that have long grown 'upon it, and their roots: This, for so much as it 'gives, is valuable; and in spungy flow-bogs, I 'always scrape together this thin coat of vege- 'table earth, before I burn the spunge below it. Preparation of the Soil.

'The destruction of this little valuable skin, 'is one objection to paring and burning; ano- 'ther is, that it manures but once; you must go 'elsewhere, when you require ashes for top- 'dressing.

'I was astonished to find the practice of burn-

'ing deep moory bogs into ashes, in heaps long 'lighted, so little practised in Scotland.' Although it affords a large quantity of ashes, ready to be applied either pure, or in composts, it costs little; and ashes are the very best manure for Fiorin.

'Though I condemn the process of paring 'and burning as a *general practice*, I approve it 'in particular cases as a cheap and effectual 'mode of *preparing* the ground for Fiorin; as, for 'instance, where the moor is *earthy*, and suffi- 'ciently deep; for then, should we destroy the 'surface, we find another at all depths, adapted 'to our purpose, and easily enriched by the 'ashes: In this case (earthy moor), I recommend 'a *very small quantity of well slaked lime*.

'As to the preparation of the moor (or indeed 'any ground) for a Fiorin crop, the water must 'first be discharged; and then it must be opened 'and loosened at least eight inches deep, raising 'the spade or plough, as the case requires: The 'surface is then to be brought to a tolerable 'level, and as many shallow superficial drains 'must be cut, as will preserve the meadow at all 'times in a sufficient state of dryness.

'Let the proprietor now consider what quan- 'tity of ashes * he can afford to his field; and let

* It would have been desirable to know the quantity of ashes Dr Richardson would recommend for an acre—the same with regard to lime, where the use of that substance is

'him spread one half of them on the surface; 'then mix these ashes with the upper part of the 'soil, four inches deep, by harrow or spade, or 'plough and harrow.

'The Fiorin stolones are to be scattered over 'the surface at random; the remainder of the 'ashes to be spread over them, pure or in com-'post; and, if not sufficient nearly to cover the 'surface, as many shovelfuls as are necessary are 'to be taken from the raw ground contiguous, 'where sufficiently loose and friable. Mode of laying down Fiorin.

'I formerly cut the stolones into portions, two 'and three inches long, but I now spread the 'strings whole: The former method may be use-'ful where stolones are scarce, but when abun-'dant it is unnecessary: It may be convenient, 'indeed, when the long strings are spread, to 'follow with a basket of cut strings, and to throw 'handfuls where deficiencies appear, and throw a 'little compost over them.

'The ground (especially the loose moor) will 'be consolidated by rotting; and the fibres from 'the joints of the strings will sooner root, and 'take a firmer hold.

'The more stolones you can afford, the better; 'but, if a plentiful supply is not within your 'reach, more surface manure will be required

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recommended. There is no doubt the Doctor will be ready to communicate his opinion on these points, and any others, to gentlemen who resolve to try the cultivation of Fiorin.

'to make the nascent stolones more numerous 'and more luxuriant, that they may clothe the 'ground sooner.

Season for Planting.

'Fiorin may be laid down in any month in 'the year; but, to give it the proper advantage 'over weeds and other grasses, it is proper to 'choose a season so late, that, when these spon-'taneous rivals vegetate, they will be so tender 'as not to bear the winter frost, and yet a sea-'son early enough to leave sufficient powers of 'vegetation to make the Fiorin take root, and 'be proof against the effects of frost.

'In rich ground, and a mild climate, I should 'say the middle of September, but, in bleaker 'regions, I recommend the very beginning.

'It is not expedient to propagate Fiorin by 'seed, like other grasses: The young tendril is 'slow of growth, diminutive and hair-like; nor 'does it come forward until the second year.'

Dr Richardson does not appear to recommend laying down Fiorin in the same year after potatoes, as the season is rather too far advanced before they are removed; but, if the operation should be delayed until April, then break the ground again as you lay down, refreshing the surface with ashes and compost.

Composts necessary.

'I have (says the Doctor) often mentioned 'Composts: they are useful when you lay down 'to cover the strings; and essentially necessary 'for future top-dressing:—But where are you to 'get them?

'The moory soil itself, when earthy, is an 'excellent basis; mixed with abundance of ashes 'and a little lime, it will be fit for use almost on 'the instant. Lime is congenial to Fiorin; but 'I beg to be understood, whenever I mention it, 'I mean the very smallest quantities;—even so, 'it is never to be considered as absolutely ne-'cessary.

'Where the soil is pure peat, strengthen it 'with consolidating material, as stiff clay: This 'should be mixed with lime, and turned, to 'make the stuff friable, before it be mixed with 'the peat soil, which is to complete the com-'post, with abundance of ashes.

'After the Fiorin is laid down, and vegeta- Weeding. 'tion commences, it is of great importance to 'weed out all prominent rivals to it, that it may 'obtain exclusive possession of the field, more 'especially the first year.'

Dr Richardson recommends to 'commence Mowing. 'mowing the Fiorin crop about the 1st of Oc-'tober, and not sooner;—say a third or fourth 'part of the field. This is to be made into hay 'that will stand through the winter. For this 'purpose, after the grass cut is sufficiently dried, 'it is to be made up in trampcocks, about 1500 'or 1800 pounds weight each.

'The larger portion of the crop is to be left 'standing, and is to be cut occasionally through 'the winter and spring, on dry days; never 'giving it to the cattle until four or five days 'cut; and then it may either stand for weeks 'without injury, or be given to them at any in-'terval after the first three or four days.

'The green food for the cattle is to be ma-'naged thus:—When cut, it is to be opened 'out and dried; then in an hour, wet or dry, 'rolled up in spherical lapcocks about 15 pounds 'each. When these have stood four days, and 'we find them tolerably dry, we carry as many 'of them as will serve to feed the stock for three 'or four days, into the interior shed, to which 'cattle have not access; and we lay them on a 'stage of sticks, or hurdles, accessible to the air 'on all sides, but protected from rain. From 'this shed, and not from the field, we carry the 'provision for the cattle, through the door, to 'the exterior shed, to which they have access 'from the mountain: In this shed they are fed, 'and have at all times protection from the wea-'ther, with free ingress and egress.

'Although it is necessary to have trampcocks 'of dry hay in the field, as a resource in the e-'vent of the severity of the weather, or snow 'preventing access to the standing crop; yet it 'is more advantageous to feed the cattle on 'green food, because its quantity is greatly in-'creased by the growth of Fiorin stolones through 'October and November; because none of the 'juices are lost by evaporation; and because the 'trouble and expense of saving, stacking or stor-'ing, is thereby avoided.

'In order that the green food may be given 'to the cattle in a state sufficiently dry, the grass 'should be removed in small quantities from the 'meadow to the interior shed, thence to the ex-'terior, where it is consumed. Were the grass 'to be accumulated in the inner or outer shed, 'it would become fusty.'

Dr Richardson recommends occasional top-dressings, in order to render the crops of Fiorin more luxuriant, and continue these crops for a series of years. It appears fully ascertained, that ashes, where these can be had or produced in sufficient quantity, are the best manure, whether used in the original preparation of the field, or in top-dressings afterwards.

There has been recently published, 'A Letter 'on the Improvement of Grassy Mountains, de-'tailing the measures by which they may be 'made to maintain, through winter, the whole 'stock that grazed upon them in summer,'—by Dr Richardson, who, from two experiments in 1815 and 1816, has come to the conclusion, that a valuable crop of Fiorin may be obtained, in those elevated situations where he had found it intermixed with other grasses, without breaking the surface, or performing any other operation than *surface-draining*, *weeding*, and *top-dressing*; by means of which, and late mowing, the 'natural mixed sole' could be converted into pure Fiorin meadow, of great value and permanent continuance.

The Highland Society will be happy to be favoured with a communication of the result of any experiments which may be made in the cultivation of Fiorin, more especially in the Highland and less improved districts of Scotland.

Since the above statement was prepared for the press, the following communications have been received from Alexander Young Esq. of Harburn, and Dr James Hamilton junior of Edinburgh, containing the result of some experiments made by them in the cultivation of Fiorin;—the former on his estate in the county of Mid-Lothian; the latter on his property in the parish of Calmonell, Ayrshire.

I. Mr Young's Experiments.

Copy Letter from Alexander Young *Esq., to a Friend and eminent Agriculturist, dated Harburn,* 19*th August,* 1815.

Some years ago, I was tempted to cultivate the *Agrostis stolonifera,* under directions from Dr Richardson, to whom I was enabled to show betwixt two and three acres of it in a very promising state, when he visited Scotland in spring 1812. I had planted this grass on tolerably good dry land, consuming the produce for two years as green food for horses and cattle. In its third year I mowed it for hay in the end of October. The produce was considerable; but it never dried properly; and I was not satisfied either with the crop or the appearance of the field, after its second year. I had been careful to keep it clean; but did not encourage the growth by top-dressings, or any kind of manure; and I should have abandoned all attempts at cultivating this grass, if Dr Richardson had not persuaded me to make a trial of raising it on a piece of very indifferent land, of nearly twenty acres, which he selected himself; the upper part, exceeding twelve acres, being a dry heathy moor; the under part, six and a half acres, of very indifferent moss, literally not worth a shilling yearly per acre.

I began paring and burning the upper part of this field in the common way; but the ashes produced by the operation were by no means abundant, and the lower or mossy part of the field I found could not be treated in the same way with any advantage. Resolving to confine my Fiorin plantation to the lower part, I got the whole very carefully trenched a full spade deep, with a proper inclination towards a large drain; and for the purpose of covering the surface, I cut down a small knoll of clayey ground in the immediate neighbourhood, which I mixed with ashes from the upper part of the field, and 78 bolls of unslacked lime, spreading the whole on the surface of the trenched moss about an inch thick; upon which, in spring and summer 1814, I planted the Fiorin grass in the usual way; and it was rolled, and occasionally weeded, in the course of the summer.

In the beginning of November last, I began to cut the crop of grass, and gave it in abundance to my cattle and horses, to whom it afforded a liberal supply of green food to the end of February last, with a few short interruptions from frost and snow. I cannot tell you what quantity of grass was produced on each acre; but I can assert with confidence, that it was at least equal to a heavy crop of clover and rye-grass.

In the beginning of July last, the crop of Fiorin on the above 6½ acres had again become so luxuriant, that I was induced, contrary to all the instructions of my preceptor Dr Richardson, to mow it for a crop of hay, at the same time with the ordinary clover and ryegrass crops of the country; and it has been treated exactly in the same way, producing hay, as I think, of a superior quality, perfectly dry; the same apparent *bulk* of Fiorin hay, when weighed against clover and ryegrass hay, in perfect good order, being uniformly somewhat less in weight.

Of my whole field, nearly 6½ acres, I only made four acres into hay; using the remainder, as I am now doing, for green food. The produce of these *four* acres, before it was put up in a stack, was carefully weighed by John Gay, tenant in Broadshaw, an intelligent farmer, who attests its weight to be 1820 stones, or 455 stones per acre. The whole operations on the field being performed at his sight, I was desirous that he should also weigh the produce, and see the stack put up, as he was formerly, when my overseer, a great unbeliever in the virtues of this grass; though the success of my experiment, I believe, has now converted him to the Fiorin faith.

I paid for trenching the 6½ acres, with some small drains - - - -	£40	0	0
For 78 bolls of lime, and leading, at 3s. 5d. per boll - - - -	11	6	6
For 52 cart loads of ashes, taken from the upper part of the field, valued at 1s. per load - - -	2	12	0
For mixing and laying on the compound - - - - - -	11	1	6
For leading, planting and rolling the grass, and weeding - - -	7	16	0
Total expense - -	£72	16	0

being at the rate of 11*l*. 4s. per acre.

The expense of trenching was considerably more than it ought to have been; but it was done deliberately, and with particular care and attention.

I intended originally to have given much more lime, but I was persuaded by a gentleman, more skilled in such matters than I pretend to be, that the above quantity, with the ashes and clay, was quite sufficient.

The first cutting of the grass last winter, and the beginning of spring, may be moderately estimated at 6*l.* per acre; in whole	£39	0	0
The second cutting of 2½ acres, at the same rate, amounts to -	15	0	0
And 1820 stones of hay, on the remaining four acres, at only 5d. per stone, is - - - - -	38	8	4
	£92	8	4

subject to the ordinary expense of cutting, winning, and leading home the produce; and I can assure you, that there is no difficulty whatever in mowing this grass with a scythe.

Thus, it is clearly demonstrated, that the first year's crop will do more than defray the expense; and, if a perpetual meadow has been thereby created, it cannot be denied that this grass possesses extraordinary virtues, and may be cultivated with advantage on the worst soils. Indeed, I have no doubt, from the present appearance of the field since the hay was taken off, that, by the end of October next, I may begin to cut a third crop of grass from it, not much inferior to those which have already been taken.

Edinburgh, 26. *April*, 1817.

Last year (1816) Mr Young had upon the field above described, without top-dressing or manure of any kind, a crop of Fiorin equal to that of the preceding year; and he has no reason to think that it will fall off (on the contrary rather apprehends it will improve) in the present year, because he has bestowed upon it, this spring, a very sufficient top-dressing with ashes of burnt clay.

Encouraged by the success of his experiment in the cultivation of Fiorin upon moss, Mr Young has taken in 14 acres of the moss adjoining to his first improved field, making 20 acres in whole. The means which he adopted were similar to those above described, with the difference of his having used burnt clay principally, as the manure or top-dressing on planting the Fiorin strings, which operation is now performing; and if it is attended with the same success as his first essay, Mr Young proposes in due time to give a detailed account of the expense, management and produce of the whole 20 acres.

It will be necessary, however, in estimating the value of a crop of Fiorin hay, to advert to the difference of weight by which hay is bought and sold in this country, which varies so considerably, that, in Galloway, for instance, the stone of hay, on one side of the river Urr, is 24 lib., and no less than 28 lib. on the other side. By calculating Mr Young's produce of 455 stones of good dry hay per acre, according to the weight used in Ireland, it was held to be inconsiderable, and much less than was common in that country; but, on inquiry, the Irish stone of hay appears to fall much short of the Scotch, or at least of the Edinburgh weight, by which Mr Young's produce was calculated. A stone of hay, as weighed at Edinburgh, he considers to be 22 lib., each lib. 22 ounces, being rather more than 30 lib. avoirdupois; by which rate, each acre of Mr Young's Fiorin produced, of good, dry, marketable hay, 6 tons, and very nearly 3 cwt.

Dr Richardson blames Mr Young for mowing his crop in summer, instead of waiting till the end of autumn, when a much heavier crop would have been procured; and, without doubt, the growth of this grass is greatest during the autumnal months; nor does it experience any material check to its vegetation by the early frosts of winter. It is not, however, so common a plant as is imagined; the Fiorin cultivated by many, being the *Agrostis Vulgaris*, which has not the properties of the *Stolonifera;* and it seems doubtful if the latter is to be found in the south of England, at least in any considerable quantity.

II. Dr Hamilton's Experiments.

The farm of Drumlamfords was totally unenclosed, and literally in a state of nature, when its improvement was begun in 1813. Its height above the level of the sea had not been accurately ascertained, though there is reason to believe that it is rather under than above 400 feet. In the middle of the arable land of that farm, there is a lake covering about 48 acres, surrounded on all sides by gently rising grounds. On the north-west of the lake, at the foot of the knoll which bounds it, there was an expanse of brown clayey moss, of the extent of above 30 acres, which was so soft that it could not bear the weight of a horse, except during the driest seasons of the year. Through the middle of this moss, in the summer of 1814, a ditch 8 feet wide at top, 2½ feet wide at bottom, and 4 feet deep, was dug at the expense of 12*l.* 2s. 11d.

In the autumn of that year, 8 acres on the north-east side of this ditch were trenched, levelled, and divided into 18 feet ridges, at the expense of 4*l.* per acre. On the 15th November, some chopped Fiorin grass was strewed upon the trenched ground, and was covered with the ashes of burned peat; and this was continued from time to time, according to the convenience of the farm-servants, till the 30th of March, when all the eight acres were completely laid down. The Fiorin was furnished from a rood of ground, on which the overseer had been for two years permitted to cultivate that grass by way of experiment.

The quantity of peat-ashes was 150 carts per acre. The cost of those ashes, as far as could be calculated, was threepence per cart; and as they were produced from what was cast out of the ditch, the expense of spreading them was very trifling. A penny per cart, perhaps, was allowing too much.

In the month of June, the Fiorin was rolled, for which no charge is made in the journal. In August, two days of a labourer at 1s. 9d. are stated for weeding. The soiling of four horses and four oxen with this Fiorin was begun about the 1st of September, and was regularly continued till the 1st of January, 1815. Previous to this, a stack of hay was made from that grass, amounting, per estimate, to 300 stones; and this hay, which was highly odoriferous, was so much relished by two blood-horses, which came by chance to the farm, that these animals turned with disgust from ordinary hay, though of a good quality.

In Spring 1815, the overseer of the farm wrote, that there was no longer occasion for tares, as the Fiorin superseded their use. About the beginning of July, the four horses and four oxen were put upon that grass, and were continued upon it, by soiling, till the end of December.

The account, therefore, seems to stand thus.

One-third of the expense of the ditch - - - -	L.4 0 11
Carry over	L.4 0 11

Brought over	L.4 0 11
8 Acres trenched and levelled, at 4*l.* per acre - - -	32 0 0
150 carts of ashes per acre, at 4d. per cart - - -	20 0 0
Suppose the expenses of rolling, weeding, cutting, &c. to be -	3 19 1
	L. 60 0 0

PRODUCT.

Four horses and four oxen, soiled from beginning of September to end of December (1815), 16 weeks, at 4d. each per day	L. 14 18 8
300 stones of hay, at 6d. per stone	7 10 0
Four horses and four oxen, soiled from beginning of July to end of December (1816), 24 weeks, at 4d. per day each - -	22 8 0
	L. 44 16 8
Remains due - -	15 3 4
	L. 60 0 0

But supposing that the daily rate of soiling was at 6d. per head of horses and oxen, the account would stand thus,—

Expense,				£60	0	0
16 weeks soiling of 4 horses and 4 oxen, at 6d. each per day, - -	£22	8	0			
300 stones of hay, at 6d. per stone, - -	7	10	0			
24 weeks soiling of 4 horses and 4 oxen, at 6d. each per day, - -	33	12	0			
				63	10	0

The above 8 acres continue in so thriving a state as to render the sowing of tares this season quite unnecessary.

It may be proper to add, that the experiment was originally made by the proprietor, under the impression that it would fail. In consequence, however, of the result of crop 1815, he was induced to direct 16 acres of the remainder of the meadow to be laid down in the same manner last season. The ground was accordingly trenched and levelled, &c.; but the unfavourable state of the weather prevented the necessary supply of peat-ashes. Under those circumstances, about 2 acres were laid down with a lime compost, and, when examined on the 26th of October 1816, it appeared that the crop had almost totally failed.

23. St Andrew's Square, April 26, 1817.

REPORT

FROM THE

COMMITTEE OF THE HIGHLAND SOCIETY,

APPOINTED TO EXAMINE THE

BEADS FOR ASCERTAINING THE SPECIFIC GRAVITY OF LIQUIDS, INVENTED BY MRS LOVI, AND THE APPLICATION OF THEM TO DISCOVER THE RICHNESS OF MILK.

Prepared by DR HOPE, Professor of Chemistry in the University of Edinburgh, at the request of the Committee, and approved by the Society.

1*mo*, THAT though the strength and value of many liquors consumed by man, or employed in the arts, are determined, with greater accuracy and facility, by ascertaining their specific gravity, than in any other way, this method is by no means generally adopted.

2do, That even when this method is adopted, a different mode of expression, in truth a different language, is employed, in regard to almost every different article.

3tio, That it would be of decided advantage for many of the arts, and of great convenience to all, were the practice of taking the specific gravities, and expressing them uniformly and simply, more generally introduced.

4to, That the patent Aerometric Beads, presented to the Society by Mrs Lovi, appear to be constructed upon sound principles, and with much accuracy; and afford, perhaps, the most simple, easy, and expeditious mode of ascertaining and denoting the specific gravity of liquids, with the advantage of being fit for exploring this character of fluids, whether mild or corrosive, whether cold or at a boiling heat.

5to, That actual experience has already shown the advantage of using them in some of the arts, and that a general use of them might prove of real benefit to many others; for instance, to the brewer, the distiller, spirit-dealer, trading and scientific chemist, apothecary, soap-maker, glass-maker, and to every one dealing in, or employing barilla and kelp, &c. &c.

6to, That they may be introduced into the dairy with a reasonable prospect of practical utility.

As the inventor has laid this contrivance of the improved Aerometric Beads before the Society, on account of their application to this branch of rural affairs, the Committee will explain more particularly their sentiments in regard to the manner in which they may be of service; being persuaded that it must be at all times a matter of considerable importance to be able to discover, with little trouble and with tolerable precision, the comparative richness of milk of different cows, and its aptitude to furnish butter or cheese, by which the value of milch cows, for the manufacture either of butter or of cheese, may be estimated.

Were milk a liquor, the value of which, as of many other fluids, is indicated by its specific gravity, the application of the beads would be simple, and their testimony immediate. This, however, is not the case. Milk is a compound fluid, consisting in a great measure of water, and owing its valuable qualities principally to the curd and butter which it contains. The richest milk abounds in oil and curd, and the poorest in water. As the oil is lighter than water, and the curd heavier, the quantity of these ingredients is not indicated by the specific gravity; for were these substances in milk in certain proportions, they would not affect the specific gravity of the fluid, however large the quantity of them might be, the one counteracting the other.

Milk possesses a specific gravity greater than that of water, which it derives in part from the saccharo-saline matters belonging to the whey, and in part from the curd; and it approaches more nearly the specific gravity of water, the greater the quantity of water it has, or the greater the proportion of cream. Hence, a low specific gravity indicates either much richness or great poverty; and consequently, the gravity of this fluid is not an immediate indication of its quality. The information given by the beads will, however, be valuable, if the specific gravity be examined after the cream is removed, as well as before.

When milk is tried as soon as it cools, say to 60°, and again, after it has been thoroughly skimmed, it will be found that the skimmed milk is of considerably greater gravity; and as this increase depends upon the separation of the lighter cream, the amount of the increase, or the difference between the specific gravity of the fresh and skimmed milk, will bear proportion to, and may be employed as a measure of, the relative quantities of the oily matter or butter contained in different milks. In this manner, therefore, by discovering by these beads the difference in the specific gravity of milk when new, and after being skimmed, the relative values of this liquor, for giving butter, may be certainly and easily determined.

The Committee conceive, that it would be of much importance to ascertain, by carefully conducted experiments, the exact quantity of butter furnished by a given measure of milk of different degrees of richness, the specific gravities of which have been examined before and after the separation of the cream. By such experiments, the quantity of butter corresponding to each degree of change in the specific gravity may be determined; and then the Aerometric Beads will serve to indicate, not only the relative qualities of different milks, for the purpose of butter-making, but also the actual quantity of butter that any given quantity of milk ought to afford.

That such information may prove of consequence in regulating the business of the dairy, is too obvious to require illustration.

The specific gravity of skimmed milk depends, both on the quantity of the saccharo-saline matters, and of the curd. To estimate the relative quantities of curd, ~~and by that~~ determine the value of milk, for the purpose of yielding cheese, it is only required to curdle the skim-milk, and ascertain the specific gravity of the whey. The whey will, of course, be found of lower specific gravity than the skimmed milk; and the number of degrees of difference affords a measure of the relative quantities of curd.

By a proper series of experiments, the quantity of cheese equivalent to each degree of the diminution of gravity in a given measure of this fluid, might be determined.

Hence it appears to your Committee, that the Aerometric Beads may be employed to explore the quality of milk, in relation both to the manufacture of butter and cheese; and your

Committee beg leave to direct the attention of the Society to this subject.

7mo, Upon the whole, your Committee are of opinion, that the improved Aerometric Beads of Mrs Lovi are a valuable instrument, deserving the countenance of the Society; and as Mrs Lovi has made this improvement at the expense of a great deal of time and labour, they are further of opinion, that the liberality of the Society would with propriety be extended to her. †

Edinburgh, June 1816.

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† The Highland Society voted a premium to Mrs Lovi, as suggested in the Report.

*** An Account of an Instrument called a Grubber, was given in the last Volume of these Transactions. Since that Volume was published, a new construction of the Grubber has been submitted to the Society, which is now under examination; and of which, if it shall ultimately be found to be an essential improvement, as is expected, an account will be given in an early Number.

END OF PART I. VOLUME V.

Printed by David Willison,
Edinburgh, 1817.

PART SECOND OF VOLUME V.

OF THE

TRANSACTIONS OF THE HIGHLAND SOCIETY OF SCOTLAND,

CONTAINING, BESIDES OTHER IMPORTANT ARTICLES,

AN

ESSAY

ON

WOODS AND PLANTATIONS,

INCLUDING

AN ABSTRACT OF THE INFORMATION
CONTAINED IN THE COUNTY REPORTS, ETC. ETC.
WITH NOTES AND REFERENCES.

DRAWN UP
AT THE DESIRE OF THE DIRECTORS OF THE SOCIETY,

By the Reverend G. J. HAMILTON,
MINISTER OF ASHKIRK, HONORARY MEMBER OF THE BATH SOCIETY,
AND OF THE LIT. AND PHIL. SOC. OF MANCHESTER, ETC.

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AN ESSAY

ON

WOODS AND PLANTATIONS.

PRELIMINARY OBSERVATIONS.

In the year 1809, the Highland Society of Scotland, with the patriotic view of obtaining information relative to a great national object, announced the following premium—

'A piece of Plate, of Fifteen Guineas value, 'will be given for the best and approved Essay 'or Communication on the best practical Mode 'of Planting and Management of Woods, viz. 'the Proper Time of Thinning Fir Plantations, 'and those of other Timber; the Proper Time 'and Mode of cutting Oak Coppice-wood, the 'Management of its Bark, and cheapest and 'best Mode of Charring all Species of Wood.'

Prompted by the repeated encouragement of the Highland Society, the author was induced to turn his particular attention to this important branch of rural economy; and accordingly transmitted an 'Essay on Woods and Plantations,' which was honoured with their approbation.

In the prosecution of the subject, the author was induced to look into various agricultural publications, from which useful information might be obtained; and, where general inferences or conclusions were drawn, to adduce the particular authorities. The Directors, in consequence of the above, observing that the information as to the best modes of planting, and the management of natural woods and plantations, was scattered through a great variety of expensive publications, did him the honour of applying to him, through the medium of their Secretary, 'to make a proper selection of everything valuable which had 'been hitherto published upon these subjects, 'classed under proper heads, with minute references, with the view of publication in the IVth 'Volume of the Society's Transactions.'

To this application he did not think himself at liberty to withhold his consent; and accordingly, to the extent of his judgment, endeavoured to collect and condense the widely scattered and best authenticated facts connected with this important investigation, agreeably to the views of the Society; omitting nothing that appeared essential, and uniformly rejecting, however plausible, the untried theories of sanguine speculation, and whatever might have a tendency to mislead the inexperienced, or be inconsistent with the established principles of rural or political economy.

In regard to arrangement, the author adopted that plan which seemed to proceed from the nature of the subject, without any regard to what had been done by others; and, though the undertaking was attended with considerable difficulties, from the numerous involved and contradictory statements of those who had written on the subject, and the uncertainty of knowing exactly what was expected of him; his great object was to present, in as narrow a compass as possible, a complete and connected Abstract on the General Management of Woods and Plantations.

It may be proper to add, for the information of the public, that this Abstract was accordingly drawn up in the year 1811, and transmitted to the Highland Society for publication in their IVth Volume; but the MSS. having been put into the hands of a gentleman, first employed as editor, (with whom all the papers for the volume were lodged), were either lent or mislaid on his removal to the country, and but lately recovered; the writer, unfortunately, having preserved no copy.* Although, from this circumstance, part

* See Transactions of the Highland Society, Vol. IV. Contents, Note, page 8th.

of the information contained in the Abstract had been in some degree anticipated by other publications, still the Directors were desirous to have it published, after being revised by the author, and adapted to the present time.

Such is the origin of the Treatise on Woods and Plantations now presented to the public.

Manse of Ashkirk,
January, 1820.

CHAP. I.

OF THE GENERAL ADVANTAGES OF WOODS AND PLANTATIONS.

SECT. I.—*National Advantages.*

Of all the arts which employ the ingenuity of man, agriculture is not only the most ancient, but the most useful. Upon this, all other arts essentially depend; and men in every rank of society, from the highest to the lowest, are supported by its fruits. 'A well cultivated soil is 'more valuable than all the mines of Peru, and 'all the pearls in the ocean.'* The improvement of any country in those articles of produce which are of greatest consequence to its safety and accommodation, ought to be among the first objects of its provident care. In this view, the cultivation of timber for the construction of ships, to enable it to repel the invasion of foreign ene-

* See Robertson's Survey of Perthshire, 4to. p. 136.

mies, and maintain the dignified naval preeminence of our sea-girt island, is an object of primary importance. *

The alarming decrease of oak timber in this country is universally acknowledged and lamented; and it has become an important desideratum to every man who wishes for the preservation and independence of his country, that some active and efficient legislative measures should be immediately adopted, to avert the impending evils that must inevitably take place. †

France has, in her public forests, a source of revenue which is almost unknown in this country. Under the old government, these forests covered three millions of acres, and yielded annually a produce of half a million Sterling, wood

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* See Bath Papers, vol. 12, p. 194, &c.

† 'Having, by long experience,' says Mr Nichol, in a letter to the Earl of Chatham, 'obtained some knowledge of 'the timbered state of this country, necessary to support the 'shipping of our Navy and Commerce, he is convinced that 'the demand very much exceeds the growth; and if some effectual means are not immediately taken either to lessen the 'consumption of oak timber, or to increase its growth, he 'fears that the time is not far distant, when we shall be greatly distressed for the want of this useful article.' The same writer adds, that he 'has of late observed, with grief, a great 'diminution in the stock of growing timber, so much that he 'does not believe there is one-tenth part of the quantity there 'was twenty years ago.' See 'Methods for Decreasing the 'Consumption of Timber in the Navy.' By Thomas Nichol, Purveyor of the Navy for Portsmouth Dock Yard. Southampton, 1793.

being the principal fuel: but, since the Revolution, the annexation of emigrant and other property has increased their extent to five millions of acres, and their revenue to nearly three millions Sterling per annum. Above eight thousand persons are employed in taking charge of these forests; and, by the restrictions imposed on the owners of private woods, Government have, in a manner, a monopoly of timber. *

Whilst the scarcity of wood is a general complaint throughout all Britain, it is particularly felt in Scotland, which is the more to be regretted, as there are so many extensive tracts of land in almost every corner of the kingdom, proper for raising wood, particularly in the Western Hebrides, (the present produce of which is almost below calculation); and yet, (excepting a few noble minds, who have taste and judgment to perceive the ornament, profit, and various uses of growing timber, and liberality and public spirit to look to the comfort of future ages), a very small proportion of landed proprietors practise this most elegant and profitable of all amusements, that of laying out, and training up young woods and plantations. †

* See Walsh on the Genius of the French Government. 8vo. 1810.

† See Farm. Mag. June, 1810. The spirit for planting, however, has become more prevalent of late years in this country, and not only deserves the highest commendation, but likewise affords a pleasing expectation to futurity. The late

If it be true, that the supply of timber of every denomination is in no respect equal to the national consumption, which will readily be admitted, it must be an object of the first importance to discover by what means the supply can best be increased, so as to answer all the purposes of internal preservation, and meet the additional consumption of the country; otherwise, it is obvious, that money must be constantly sent abroad to purchase foreign supplies, by means of which a portion of the national wealth must be extinguished for ever.

It is a reflection, however, highly consolatory to the patriot and the philanthropist, that there are so many millions of acres of waste and uncultivated lands, in England, Scotland, and Wales, which are capable of producing the various articles of human sustenance; and of raising timber fully adequate to our extensive and increasing consumption.* In Scotland alone, as ap-

Dr James Anderson informs us, in his valuable Survey of the County of Aberdeen, that Sir Archibald Grant of Monymusk had planted no less than *fifty millions* of trees; and that, at the time of his death, there were some trees of his own planting that were near *one hundred feet* high, and about six feet in diameter. See Communic. to the Board of Agric. Vol. 4th, Note, p. 257.

* It has been stated, by authority, that 'Great Britain 'contains sixty-seven millions of acres, seven millions of 'which are taken up by houses, roads, rivers, lakes, &c. con- 'sequently incapable of cultivation; and that, of the remain- 'ing sixty millions, only five millions are employed in raising 'grain, and twenty-five millions in pasturage, while thirty

pears from the Report of the Committee of the Board of Agriculture, * there are upwards of fourteen millions of acres of waste or unproductive lands, capable of being made subservient either to the purposes of agriculture, or of furnishing a future supply of Oak for the Navy, and other species of timber for home consumption; and thus adding to the productive energies of the kingdom, and furnishing employment and food to thousands of indigent families, who are now compelled to remain idle half their time, to resort to precarious and unwholesome manufactures, or to emigrate to a foreign country.

There is much truth and good sense in the observation that has frequently been made, that, if the proprietors of the waste and moor ground in Scotland, 'could resolve to encounter the expense of draining, enclosing, and planting a portion of these lands, the returns, though distant, would, in the end, be of incalculable benefit to themselves, their families, and their country.' In consequence of the late opening up of the remoter districts of the kingdom, by means of roads, bridges, and canals, through the assistance of the Legislature, the stimulus to more extensive planting has been greatly increased.

Of the thirty millions of acres of waste and unproductive lands in England, Scotland, and

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'millions are either completely in a state of waste, or cultivated under a very defective system of husbandry.'

* See Appendix (A).

Wales, we may safely suppose that at least one-fourth or fifth part is capable of being enclosed, and brought to some degree of cultivation; and the remainder might be appropriated to the sheep husbandry, and the rearing of wood, by which means almost every acre would be rendered productive to the community.* The time is arrived at which it is become the indispensable duty of every individual, who has it in his power, to lend his aid in clothing the naked waste, and to render every encouragement to agriculture in general, to enable the farming interest to supply

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* Were only two millions of acres of the forests and wastes of Great Britain enclosed, and appropriated to the growth of larch, oak, and other valuable timber (according to the nature of the soil and situation) so much wanted for our Navy, and other necessary purposes; after the lapse of a century, when the timber may be supposed to have arrived at perfection, it would amount in value to the sum total of the national debt! But was the improvement of the waste and unproductive lands in Scotland and England, by planting, &c. to be averaged even so very low as five shillings per acre, there would still be a clear annual gain of from seven to eight millions sterling, besides creating food for many thousands of additional inhabitants, and furnishing employment to every individual capable of labour, now taxing the landed interest for support.

For some judicious remarks, on the benefits that would result from a system established by the Legislature for the growth of wood and timber on our wastes, see 'Essay on 'Enclosures, Improvement of Commons and Waste Lands, 'by the late John Robinson Esq. Surveyor-general of Woods 'and Forests:' And for some hints regarding the Royal Forests, see Appendix (B).

the country with food for its accumulating population, which can only be effected by cultivating our numerous wastes and commons, and improving the management of those already in a state of production.

There is but a small proportion even of the waste lands in the kingdom, comparatively, which, if properly drained, enclosed and planted, at the termination of twenty or twenty-four years, would not yield timber and fire-wood to the value of an hundred pounds per acre; * or, if the whole should not be cut down at that period, but properly thinned, the remainder would continue to improve in the same proportion.

In situations sheltered from the west and south-west winds, and where loose rocks and large stones render the land unfit for cultivation, oak, ash, beech, sycamore, and all the pine tribe, grow remarkably well. In short, there is scarcely any land so poor, barren, rocky, or unproductive, as not to admit of this species of improvement, provided seedlings, and plants of a small size, adapted to the nature of the soil and situation, and proper modes of planting be practised. Nature hath most bounteously furnished us with seeds, plants, trees and shrubs, suited to various soils and situations, if we would only learn to open

* It has been sufficiently ascertained, by the late Lord Bishop of Landaff, that an acre of larches, at twenty-four years' growth, is worth 100*l*. Comm. to the Board of Agric. vol. VI. p. 8,

our eyes to view her operations, or to copy the example which she daily sets before us.

That art and industry might soon invest many of the bleak wastes of the island, from the extremity of Cornwall, to the most northern boundaries of Caithness, at present unproductive to the proprietors, and disgraceful to the country, with all the ornaments of forest scenery, is abundantly evident from the still perceptible remains of ancient forests. In many districts, both south and north of the Tweed, the little hills exhibit undeniable vestiges of ridges formed by the plough, perhaps a thousand years ago, when inaccessible thickets covered the now cultivated plains. *

* 'Were I the owner of a million of acres,' says an intelligent and patriotic agriculturist, 'I would not suffer one to 'lie unoccupied. What would not bear corn or grass, I would 'plant with wood.' See Wimpey in Bath Papers, Vol. VII. p. 30. The planting of wood being an important branch of national improvement, were tenants allowed to have an interest in the growth of trees, as suggested by Mr Brown of Markle, late Conductor of the Farmer's Magazine, and a certain proportion of each plantation made and trained up by them, to be their property at the conclusion of a lease, or rather allowed a certain value for it; it is highly probable that innumerable pieces of land, banks, and corners of enclosures, upon every farm, would be immediately devoted to timber culture. See Appendix, (C). It is also universally known, that 'such estates as have a portion of growing timber up- 'on them, when brought to sale, bring an extra price, ac- 'cording to the quantity and quality of the timber, not only 'at the time of sale, but counting on its value at a far distant

The increased value of oak and other bark, is also a strong inducement to this species of improvement. * In different parts of the Highlands of Scotland, the undergrowth of oak coppice wood, principally natural, is sold every twenty or twenty-five years at the rate of about fifty pounds Sterling per acre, the purchaser being at all expenses of cutting and carriage; and this on land fit for little other purpose.

At a time, too, when the price of dressed leather has risen to an exorbitant pitch, the cultivation of oak, larch, and birch, for the tanpit, would be a valuable acquisition.

The juices extracted from resinous trees, the fir and the larch especially, whence resin, tar and turpentine, are prepared, might, by an easy and lucrative process, be converted into a source of national wealth, by preventing the disadvantageous importation of those commodities, multiplying the means of British industry, and diffusing comfort and happiness to the remotest corners of the island. †

'period. Thus, supposing the *half-grown* timber on an estate 'to be valued at 10,000*l.* on the day of sale, instances are 'not wanting where 20,000*l.*, or even 25,000*l.*, have been 'given, over and above the value of the land.' See Nicol's Practical Planter, 2d edit. p. 259.

* See Appendix (D).

† See further, on this subject, in Note on Chap. IV. Sect. xiii. § 3.

SECT. II.—*Of the different Domestic Purposes to which Woods and Plantations are applicable.*

The subject of Woods and Plantations, in whatever point of view it is considered, is certainly of the most essential importance to the prosperity and comfort of the country.

Abundance of wood not only provides a copious supply of timber for the Navy, and thus materially secures the safety and independent sovereignty of the State; but it also furnishes materials for buildings of every description, for instruments of husbandry, * and other domestic purposes; it provides the means of enclosure, and fuel † for the use of the poor, whose very existence will soon, in many parts of the kingdom (as at present in some of the Hebridean isles), absolutely depend upon it; it affords shelter to every species of live-stock; it breaks the current of the winds, meliorates the bleakest climate, and communicates warmth and softness to the surrounding atmosphere; it produces vegetation in the adjoining fields much earlier in the spring, and causes it to continue fresh and vigorous much later in the autumn. Plantations also afford ma-

* For wood proper for instruments of husbandry, see App. (E).

† See Trans. High. Soc. vol. I. p. 305. And Hebrides Rep. &c.

terials for the tanner, the shoemaker, the joiner, the coachmaker, the painter, the smelter of ore, the manufacturer of gunpowder, and the chemist. In short, it would be difficult to specify a single article of convenience or luxury in social life, to which this useful material does not contribute a liberal proportion.

CHAP. II.

OF THE PROFIT TO BE DERIVED FROM WOODS AND PLANTATIONS.

SECT. I.—*Profit from Woods, or Oak Coppices and Underwood per Acre.*

IT may be remarked, that a Wood differs from a Plantation, in that it is either entirely a natural production, or *sown* (not planted) by the hand of man; and generally consists of a mixture of timber trees, chiefly of oak and ash, and sometimes of fir, with underwood or shrubs, as birch, hazel, holly, thorn, or willow. The extent of a wood varies from an acre to several square miles, when it assumes the appearance of a forest.*

As the period of cutting natural woods and coppices varies in different districts in Scotland, from ten to thirty or forty years, according to the quality of the soil, the growth of the trees, and the purposes to which the wood is to be applied, so also does the profit to be derived from them.

* See Nicol's Planter's Kalendar, p. 43.

The most common, however, as well as the most advantageous period, is probably from fifteen to twenty-five years; and upon comparing a variety of the most accurate accounts from different parts of the kingdom, the value of an acre of good natural wood may be stated, at an average, from twenty-five to thirty shillings per annum.

In Dumbartonshire, the annual profit of natural woods, in which the oak prevails, is estimated at one pound Sterling per acre, when cut in twenty years. *

In Lanarkshire, on the banks of the Clyde, where the demand is considerable, the copse-woods, consisting of oak, ash, elm, birch, alder, &c., are cut down once in twenty-five or thirty years, and sold at from 25*l.* to 40*l.* per acre, according to the value of the underwood. †

In the counties of Perth and Stirling, the annual value of a Scotch acre of coppice-wood is estimated at twenty-five shillings; ‡ and that on soil so poor and sterile, which, for any other agricultural purpose, would not yield sixpence per acre.

In the Highlands of Scotland, most of the natural woods are cut down at intervals of nineteen or twenty years, to supply the iron furnaces;

* Dumbartonshire 4to Rep.

† Clydesdale Rep. &c.

‡ See Gen. Rep. of Scotland, Vol. II. pp. 248 & 249.

and generally yield in that period from forty to fifty pounds Sterling per acre. *

In many parts of Gloucestershire and North Wilts, the profit that has been made by planting willow and ash for underwood, on cold and even boggy soil, on the sides of hills, is almost beyond credibility. Eight pounds an acre per annum have been made of plantations of this description, in the neighbourhood of Highworth, on land not intrinsically worth ten shillings per acre for any other purpose. †

In Nottinghamshire, a single acre, planted with the Huntingdon willow, has been known, at ten years' growth, to yield 300*l.*! ‡ And Mr Day, a yeoman of Kent, has made from the underwood

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* In the west of England, an acre of coppice in thirty years will produce at an average 60*l.* clear of expenses; and sixty acres of woodland, when cut annually in patches, about 100*l.* per annum. The beech woods of Lord Ducie, in Gloucestershire, which reproduce themselves from seeds self-sown, and which are supposed to arrive at perfection in seventy years, will then be worth from 80*l.* to 100*l.* per acre.—*Gloucest. Reprint. Rep.* p. 240.

The average yearly value of woodland in the county of Essex, is upwards of 5*l.* per acre.—*Essex Rep.*

In Herefordshire, from 12*l.* to 22*l.* per acre, at thirteen years' growth.—*Herefordshire 4to. Rep.* p. 96.

The underwoods in the county of Westmoreland, usually cut down every sixteenth year, vary from 10*l.* to 15*l.* per statute acre; and if altogether of oak, about twenty guineas;—6*l.* for the charcoal, and 15*l.* for the bark.—*Westmoreland Reprint. Report.*

† See Bath Pap. Vol. X. p. 311. ‡ Nott's Rep. &c.

of some of his plantations, 94*l.* per acre, at only ten years' growth; and, in the year 1806, felled some plantations, of which the underwood alone produced him 150*l.* per acre, exclusive of the expense of falling.*

The profit derived from a plantation of osiers, by the late Mr Sherriff of Craigside, near Edinburgh, holds out great encouragement to the occupiers of land fit for that purpose. Mr S. planted about five statute acres, on a clayey loam, of coarse quality, at two different periods, prior to the year 1801. These, one year with another, netted fully 18*l.* 10s. an acre. The whole osier ground in his possession, which extended to twelve and a half statute acres, was cut in November and December 1802, being only a single year's growth, and was sold for 220*l.*; and by special agreement, if not all cut before Christmas, the price was to be 250*l.* †

'As to the value,' says Mr Sherriff, ‡ 'I know 'three-fourths of an acre let for 14*l.* per acre, §

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* For an account of the profit of Mr Day's ash plantations, see Trans. Soc. Arts, &c. Vol. I. p. 109, and Vol. XXV. pp. 4–14. Mr Day mentions, in a letter to the author of this Abstract, (13th July 1810), that he had made a calculation on planting an hundred acres of waste land with ash, and there appeared to be a profit of 6828*l.* 10s. in 24 years, which he knew from experience to be correct.

† See Trans. Soc. Arts, &c. Vol. XXI. p. 121.

‡ MS. communication to the author.

§ Per Scots acre, which is to the statute acre as five to four nearly.

'and several acres of oziers for 12*l.* an acre, for 'six years. I made more by peeling and selling 'to basket makers.'

In the Ayrshire Report, it is stated, that 'when 'the willows grow well, the shoots are in three 'years ready for the market, and frequently sell 'for 24*l.* per acre.'

'A few acres of osiers, planted after a crop of 'potatoes in February 1801, upon the south expo-'sure of a sloping bank, sheltered from the south-'west by a belt of plantation, and in a cold, hu-'mid, clay soil, on the farm of Hayfield, near 'Kirkcaldy; has yielded from 25*l.* to 30*l.* per acre 'annually, for a number of years past.' *

The crown willow, *S. purpurea* (?) though inferior to many other species, being much in request by the Victualling Office, is particularly profitable. Ten shillings per thousand yearling shoots, was given for this sort by the Commissioners, delivered at Deptford, several years ago. On a Scots acre, 24,000 plants will stand, at eighteen inches distance from plant to plant, in and between the rows; and if six shoots grow on a stock, the amount is 144,000; which, at ten shillings per thousand, gives 72*l.* Sterling for the produce of a Scots acre.

The expense of a plantation of osiers, in a favourable soil, and near to a good market, may be estimated at from one to two pounds Sterling per

* See Nicol's Plant. Kalendar, App. I. p. 549.

acre per annum; and will be found to yield a return of 300 or 400 per cent. per annum! *

Sec. II.—*Profit of Plantations, or Timber Trees, per Acre.*

There is a great quantity of land in Scotland of very little value in its present state, and incapable of being profitably converted either into arable or good pasture land; yet a very large proportion, two acres of which do not afford sustenance for one sheep during six months of the year, might, with considerable prospect of success, be planted with larches, and other valuable timber.

§ 1. *Larch.*—The late Bishop of Landaff, in his valuable Preliminary Observations to the Westmoreland Report, affirms, that such land would immediately pay a rent of thirty shillings a year. The high barren mountain of Wansfell, near Ambleside, on which his Lordship made a plantation of 48,000 larches, has been for many years let at a greater rent, as a sheep pasture, (even making allowance for the depreciation of money), than could be had before it was planted, without the least injury to the plantation; thousands of the larches measuring from fourteen to eighteen inches in circumference, at six feet from the ground.

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* See Nicol's Plant. Kalend. edited by Sang, p. 553.

In the years 1804 and 1805, the Bishop planted 322,500 larches on two elevated contiguous mountains, called Birkfell and Gomershow, situated near the foot of Windermere, in the parish of Cartmell, and county of Lancaster. The sum expended in planting these 322,500 larches, at 30s. a thousand, on 379 acres of land, worth half a crown an acre, is calculated by the Bishop at 483*l.* :—the whole loss, in sixty years, at 13,798*l.*, and the probable profit, upon the most moderate computation at the end of the same period, is estimated at 150,000*l.*, if the commerce of the country, and the price of foreign fir, should continue for sixty years without diminution. *

In other situations, however, more favourable to the growth of trees, the profit is estimated much higher.

In the Hampshire Report, p. 30, it is stated by two very experienced nurserymen, that even poor land, when planted, will produce at the end of twenty-five years, at least 100*l.* of value in timber and fire-wood.

In Scotland, Dr Robertson states the profit at

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* See Comm. to Board of Agric. Vol. VI. Part I. p. 5. The Bishop also calculates, that a barren estate, consisting of one thousand acres, though placed in a high and bleak situation, may be improved by plantation from 4*l.* 3s. 4d. to 400*l.* per annum, or eight shillings per acre; reckoning the value of a reversion at a present certainty, and stating the interest of money only at 4 per cent. See Report on Waste Lands, p. 17, and West. Reprinted Rep. p. 285.

six shillings per acre.* The just and proper medium profit from an acre of larches, applicable as an average to the whole kingdom, may be stated at thirty shillings per annum.†

Annual Increase.—With regard to the annual increase in value of an acre of larches, in a given situation, and of a given age, it has been ascertained by admeasurement, that an acre from 24 to 27 years' growth, by the increase of the wood, pays annually a rent of three pounds five shillings. What rent an acre of land would pay, when the larches were 40, 50, or 60 years old, cannot be accurately known, except by actual admeasurement; but it is presumed, that, at 50 years from the first planting, it would pay a rent of not less than fifteen pounds per annum!

There is another mode of turning a plantation of larches to profit, which has been suggested by the late Bishop Watson; it consists in cutting down the whole at twenty or thirty years' growth, and replanting the ground:‡ but this practice,

* Perth Report, p. 107.

† It has been already observed, that an acre of larches, at 24 years' growth, on but indifferent land, is worth 100*l.* Now, the present value of 100*l.*, to be received 24 years hence, is 31*l.*; which, being lent at legal interest, will produce thirty-one shillings a year, which may be considered as the rent to which an acre of land is immediately raised by planting it with 1000 larches, at an expense of only thirty shillings. See Comm. to the Board of Agric. Vol. VI. Part 1. p. 8.

‡ 'Supposing,' says the Bishop, 'five hundred acres to 'be planted with larches at six or eight feet distance: after

at least with the same species of plants, for obvious reasons, has not always been found to answer.

§ 2. *Ash.*—' On the east side of Cottage Wood, ' in Staffordshire,' says Mr Waistell, * ' there are ' now growing, (1807), within twenty-two yards ' square, as under, viz.

' 50 Ashes, containing 300 feet at 1s. 6d. -	L.22	10
' 13 Oaks, 7 do. 2s.	0	14
' Bark - -	0	6
	L.23	10 or per Acre 335*l.* 10s.

' The above is part of two acres planted in ' 1776, partly on heaps of earth in clay pits, and

' twenty-five years, let twenty acres be cut down, and the ' land be replanted; when the whole is thus gone over, the ' first replanted part will be twenty-five years old, and be rea-' dy for the axe; and all the other parts will be ready in suc-' cession, twenty acres every year, for ever; affording a rent, ' after the first twenty-five years, of 1500*l.* a year, from 500 ' acres of waste land. This rent is founded on the supposi-' tion of an acre of larches, of twenty-five years' growth, ' being worth only 75*l.*: though there is good reason to con-' jecture, that it will be worth more; and a certainty, that, ' for the first twenty-five annual falls, its value will be increas-' ing on account of the increasing age of the wood.'

This is the mode practised in the wood of Soignies, near Brussels, in the Netherlands, which, according to Dr Anderson's calculation, yields an annual revenue of upwards of 18,000*l.* Sterling. See Agricola's Letters on Planting. Scots Mag. vol. xxxiii. p. 294.

* See Trans. Soc. Arts, &c. vol. xxvi.

'partly on strong soil upon a deep bed of sand, 'value about fifteen shillings an acre. Fifteen 'shillings per annum, forborn 31 years, and im'proved at 5 per cent. compound interest, would 'amount to 53*l*. But the value of the timber is 'more than four times this amount.'

§ 3. *Oak.*—In the 4th volume of Bath Papers, the value of fifty acres of oak timber, is computed to be worth 12,100*l.* in an hundred years, which is nearly 2*l.* 10s. annually per acre; and when it is considered that this is continually accumulating, without that expense or risk to which annual crops are subject, it can hardly be doubted, that timber planting, is one of the most profitable articles, to which various descriptions of soil can be appropriated.

Evelyn calculates the profit of a thousand acres of oak land, in one hundred and fifty years, at no less a sum than 670,000*l.* Mr Young states the plantations of Mr Fellowes, as yielding a regular income of five pounds a year per acre, by being cut in a regular rotation.* And those of Mr Mitford, who allows his plantations to stand till they are forty years old, as high as 22*l.* 11s. per acre per annum.

Other instances might be adduced, where the profits of planting oak have been remarkably conspicuous. These profits, however, must vary, in every country and district of the kingdom, according to the nature of the situation, the quali-

* Young's Tour through the East of England.

ty of the soil, the demand, and other local circumstances.

§ 4. *Sycamore.*—One instance is stated by Mr Nicol, in his 'Planter's Kalendar,' (p. 123), as having come under personal observation, where a plantation of an acre and a half of sycamores, of 60 years' standing, was offered to be purchased, at the rate of 14*l.* per acre, per annum, since the time of planting; 'and perhaps,' he adds, 'this same land, would not, at an average, have 'rented at 30s. per acre per annum.'

§ 5. *Scots Pine.*—The Scotch pine, or common fir, planted on very poor land, in the lower part of the county of Lanark, at 25 years old, sells for 25*l.* per acre; and, at 50 or 60 years' growth, when properly thinned, at upwards of 80*l.* *

In Galloway, plantations of Scots fir, under fifty years of age, have been lately cut, the best of which were estimated at from 300*l.* to 400*l.* per acre, and one is said to have reached upwards of 600*l.* per acre, sold in the planter's lifetime. †

'There are acres of wood,' ‡ observes Mr Curwen, 'which at fifteen years' growth, will leave 'a clear profit of 45*l.* Supposing this to proceed 'for ninety years, with interest, the acre would 'produce 815*l.*' §

The plantations at Inverary, are reckoned to amount to about two millions of trees, worth four shillings each, which makes their present value

* Clydesdale 4to Rep. p. 43. † Galloway ditto.
‡ Ash. § Trans. Soc. of Arts, &c.

400,000*l*.* The land, seventy years ago, is supposed to have been only worth 50*l*. per annum.†

Calculating the expense and accumulated interest thereon, at 105,137*l*., there remains a balance of 294,862*l*. 10s. of clear profit on the Inverary plantations.‡

A calculation of the expense and profit that would attend the supposed planting of the Moor of Orchill, in Perthshire, seven miles by three in extent, is given by Dr Robertson, in his Agricultural View of that County, in which he shows, that ten thousand acres might, if improved, by judicious planting, in the course of eighty years, yield a profit of upwards of two millions Sterling, which demonstrates the immense advantage resulting from such appropriations.§ 'Et dubitant homines serere, atque impendere curam?'

§ 6. *Expense of Plantations.*—The original expense of a plantation very much depends on the size of the enclosure, the facility of procuring materials for that purpose, the price of labour in the district, and various other local circumstances; so that the expense of planting necessarily

* See Knox's Tour.

† Argyleshire Rep. p. 151. In 1751, the valued rent of all the pleasure grounds about Inverary, consisting of 12½ merklands, is stated at 50*l*.

‡ Hebrides Report, p. 352.

§ The reader is referred to the same intelligent Report of the Hebrides, for a calculation on a still more extended scale, of planting 200,000 acres in the Western Islands.

varies in every county and district of the kingdom.

The larger the enclosure is, the expense of fencing it, by the acre, is the less. Thus, the enclosure of twenty acres exceeds a fifth of the cost, though it is but the twenty-fifth of the space of one of five hundred.

In the North of Scotland, 'the expense of 'enclosing a plantation of at least one hundred 'acres, and planting it with Scotch fir, is gene'rally calculated at twenty shillings per acre, 'and the undertaker upholds the plants for seven 'years.' * In the East of England, the expense of enclosing and planting is said to be three pounds per acre. †

In the county of Galloway, the expense of planting by contract is five pounds per acre: ‡ and in Dumbartonshire, when enclosed with hedge and ditch, and drained, the expense has been estimated at seven pounds per acre, viz.

'Enclosing with hedge and ditch, per 'acre - - -	L.2	0	0
'Draining - - -	0	15	0
'Price of plants - -	3	10	0
'Putting in - - -	0	18	0
	L.7	3	0' §

* Young's Tour, vol. I. p. 330.
† County Reports, &c.
‡ Galloway Rep. p. 182.
§ See Gen. Rep. vol. II. p. 299.

In Scotland, the average expense may be stated at from 30s. to 2*l.* per acre. The very injudicious and imperfect manner in which many extensive plantations have been planned and executed, and the serious expense attending them, have accordingly deterred many public-spirited individuals from embarking in this most elegant of all improvements. * An eligible method of effecting this object, on bare soils, and elevated situations, at far less expense, and with equal success, by sowing the seeds of trees on the spot where they are finally to grow, has been sufficiently evinced by numerous and successful experiments, both in England and Scotland, as well as in various other countries; and for a short description of which, the reader is referred to Chap. V. Sect. iv. of this Abstract.

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* For a table, or state of the natural woods and plantations of Scotland, in Scots and English acres, see Appendix (F).

CHAP. III.

OF THE DIFFERENT SOILS AND SITUATIONS, THE BEST CALCULATED FOR WOODS AND PLANTATIONS IN GENERAL.

The nature and qualities of the different soils, subsoils, and situations, peculiarly adapted to the growth of the various species of timber, have hitherto obtained but a very inadequate illustration from those writers who have turned their attention to this interesting subject.

Sect. I.—*Soils and Subsoils.*

It may in general be remarked, that as soils of a ferruginous kind, with little depth, are found to be the most unfavourable to the growth of timber; so, gravelly, or light sandy soils, on porous subsoils; loamy, gravelly, or clayey soils, with retentive subsoils; and thin, moorish, heathy soils, on gravelly, porous or retentive subsoils, are found best adapted to the cultivation of the various species of timber. *

The oak generaliy thrives best in a strong deep loam, incumbent on gravel or dry rock; the ash is found in the greatest perfection on dry loamy soils; the beech and chestnut in sandy loams, and all calcareous soils; and the elm and the larch (the most valuable tree in Scotland) are to be seen in almost every soil. †

* The following soils, and their substrata, are recommended by the late Mr Nicol in his 'Planter's Kalendar,' p. 50, as best adapted for planting, viz.

'Sandy or gravelly soils, incumbent on rubble, or loose sand-'stone.—Loamy soils, on a gravelly or porous subsoil.—Sandy, 'gravelly, or loamy soils, on a clay or retentive subsoil.—'Chalky loam, or flinty chalk, on a porous, or rocky sub-'stratum.—Loamy clay, on sandstone, or on limestone rock. '—Clay on the same.—A mixture of loam and argillaceous 'schistus, on basalt or whinstone rock.—Free loamy soils, on 'granite rock.—Strong loamy or clayey soils, on irony or blue 'till.—Thin, heathy, or moorish soils, incumbent on rubble; '—and the same incumbent on clay, or on till.'

† The constituent parts of the soil about Sheffield-place, reckoned by Mr Pontey, so remarkable for the production of timber, and where the oak and the larch equally flourish; has been analyzed by Sir Humphrey Davy, and found to produce the following result, viz.

Water - - -	3.
Silex - - - - -	54.
Alumine - - -	28.
Carbonate of lime - -	3.
Oxide of iron - - -	5.
Decomposing veget. matter -	4.
Loss - - -	3.
	100.

In wet spongy soils, which cannot be drained without too great expense, the ash, elm, alder, poplar, and sallow tribe may be planted to advantage, and in twenty years will frequently yield a profit of three pounds per acre per annum for the whole time. *

Important information respecting the soil, subsoil, and exposure best adapted to the various species of trees intended to be sown or planted, may be obtained by carefully observing in what particular soils and situations natural wood thrives best in the surrounding country, and by noticing the different degrees of success attending those trees that have been formerly planted on similar soils, situation, and elevation. For the tree that suits one soil and exposure, will not in general answer another; like *ascripti glebæ*, every tree seems to have a particular attachment to its own peculiar soil, in which respect it requires to be gratified; and in the selection and adaptation, there are no better guides than observation and experience.

Nothing can be more absurd than the planting of extensive tracts with a great variety of different kinds of trees, without regard to selection; for, though in most soils, any of the common sorts of forest trees will grow, yet, in almost every instance, some one or more will be found to grow with greater luxuriance than others.

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* See Bath Pap. vol. II. p. 347.

Sect. II.—*Situation.*

It may be remarked in general, that, in the inland and interior parts of the kingdom, so bulky and expensive an article as timber, particularly what is requisite for home consumption, ought to be raised on the spot; whereas, on the sea-coast, where wood can be imported with facility, and where the blasts and breezes from the ocean are in some degree unfavourable to the growth of timber, land fit for the plough ought never to be planted except for the purposes of ornament or shelter. Perhaps all land, from the annual value of from fifteen to twenty shillings per acre and upwards, might, in general, be more profitably applied to the purposes of cultivation; the advantages to be derived from an annual rent produced from corn, grass, &c. with its accumulating compound interest, will, in a term of years necessary for bringing a crop of timber to perfection, produce a larger sum than can be realized from the growth of wood.

Timber and underwood ought, in general, except as ornamental decorations to gentlemen's seats, and in the corners of fields in the state of tillage, or the hedge-rows of those in the condition of grass, to be raised only on rocky and more barren soils, that they may shelter the bleak heath, afford that protection which the numerous herds of cattle and flocks of sheep in the country so much require, and be the means of imparting fertility to the more sterile tracts. There is ordinary and mountainous land enough in the kingdom for the growth of timber, equally unfit for tillage or pasture, where nothing else will live; and trees are often observed to thrive, even amidst rocks and stones, where there is scarcely any visible soil to nourish them.

The natural advantages resulting from precipices, gullets, steep banks of rivers or canals, and the islands or islets of fresh-water lakes and sea-coast, by lessening the expense of enclosures, also hold out strong inducements to the planter of wood, to cover such situations with young plants.*

The numerous and extensive dry mosses and moorlands, in the hollows and on the declivities of hills, abounding in the interior of the Highlands, should also be devoted to this species of improvement. 'These lands are generally cover-
'ed with short heath, mixed with so little grass,
'that they are not worth sixpence per acre. The
'trunks of trees generally found in them, give

* For the same reason, the corners of fields or enclosures may by planted at a trifling expense, two parts of the work being already done, and nothing remaining but to make up the third with a fence or paling. These small clumps soon become of important service, affording an ample profit to the landlord, an abundant supply for the purposes of the husbandman, and shade and shelter for cattle. See Trans. Highland Society, vol. I. p. 189.; and Argyleshire Report.

'however a sufficient proof of their aptitude to 'grow timber; and they can never be turned 'to better account than by planting them, and 'that with the same kind of timber that is found 'in them. This is generally fir, and sometimes 'oak.' *

Another species of ground that should be exclusively devoted to planting, is, that on which a number of venerable firs, or other native timber, is still growing. These remains of our ancient forests, are not unfrequent in the upper parts of Argyleshire, in the Northern Highlands, and in Braemar at the source of the river Dee, &c. †

Wherever there are natural stools of wood already enclosed, or tracts covered with brushwood, such as hazel, birch, &c. seldom allowed by the cattle to rise above two or three feet high, being marked out by nature as fit for raising wood, ought to be filled up with oak, ash, elm, and other valuable kinds of timber, which might be effected at a trifling expense. ‡ Were such tracts only efficiently enclosed, and cattle of every description excluded; from the seeds shed in winter, beautiful woods would soon rear their heads of the most valuable quality.

But where no natural shelter can be obtained, such as flat barren wastes, and the bleak sides of hills of considerable elevation, artificial means of producing a shelter must be resorted to. In such circumstances, the following plan has been

* Argyleshire Report, p. 154. † Ibid. ‡ Ibid.

recommended by the late Mr Nicol. * 'Fix 'upon the most exposed side of the proposed 'forest plantation; mark off a horizontal stripe, 'or belt, at least a hundred yards in breadth. 'Let this portion of ground be planted thick, 'say at the distance of thirty inches, or at the 'most three feet; with a mixture of larch, syca-'more and alder, nearly in equal quantities, or 'with Scots firs, if the soil be better adapted for 'them. When the trees in this belt, or zone, 'have risen to the height of two feet, such hard-'wood trees as are intended ultimately to fill the 'ground, should be introduced, at the distance 'of from eight to ten feet from each other, as 'circumstances may admit. At this period, or 'perhaps a year or two afterwards, according to 'the bleak or exposed situation of the grounds; 'let another belt or parallel zone of nearly equal 'breadth, be added to the one already so far 'grown up, and so on, till the whole grounds be 'covered, mixing the nurses over the whole 'plantation.' †

Plantations of larch, margined with a double

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* See Nicol's Plant. Kalend. p. 29.

† In such exposed situations, it is necessary to plant thick; and to use small, well-rooted plants, as the opposite practice has operated very much against the interests of planting, as is daily visible over the whole of England. The hard-wooded plants for the principal crop, should not exceed eighteen inches in height; the larch nurses from six to nine inches high; and the Scots fir, two-year seedlings, one year transplanted.

or triple row of spruce and common firs, and the latter headed down at twelve or fifteen feet from the ground, are peculiarly well calculated for a skreen or shelter for live stock. The firs thus treated, throw out lateral boughs, and feather to the ground; intercept the current of the blast, and prevent the snow blowing through, and lodging on the leeward side, to the annoyance and danger of sheep that have repaired to it for shelter; while the larches, in their more advanced state of growth, by permitting the winds to pass through the upper part of the skreen, break the current, and mellow the blast. *

But although all trees require shelter from the most impetuous blasts, before they can be reared in perfection, yet they differ very much from one another in the degree of shelter that they require; some being able to thrive in a situation where others would totally perish. 'Of all the trees,' says Dr Anderson, 'that I am well acquainted 'with, the ash, the elm, and the rowan, (moun- 'tain-ash), are least hurt by open exposure, and 'therefore thrive best when planted alone, or in 'single rows; and few of our hardy deciduous 'trees are less able to endure an exposed situa- 'tion than the oak when young, which is proba- 'bly one reason why this last is in so little esti- 'mation in Scotland, and the others so general- 'ly cultivated; although it must likewise be ac-

* See Marshall.

'knowledged, that the two first are deservedly
' much esteemed; not only because they can be
' reared in almost any situation, but also on ac-
' count of the valuable qualities of their wood,
' which is perhaps better adapted to the various
' purposes of the husbandman, than even the
' sturdy oak itself.' *

In short, the species of trees to be sown or planted, should always be regulated by the nature of the soil and situation.

On elevated and mountainous tracts and situations, all the pine tribe, the mountain-ash, the beech, larch, ash, birch, sycamore; and (where there is any depth of soil) the oak; may all be planted with reasonable hope of success.

Where the soil is mere sand, the Scotch fir will generally succeed. 'I know several planta-
' tions,' says a writer in the Bath Papers, ' where
' the soil has been so perfectly sandy, that there
' was not grass enough to keep one sheep on an
' acre; and yet, after being planted twenty years,
' there have been 3000 trees on an acre, worth,
' at the lowest estimate, one shilling each as
' they stood.' †

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* Agricola's Letters on Planting, Scots Mag. Vol. XXXIII. p. 293.

† 'Very few situations in this country,' observes Mr Borthwick, in a sensible Letter on Planting Scotch Firs, ' seem to have a natural predilection for fir. In most situa-
' tions, where the natural propensity to wood is shown, we
' see that some kind of hard-wood, as oak, birch, or hazel, is

In more sheltered congenial situations, timber trees, such as the oak, larch, elm, beech, lime,

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'the most grateful. Timber, of the nature of these trees, is 'by far the most useful for every purpose; and therefore it is 'a fair and an important question, whether the invitation of 'nature to plant hard-wood in this country, has not been for 'several years past, and is not yet, too much neglected. According to the prevalent taste, a gentleman, wishing to show 'the world that he has been doing something on his estate, 'plants a great number of stripes and clumps of Scotish fir: 'these, if upon moory and exposed situations, never come to 'any thing; and, if on favourable situations, hard-wood would 'have grown there equally well, and at any given age would 'have been much more valuable.' See Farmer's Magazine, Dec. 1809. That these observations are, in general, well grounded, will be readily acknowledged; but in bleak and barren situations, the larch, and Scots fir, particularly the former, will generally be found the most profitable for timber; as appears by the extensive and flourishing plantations of the Dukes of Athol, Argyle, and Gordon; of the Earls of Bredalbine, Fife, and Mansfield in Scotland; and those of Mr Anson, in the barren mountains of Staffordshire; of the late Mr Johnes in Cardiganshire; of the Marquis of Bath on the Wiltshire Downs, near Warminster; and of Mr Curwen, and the late Bishop of Landaff, in the counties of Cumberland, Westmoreland, and Lancashire.

The late Mr Davis asserts, from most extensive experience, that 'although fir timber is worth individually less per acre 'than oak or beech of the same size, these trees will nevertheless grow faster and thicker together than any other trees. 'Four firs will grow where but one oak or beech will grow; 'for fir trees are the better, and deciduous trees the worse, 'for being crowded.' See Bath Pap. Vol. X. p. 313. But taking into consideration the general demand of countries, and the peculiarities of different soils and situations, no kind of plane, chestnut, walnut, spruce and silver firs, may be planted with a certainty of success; though the two former, both for beauty and utility, deserve a decided preference.

There is still another species of planting, deserving of notice, but the utility of which has been much disputed, viz. that of setting hedgerows with trees of the timber kind. It has been objected to this mode of planting, that it is injurious both to the hedge and crops, from the dropping of the trees, and the spreading of the roots; but these inconveniences are more than counterbalanced by the degree of shelter and ornament afforded, and the great quantity of useful timber, of the best and soundest quality, that may be raised in this manner at a trifling expense.

Such trees as either have the cleanest stems, or can best stand pruning without injury, should be selected for this purpose; and planted when the fields are about to be broken up from a state of lea, at two feet distance from the line of the hedge. In stiff fertile soils, the elm obtains a preference, as it grows erect, and does least damage to the land by its under branches; and next to that, the oak; its principal nourishment being derived from a tap root, which descends perpendicularly into the earth. In more bleak and exposed situations, the beech has been es-

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wood is so generally profitable for plantations of timber, as larch;—and for coppices, as oak and ash.

teemed the best for this purpose; and, in the vicinity of the sea, the sycamore.*

This mode of planting, has not only a tendency to beautify the country, but also to improve the climate; and has given the southern part of the kingdom that appearance of richness, fertility, and beauty, which delights the eye, and enlivens the heart of every beholder.†

* Where the planting is performed in the hedge-rows of grass lands, the trees should always be perfectly secured from the croppings of cattle, as well as from the rubbing of sheep or other animals, otherwise they are soon destroyed.

† See Kincardineshire Rep. p. 32.

CHAP. IV.

OF THE DIFFERENT SPECIES OF TREES BEST ADAPTED FOR CULTIVATION IN THE WOODS AND PLANTATIONS OF SCOTLAND, THEIR PROPERTIES, RELATIVE VALUE, &C.

THE various species of trees, the most likely to thrive in every soil and climate by cultivation, are those which are found growing spontaneously in the neighbourhood, or of which some traces or remains are discovered to be incorporated with the soil.

In the natural woods of Scotland, the following sorts have been found to thrive peculiarly well:—alder, ash, birch, elm, hazel, holly, mountain-ash, oak, and willow. And in plantations the following;—alder, ash, aspen, beech, birch, chestnut, elm, horse-chestnut, laburnum, larch, lime, maple, mountain-ash, oak, pines, plane, poplars, spruces, walnut, willow, and yew. But of the above, those that stole, or grow after cutting, are the most valuable.

Of all the trees hitherto known to us, whether indigenous, naturalized, or exotic, the following twenty-four species, with some of their most valuable varieties, are probably the most deserving of culture in Scotland.

The Alder, *	The Larch, † (*var. spec.*)
The Ash, *	The Lime, *
The Beech, † (*var. spec.*)	The Maple, *
The Birch, *	The Mountain-Ash, *
The Chestnut, *	The Oak, * (*var. spec.*)
The Elm, * (2 *spec.*)	The Plane, *
The Esculus, †	The Pine, † (*var. spec.*)
The Fir, or Spruce, † (*var. spec.*)	The Poplar, * (*var. spec.*) †
The Hazel, *	The Robinia,
The Holly, *	The Walnut, †
The Hornbeam,	The Willow, * (*var. spec.*)
The Laburnum, †	The Yew. †

SECT. I.—ALDER, ‡ (*Betula alnus*, Lin.)

§ 1. *Value as a Nurse.*—Though the culture of this tree is not accounted very profitable for timber, it is valuable as a nurse, and equal to the sycamore in resisting the effects of the sea spray and storm.

§ 2. *Other Properties.*—The wood of this tree

* Trees that stole, or grow again.

† Trees that do not stole.

‡ It has been deemed preferable to adopt an alphabetical arrangement of the trees recommended in this Abstract, and to enlarge on those of most value.

is in considerable demand for various kinds of machinery, being superior to every other for the cogs of wheels; and, from its quality of resisting injury from water, it is valuable for pump-trees, pipes, drains, conduits to reservoirs, pipes under water, props in coal and iron mines, and all kinds of wood-work which is kept constantly wet. The charcoal of it is much used in the manufacture of gunpowder; and its bark is valuable in the dyeing of black cotton stuff; for some of the colours used in the manufacture of tartan, and in the tanning of leather.

It retains its leaves, which are of a fine green, late in the autumn; is often employed, in consequence, for the purpose of concealing a marsh or stagnant pool; and forms a pleasing contrast with other deciduous trees.

Alder wood is also used by the turner and patten maker; for flooring, lining of carts, and the roofing of sheds and outhouses.

§ 3. *Soil and Situation.*—The alder grows in wet and boggy soils, and will thrive on the sand of the sea-shore; and in moss, it has been found to succeed as well as the willow, or any of the sallow tribe.* The alder is most naturally found growing by the sides of the most rapid rivers and streams; and perhaps no tree is equally well adapted to the upholding their banks, from the multiplicity of its roots, and their peculiar

* See West Lothian Rep. p. 141.

disposition to seek continually along the edges of the water-courses in quest of their natural food.*

§ 4. *Propagation.*—The alder is principally propagated from the seed.

SECT. II.—*The* ASH, (*Fraxinus excelsior*, Lin.)

§ 1. *Species.*—Of the four species of the ash enumerated by Wildenow, eight are included in the Kew Catalogue; and only one of these (*Fraxinus excelsior*) is a native of Britain.

Michaux the younger, in his admirable work, supposes that, to the eastward of the Mississippi, including Canada and the United States, thirty species of ash at least exist, being double the number enumerated in the late work of Wildenow.†

§ 2. *Properties.*—The tall and magnificent appearance of the common ash, the hardness, toughness, and great durability of its timber, are sufficiently known and appreciated; but this, like others of our native forest trees, has not escaped the mischief arising from the practice of raising a stinted progeny from it by layers, and even cut-

* See Nicol's Plant. Kalend. p. 51.

† See Dr Yule's excellent Paper 'On the Naturalization of Useful and Ornamental Plants under the Climate of Scotland.'—Caled. Hort. Soc. Mem. vol. ii. pp. 394, 395.

tings; although daily experience shows with what ease the seeds germinate, on dropping from the tree, without even a covering of earth. *

The ash is the most useful tree to the husbandman, arrives the soonest at perfection, and serves the greatest variety of purposes of any in the forest. A root-grown ash, possesses the singular property of perfection even in infancy; † the wood, from the period its stem is three inches in daimeter, being equally durable until it reaches three feet, or any size or age whatever; and, in the character of fuel, it burns nearly as well when green as dried.

Its value in all kinds of husbandry work, for tools, utensils, ploughs, carts and wheels, and the coarser articles of furniture, is universally known. It is also prized by coachmakers. From the degree of astringency which the bark of the ash possesses, it also seems extremely probable that it might be of use in the business of tanning, superior even to the birch, and an excellent succedaneum for oak bark; and it is said to afford a much greater quantity of potash, than any other tree in this country.

§ 3. *Soil.*—The ash grows most freely on a deep

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* See Caled. Hort. Soc. Mem. vol. ii. pp. 394, 395.

† This is only the case with a root-grown plant, which is tough and strong from its earliest infancy; but not with one from the seed, as has been inaccurately stated by Dr Graham and Mr Nicol.—See Gen. Rep. and Nicol's Kalend. p. 76.

loamy soil, more particularly if in some degree calcareous; and delights also in dry land, especially in a sandy soil, on the banks of rivers and the margins of rivulets. Nevertheless, it grows well on most soils, except on stiff clay, with a hard, retentive bottom. It likewise thrives on the more tenacious sorts of bog earth, after being well drained; and is calculated to flourish in almost every part of the Highlands of Scotland. It may be proper to add, that the ash is by far the best and most profitable species of underwood amongst oak timber.

§ 4. *Situation.*—In a close grove, (the best situation for the ash), and in a congenial soil, it lengthens out into a beautiful clean stem, and rises to an astonishing height; but standing alone, or singly, it throws out large arms, forms a full spreading head, and swells out into a proportionable stem.

§ 5. *Profit, and Mode of Propagation.*—The great utility and immense profits arising from the cultivation of ash timber, * have been already noticed in Chap. II. pp. 224—225. of this Abstract; and the mode of raising them will be found detailed in the Trans. of the High. Soc. Vol. I. p. 201. Trans. Soc. Arts, &c. Vol. XXV. and

* 'A gentleman,' we are informed by the late Dr Smith of Campbelton, 'who planted 100 ash trees, sold them, in 50 'years after, for 500*l.*; and the longer they are allowed to 'grow, the greater the gain.'

in Marshall's Plant. and Rur. Orn. Vol. II. p. 133. &c. *

SECT. III.—*The* BEECH, (*Fagus sylvatica*, Lin.) var. spec.

§ 1. *History.*—The beech was not copiously planted in Scotland till the Revolution; and the trees planted about that period, now form, in many places, considerable timber; as at Arniston, Inverary, Hopeton House, and elsewhere. This tree is found in great perfection in the Highlands of Scotland; is strongly to be recommended as a free grower; and applicable to many useful purposes.

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* The white ash (*fraxinus Americana*, Mich. Arb. *and* Wild.) and some other eminently useful species, are deserving of notice.

1. The white ash is a fine tree, no less interesting from the magnificence of its growth, than the beauty of its foliage, attaining the height of eighty feet, with about three feet in diameter; is found from the northward of the river Hudson, to the southern limits of Jersey and Pensylvania. It endures the severest cold of Nova Scotia and Canada, without any diminution of size. It occasionally rises perfectly straight, and without branching, to the height of forty feet, and has obtained its name from the whiteness of its bark.

The white ash unites all the valuable properties of our common ash, strength, toughness, and durability, and is used in America for similar purposes by the coachmaker and cartwright, and for many others in the mechanical arts. See Caled. Hort. Soc. Mem. Vol. II.

§ 2. *Properties.*—In respect of actual utility, the beech is only inferior to the oak and the ash. It is extremely useful in husbandry, and various branches of machinery; and its close grain and firm texture render it unparalleled for water-works of all kinds; for, when kept constantly wet, it appears as perfectly sound after the lapse of forty years, as when first immersed.

It also makes durable fuel; is esteemed by the herring curers, and much used for bed-posts and waggon-ways; so that few trees yield more profit to the planter, where there is a sufficient demand.

§ 3. *Situation.*—It has not been found prudent to intermingle beech with oak and other timber; it is more profitable in open groves, or mingled with ash, than in coppices of underwood; for, being a quick grower, and extending its roots to a distance, it both overtops and starves its neighbours.* In thick groves, its leaves and mast exterminate grass, and every thing green beneath it.

§ 4. *Soil.*—The beech delights most in light, deep, chalky, or sandy loams, and in all calcareous soils; but will thrive also in soils and situations where few other trees will grow.

Even among the granite rocks of the Highlands, and on elevated situations where soil is hardly visible, this tree arrives at great magni-

* Bath Papers, Vol. VI. p. 29.

tude; and, as a hedge-row tree, for shelter, it stands unrivalled.

In low situations, by the banks of rivers and rapid streams, as at Newbottle, * Ardkinglass, and Panmure, this tree has grown to a very uncommon size. †

§ 5. *Growth.*—A Beech tree, provided that it meets with no accident, will grow with sound timber, for at least 250 years. At the age of 60 years, a beech has been known to contain 100 feet of timber; and in 24 years after, it was calculated to contain 112 feet; being more in the last 24 years, than in the 60 preceding;—an example of uncommon increase. ‡

§ 6. *Species.*—Besides our native tree (*Fagus sylvatica*), we are as yet acquainted only with three other species of Beech. The timber of the

* One tree, in particular, at this ancient seat, lately blown down, contained upwards of one thousand measurable feet of timber (20 loads, or 25 tons), and is reasonably supposed to have been one of the largest beeches that ever grew in Scotland. On the 6th July, 1789, Dr Walker found the trunk, where thickest, to be seventeen feet in girth; and the span of the branches, eighty-nine feet. He supposed it to have been planted between 1540 and 1560. See Nicol's Plant. Kalend. Note, p. 52.

† Some of the finest beeches in Scotland are to be seen at the seat of Mr Forbes of Callendar, and on the banks of Lochlomond, the seat of Hector Macdonald Buchanan, Esq. of Ross. Several of these have been estimated to be worth near 50*l.* each. Gen. Rep. Vol. II. p. 258.

‡ See Highl. Soc. Trans. Vol. I. p. 204.

white (wooded) beech (*Fagus sylvestris*, Mich.) of Canada, and the middle States of America, although a tall and magnificent tree, is inferior to our own, both in strength and durability: But the Red-wooded species of the Northern States, (*F. ferruginea*, Mich. p. 174), equals our native species in every respect; and the colour of the heart-wood, renders its cultivation desirable for the various articles of cabinet-work, bed-posts, &c. in which our own is at present employed. It may be added, that the Purple-leaved beech, now common in our plantations, is a variety of the common beech, totally distinct from this American or Red-wooded species. *

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* Caled. Hort. Soc. Mem. Vol. II. p. 385. It is mentioned by Dr Yule, in the valuable Paper just referred to, 'as an additional illustration of the importance of this tribe, in an economical point of view, that the seeds of our native species (*F. sylvatica*), freed from the husk, afford, by pressure, one-sixth part of a fixed oil of excellent quality; and, when the process is properly regulated, nearly equal to that of olives. In Germany, and the north of France, this oil is prepared by pressure from the fresh seeds obtained from the forests of Crecy and Compeigne, in great abundance, as a substitute for that of olives.

'The bark of the beech, although inferior no doubt to that of oak, is employed in America in the tanning of leather, which is light-coloured, but of good quality.' See Caled. Hort. Soc. Mem. Vol. II.

SECT. IV.—*The* BIRCH. (*Betula alba*, Lin.) var. spec.

§ 1. *Soil and Situation.*—This tree will grow in almost any soil or situation, but succeeds best in a light dry soil. It is found at higher elevations than any other native tree of Scotland, except the mountain-ash; and the greater the height, the more durable the timber.

§ 2. *Properties.*—The birch is an excellent coppice plant, and is very generally found in that character in the Highlands of Scotland, and in many other parts of the country. * It is particularly useful for harrows, and other utensils in husbandry; and in coaleries, for underground props, and waggon-road sleepers.

Birch, may be said to be the universal wood of the Scots Highlanders. They make almost every thing of it; they build their houses; make their beds, chairs, tables, dishes, and spoons of it; construct their mills; make their carts, ploughs, harrows, gates, and fences; and even manufacture ropes of it. †

Its utility as a nursing plant, in bleak and barren situations, and also in making wine, are generally known. Its bark is also valuable for tanning, and frequently used with that of oak. The birch-oil, to which the celebrated Russian

* Nicol's Plant. Kalend. p. 80. † Ibid.

leather owes its fragrant smell, we are told by Pallas, is prepared from the white bark of this tree. *

The birch, is further useful to the inhabitants of the bleaker districts of the country, in affording them excellent fuel, the flame of which is clear, and its smoke less offensive than any other species of wood.

§ 3. *Growth.*—In the forest of Darnaway, in Morayshire, many birches are nine feet in girth, which is about the largest size to which it arrives in Scotland. It is a quick-growing, but a short-lived tree. In 30 years, it will rise to 40 feet in height; but seems to arrive at its full maturity in about 70 years, or, at most, within a century. Its great merit consists in growing freely, in a mossy soil, and at a high elevation, where more valuable timber cannot be so soon, or so easily raised. †

§ 4. *Variety.*—A striking and elegant variety of this species of tree, with pendulous branches, is the Weeping Birch; now in considerable demand, and frequently to be found in the Highlands, where it often assumes a highly picturesque form. The plants may be distinguished from the *Betula alba*, by their glutinous feeling; and the tree, by its pendulous branches.

§ 5. *American Species.*—To our native White

* Pallas's Flora Rossica.

† See Walker's Essays on Nat. Hist. and Rur. Econ. p. 48.

Birch (*Betula alba*), and the above elegant pendulous variety, the utility of which are well known; some enterprising planters have lately added certain American species, but particularly the three following, described and recommended by Dr Yule in his Paper in the second volume of the Caledonian Horticultural Society's Memoirs, formerly referred to, viz.

1. The Mahogany Birch, (*B. lenta*, (Mich. Arb, p. 147. and H. K.) Mountain Mahogany, Cherry Birch of Canada). The bark of this tree is of a brown colour, spotted with white. In the middle States of Pensylvania, New York, and the Jerseys, where it abounds, it attains a height of seventy feet, and is likely to succeed in this climate better than our own species.

The great value of the timber is well known to the cabinet-maker, equalling in beauty that of mahogany, and susceptible of a fine polish. To this, it is added, that the leaves, which appear early in spring, are said to possess a peculiar fragrance, which, on infusion with boiling water, afford an agreeable diluent, superior to some of the common teas of commerce.

2. The Yellow Birch, (*B. lutea*, Mich. Arb. For.) is an inhabitant of the Northern States, and of Nova Scotia. The bark is of a shining yellow, from which it derives its name. It is said to be often imported from Canada, under the name of Black Birch (to which it is inferior), and used instead of it, by our cabinet-makers.

The seeds included in the ripened catkins, can be easily obtained from America.

3. The Black Birch, (*B. nigra*, H. K. Mich. Arb. t. 2. f. 6.) is now become common in our plantations. It is of very quick growth. In the 12th Vol. of the Trans. Soc. Arts, &c., an instance is stated of this tree attaining, in 19 years, the height of 45 feet. *

SECT. V.—*The* CHESTNUT. † (*var. spec.*)

§ 1. *History.*—The Sweet or Spanish Chestnut is a native of the southern parts of England, and of North America.

This is a deciduous tree of the first magnitude, growing to a great height, and swelling to an immense size.

Of all the various species of chestnut, it

* See Caled. Hort. Soc. Mem. Vol. II. p. 381. According to certain researches lately made in Sweden, on the different kinds of wood indigenous to the country; it has been ascertained that the birch reaches the farthest north, growing beyond the 70th degree; the pine reaches to the 69th; the fir-tree to the 68th; the osier, willow, aspen, and quince, to the 66th; the cherry and apple-tree to the 63d; the oak to the 60th; and the beech to the 57th; while the lime-tree, ash, elm, poplar, and walnut, are only to be found in Scania.

† *Fagus castanea*, L.; or *Castanea vesca* of Brown; *Monœcia Polyandria*; *Amentaceæ*, Juss. It has a place in 'English Botany,' t. 886.

seems to hold the preeminence; and was probably much more common in this country formerly, than it is now. The old houses in London and Glocester, are said to have been generally built of this tree;* and the roof of Westminster Abbey, and that of the Parliament House in Edinburgh, afford sufficient proofs of its durability.

§ 2. *Soil and Situation.*—The chestnut flourishes in the vallies of the Highlands, particularly at Taymouth and Dunkeld. It seems to dislike cold stiff land, and luxuriates most in deep sandy loams, † or in loam incumbent on clay, ‡ and in gravelly alluvial soil, near to a river. §

§ 3. *Growth.*—The great chestnut which stood at Finhaven in Forfarshire, was long accounted the largest tree in Scotland; and supposed, from its dimensions, to have been planted about 500 years ago; and to be the oldest planted tree that we have any account of in Scotland. The greatest circumference of the trunk of this enormously large tree was forty-five feet. ||

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* Many pieces of wood, however, found in the old buildings of London, and supposed to be Spanish chestnut, were examined by Mr Knight, and found to be forest oak.

† As at Alva, Stirlingshire.

‡ Brechin Castle, Forfarshire, and at Gargunnock, Stirlingshire.

§ As at Finhaven, Forfarshire. See Nicol. Plant. Kalend. p. 55.

|| Mr Nicol, Dr Walker, &c. In England, the chestnut is still more remarkable for its growth. The very remarkable

§ 4. *Properties.*—The common chestnut is much esteemed by the cabinet-maker for various purposes, and for gate-posts. It is supposed inferior only to the larch and the yew; and its bark, which is strongly astringent, affords a tan equal to that of the larch and mountain-ash. *

It is also a good coppice tree, and is generally used in the hop counties for poles, and for pipes to convey water under ground: where 'it stands wet and dry,' it is more durable than the elm, and perhaps equals the oak. †

§ 5. *Distinct Species.*—To the common chestnut tree, which ripens its fruit in our sheltered valleys, has been added a distinct species (*C. microcarpa?*) from North America. This, like the European species, occasionally attains a magnificent size. Michaux measured several of them in the mountains of North Carolina, of the circumference of fifteen and sixteen feet, with a proportionate height. The European, is now grafted on the stock of the American species with great advantage. Mr Neill, in the article Horticulture, published in the Edinburgh Encyclopædia; informs us, that in Devonshire, where the chestnut is cultivated on account of its fruit, grafting from branches bearing the largest and

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chestnut at Tortworth House, Glocestershire, is supposed to be 1000 years of age, and in 1791 measured 44 feet 4 inches in circumference. See Glocest. Rep.

* See Nicol's Plant. Kalend. p. 85. † Ibid.

finest nuts, is general, and produce fruit sweeter than those imported from Spain.

The Chinquapine, or dwarf American species (*C. pumila*), is said to be undeserving of attention. *

Sect. VI.—*The* Elm. (var. spec.)

Scots elm (*Ulmus montana*, L.); English elm (*U. campestris*).

§ 1. *Varieties.*—Of the elm tribe, Linnæus enumerates three species; Miller, six; Hanbury and Willdenow, seven; and Marshall, only two: But there are nine distinct species now known to botanists. The two in most general estimation, however, are the Scots or Wych elm, † and the English elm; ‡ the former a native of the Highlands of Scotland. §

§ 2. *Soil and Situation.*—The Scots elm accommodates itself to almost every soil and situation. It attains its greatest magnitude, and flourishes

* See Caled. Hort. Soc. Mem. Vol. II. p. 375; and Edin. Encyc. Art. Horticulture, 197.

† *Ulmus montana*, L. (Eng. Bot. 1887), (broad rough-leaved).

‡ *U. campestris*, L. (Eng. Bot. 1886), (narrow-leaved).

§ The white elm of North America (*U. Americana*, Mich.) from the surprising magnificence of its appearance, deserves attention; and would flourish in the sheltered vallies in the Highlands of Scotland. Caled. Hort. Soc. Mem. Vol. II. p. 391.

most, in a deep, rich, black mould; it thrives well, and produces the most valuable timber, in a hazelly, sandy loam, or a gravelly subsoil; but rejects chalk and morass. *

It bears inundation with considerable patience; and finds food on the bleakest hills, by insinuating its roots into the crevices of rocks. †

The English elm, on the other hand, rarely abounds, except where the soil is light, dry, and fertile; unless when grafted on the Scots elm, by which its growth is greatly accelerated. ‡

The Elm requires an open space, and much room for its roots to spread; and consequently, should either be planted in single rows, in small clumps, in the grove, the park, or in hedge-rows.

§ 3. *Properties.*—Among the trees most deserving of culture in Scotland, the elm is justly entitled to be placed next to the ash; and, as a valuable forest tree, probably gives place to the oak and larch only. Its timber is particularly valued by the coach-maker, the cabinet-maker, the mill-wright, the pump-maker, and the ship-builder. It is much in demand in boat-building, for floor, keel, stem, ribs, &c.; and, for the purposes of husbandry, it has been long in estimation, as we learn from Virgil:—

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* See Bath Papers, Vol. VI. p. 11.

† Nicol's Pract. Planter, Edit. 2d. p. 43.

‡ See Pontey's Profit. Planter, Edit. 3d. p. 109.

'Continuo in sylvis magnâ vi flexa domatur
In burim, et curvi formam accipit ulmus aratri.'

On this tree the sea storm appears to make but a feeble impression. On the west coast of Scotland, it effectually resists the prevalent south-west winds from the Atlantic. 'When violent gales 'occur early in the season, it will render the 'leaves black; but, if not succeeded by repeat-'ed gales, they soon recover their verdure.'* Hence it is peculiarly adapted for the external rows of plantations on the sea coast; being found, together with the sycamore, most patient of the sea breeze and moisture. The timber of this tree being also highly valuable, renders it worthy of a fair trial, by the agricultural planter, on the eastern coasts of Scotland. The timber of the fine leaved, or English elm, is much inferior to that of the Scots elm, both in value and durability.†

§ 4. *Growth.*—The growth of this tree, compared to that of oak, in a hazelly loam, has been found to be as three to two; and the value of the timber, if long and straight, as two to three. The profits of the planter, therefore, in oak and elm, will be nearly on an equality. But though

* MS. Communication from the late Robert Reid Cunningham, Esq. of Auchenharvie.

† Dr Yule gives a preference to the English elm; but in this he is singular. See his Paper, in Caled. Hort. Soc. Mem. Vol. II. p. 390.

the Scots elm abounds, and is to be met with in several places of a great age, both in natural woods and plantations in Scotland; yet in England, it is often to be seen of much greater magnitude. *

A single elm has been known to produce twelve tons of timber, round measure; and, when allowed sufficient range, this tree will increase about an inch and a half annually; though, in situations particularly favourable, it has been found to gain two inches annual increase. †

§ 5. *Propagation.*—The Scots and English elms, unfortunately, are easily propagated from layers, which never make good trees, but produce a stinted race of dwarfs only, instead of the tall magnificent progeny of nature. When intended for ornamental trees, for the park, or the lawn, they ought to be raised from the seed; and the English, budded or grafted on the Scots elm; by which means, trees of superior vigour and appearance would be obtained. ‡ Very good trees may

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* Mr Marsham (in Bath Papers, Vol. I. p. 76.) mentions a Wych, or Scots elm, by Bradley Church, in Suffolk, which in 1767 measured 26 feet 3 inches, at five feet from the ground. And Dr Plot (Nat. Hist. Staffordshire, p. 211.) gives an account of a Wych elm, which measured 51 feet, or 17 yards in circumference.

† For a valuable paper on the Growth of Elms, see South. in Bath Pap. Vol. VI. p. 1.

‡ For the modes of propagating the elm, see Hanbury's Directions, as quoted by Marshall in his work on Plant. and

be produced from suckers, if placed for two or three years in a good nursery.

Sect. VII.—*The* Æsculus Tribe. (var. spec.)

§ 1. *Description.*—The common Horse-chestnut tree, (*Æsculus hippo-castanum*, L. Schm. Arb. t. 38.) though originally from the north of Asia, is a tree of the second class, growing occasionally to the height of seventy or eighty feet, and highly ornamental. The elegant palmate form of the leaves, seven together, and the numerous and large spikes of white flowers streaked with yellow and rose colour, appearing early in June, are interesting and beautiful. The beauty, therefore, rather than the value of the timber of this tree, renders it an object of interest. *

§ 2. *Uses.*—The timber of the Horse-chestnut, from the scarcity and high price of other woods, has of late been applied to several purposes. It has been used in the building of temporary sheds, and out-houses; in the cleathing of stone carts, as it does not easily splinter; and for lime-boards, troughs, boxes, &c. †

§ 3. *Species.*—The variegated kind, and the

Rur. Orn. Vol. II. p. 427.—Trans. Soc. of Arts, &c. Vol. XXV.—Vancouver's Devon. p. 257, &c.

* Caled. Hort. Soc. Mem. Vol. II. p. 401.

† Nicol's Plant. Kalend. p. 83.

scarlet-flowering species, (*Esculus pavia*)* both of which are propagated by budding, on stocks of the common horse-chestnut; are also much esteemed, and extremely ornamental.† The tetrapetalous flowers arranged in spikes, and the five-palmated leaves, are common to the whole of this tribe in America.‡

The *P. Lutea* (Mich. p. 238.; *Esc. flava*, Willdenow) is also a fine tree, attaining a height of more than seventy feet, and worthy of being introduced into this country. It grows in lat. 39. N. §

SECT. VIII.—*The* FIR, *or* SPRUCE TRIBE.

§. *Species and Varieties.*—As the Fir, or Spruce family, differ in many essential particulars, both from the larch and pine tribe, it has been deemed proper to assign a distinct section for each. An attention to accuracy of character, even in a popular view, is becoming daily more urgent, in order to avoid utter confusion.

The spruce fir is a hardy tree, and an excellent nurse; and, though possessing alternate leaves like the larch, differs widely from it in the form of the buds, the structure of the flower, and general aspect. The species of this tribe affording timber most in demand, is the

* Buck's Eye of North America. † See Nicol.
‡ Caled. Hort. Soc. Mem. Vol. II. § Ibid.

Norway fir,* and the Black spruce.† Another species cultivated in our nurseries, the White Spruce,‡ is occasionally planted, for ornament during winter; the perennial leaves being of a pale bluish green, although the timber is of small value. In a close examination of this family, it appears that traces of at least *two* natural genera are included under it, viz.

1. The proper spruces already mentioned—*A. excelsa* of the north of Europe, and *A. nigra* and *A. alba* of North America.

These three species, and others that might be added, agree in certain well defined characters; in all of them, the single quadrangular alternate leaves, surround the shoots from whence they germinate.

2. Of the Fir genus, the Silver fir of Europe (*A. picea*), and its relatives, *A. balsaméa*, and *A. Canadensis* of North America, afford evident instances; the flat, and generally emarginate, lateral, and nearly pinnate leaves, readily distinguishing them. Thus, the Pine genus of Linnæus and of Lambert, even as characterized by Willdenow; not to mention the additional species lately described by Michaux the younger, in fact includes *several* kindred tribes.||

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* *Abies excelsa*, Sal.; *Pin. abies*, H. K.

† *A. nigra*, Mich. Arb. For.; *P. nigra*, H. K. See Lamb. Pin. t. 25. and 27.

‡ *P. alba*, H. K.; *A. alba*, Mich.

|| See Caled. Hort. Soc. Mem: Vol. II. p. 365.

We shall notice only the most useful, in their order.

1. Norway Spruce fir, (*Abies excelsa*, Sal.; *Pin. abies*, Lin. and Hort. Kew.) This species of fir is a native of Sweden and Norway, and its timber in considerable demand.

§ 1. *Properties.*—The wood of this species is called white deal in England; it is firm, straight, and regular in the grain, and capable of resisting moisture for a long period. That which is grown in England is said to be more durable than that which is imported, and is particularly in demand for ladders, cottage tables, and other furniture; but in the north of England, it is reckoned less durable than the red deal, and bears an inferior price. *

For the purpose of shelter, the merits of the spruce fir have hitherto been but inadequately appreciated. It is, of all other trees, perhaps the best calculated for a nurse. It is thickly leaved, its branches of a strong unpliable nature, and it feathers to the very ground. Consequently, it affords much protection to deciduous trees of every description, and does much less injury than

* The genuine Burgundy pitch is prepared from the resinous juice of this tree. A healthy tree, in a good soil, will yield thirty or forty pounds of resin each year, according to Du Hamel; from which Dr Anderson calculates, that the value of a Scots acre would amount to 33*l.* 6s. 8d. Sterling per annum.—Scots Mag. Vol. XXXIII. p. 406.

the larch, by lashing or wind-waving.* Memel log is said to be the produce of the spruce.

§ 2. *Soil.*—The spruce, like all the pine tribe, will grow in very different soils. On a dry soil, it makes for some years a very pleasant appearance, but soon ceases to be luxuriant; in deep, sandy loams, where it enjoys moisture and freedom of space, it retains its lower branches to the ground, and is found in greatest perfection.† In shallow soils and exposed situations, it seldom succeeds.‡

This tree should be planted thick in masses or groves, by itself, as in Sweden, Norway, and Denmark; and, if afterwards properly pruned and thinned, will produce tall clean timber.‖

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* 'From my own experience,' says the Lord Chief Commissioner (Adam), in his Letter on Planting, appended to the Kinross-shire Report, 4to edit. 'I have no hesitation in saying, that the spruce is to be preferred beyond all other trees 'as a nurse. I have thousands of instances of oaks and elms 'growing up uninjured in the bosom of spruces. It does not 'lash the neighbouring trees as the larch does,' &c. See Supplement to Kinross-shire Report, 4to.

† Fine trees of this species may be seen at Milton Abbas in Dorsetshire, and at Paine's Hill, &c.

‡ Nicol, &c.

‖ Mr Marsham informs us (Bath Papers, vol. i. p. 77), that in the dock-yards at Venice, he saw spruce and silver firs above 120 feet in length; and one, which was 117 feet long, was 18 inches in diameter at the small end. He was told they came from Switzerland.

The late Dr Walker, in his Economical History of the

§ 3. *Propagation.*—The mode of propagating this tree is nearly similar to that of the Scots fir; only, it may be remarked, the spruce will grow more easily when of a large size, and, consequently, does not require removing so often in the nursery.

Hebrides, observes, that 'the spruce fir has been planted above a hundred years in Scotland; but in most places in an improper soil, as the natural soil of the tree has either been unknown or disregarded. We hear of vast trees of this sort growing in Switzerland, Germany, Sweden and Russia; and the climate of Scotland is certainly as favourable for it as that of any of these countries. It requires but about one hundred years to arrive at its greatest bulk and perfection. We have great numbers of spruce firs in Scotland, which approach nearly to this age, and many which even exceed it; yet we seldom find, among them, trees of such a size as is common in the natural woods of the above countries. This is not owing to difference of climate, but to the tree being generally planted with us in an improper soil. The largest spruce firs in Switzerland and Germany are at the foot of mountains, where there is abundance of moisture, or in swampy grounds. Professor Gmelin and his company, in traversing Siberia, always found water wherever there was a group of tall pitch-fir trees. Accordingly, the only large pitch-fir trees in Scotland, are a few which have been planted, accidentally, in wet ground: such are the lofty pitch-firs at Bargaly, in Galloway; at Castle Menzies, in Perthshire; and such *was* the noble group of pitch-firs at Drumlanrig; while in all the adjoining plantations that were dry, the tree was of an inferior and stunted growth.' This train of remarks shows the great utility of paying due attention to the native soil of the foreign trees which we cultivate.

2. The Black Spruce of North America, (*A. nigra*, Mich. Arb. For.; *P. nigra*, Lin. and Hort. Kew.), is also well adapted for planting in the vallies of the Highlands; the timber of this and the Norway spruce, especially for deals and all manner of inside work, being infinitely stronger and more durable than that of any other of this tribe whatever. The Black spruce is a native of New England, Canada, &c.; and in America, is used for knees in ship-building, where neither oak nor black larch can be easily obtained.

§ 1. *Variety*.—The Red spruce (*P. rubra*, H. K. and Lamb, P. t. 28.), according to Michaux, is not a distinct species, as has been generally supposed, but only a variety of the Black spruce, arising from soil and situation, and, in fact, by far the most valuable of the two. * The timber of this species, according to Dr Yule, † is universally preferred throughout the United States, for sail-yards, and indeed imported for this purpose into Liverpool from Nova Scotia, where it is also used for constructing casks for salted fish.

It is from the decoction in water of young shoots of the Black, and not from those of the White spruce, as supposed by Lambert, that the celebrated beer is prepared by fermentation, with

* 'C'est dans cette nommée Sapin Rouge (Red Spruce) 'qui se trouve réunies au plus haut degré toutes les qualités 'qui font rechercher cette espèce, viz. la force, l'élasticité, 'et la legèreté.'—Arbres For. tom. ii. p. 128.

† Caled. Hort. Mem. vol. ii. p. 364.

a due proportion of sugar and molasses. The essence of spruce of the dealers, is said to be prepared by evaporating this decoction to the consistence of honey. *

3. The third species of the Spruce fir above mentioned, or White Spruce (*Pin. alba*, Lin. and H. K.; *A. alba*, Mich.), is also a native of North America, above the 34th degree of north latitude; but it disappears to the southward. It is recommended by Wangenheim as a hardy, profitable tree; although perhaps it is more ornamental than useful; and, from the peculiar glaucous nature of its leaves, makes a beautiful appearance when mixed with other trees.

Fir Genus.—Of this genus, the Silver fir of Europe (*A. picea*), is the only species that deserves attention. †

§ *Growth.*—In the vallies of Switzerland, it attains a magnificent height, rising above an hundred feet; and affords timber greatly superior to the silver fir of America, the vaunted balsam of Gilead. ‡

Soil.—Its proper soil seems to be a deep sandy loam, on a gravelly or pervious subsoil. It fails on a thin clay or poor sand.

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* See Caled. Hort. Soc. Mem. vol. ii. p. 364.

† The other two species of this genus, the hemlock spruce (*A. canadensis*, Mich.) and the American silver fir (*A. balsamea*), afford only a soft and brittle timber.

‡ The balsam of Gilead is merely a variety of turpentine. See Hort. Soc. Mem.

Properties.—Turpentine is extracted from this tree; and it proves a good nurse, although inferior, in this respect, to the Norway spruce.*

There may be seen some fine specimens of this tree at Panmure; at Newhall in Haddingtonshire; at Lochnell in Argyllshire; and in Dunmore park and wood, Stirlingshire; which last have grown with great rapidity, and promise to equal any trees of the kind, in Britain.

Sect. IX.—*The* Hazel.† (spec. var.)

The common hazel is a native of Britain; and, although a valuable forest tree when raised from the seed, much attention has not been paid to the rearing of it in Scotland.

§ 1. *Varieties.*—There are several varieties of it: the common hazel, or white filbert tree, with small, pale-coloured fruit; the red filbert, *Noisettier à fruit rouge*; the cob nut, with large round fruit; the cluster-nut; and the dwarf prolific nut:‡ but the latter are but little known in this country; the greater proportion of our fruit be-

* See Supplement to Kinross-shire Rep. 4to Edit.

† *Corylus avellana*, Lin.; Eng. Bot. t. 723.; *Monœcia Polyandria*; *Amentaceæ*, Jussieu. The trivial name *Avellana*, is derived from a town near Naples, where the Spanish filbert has long been extensively cultivated. See Art. Hort. Edin. Encyc.

‡ Ibid.

ing obtained from the common variety, which abounds in our woods, particularly in the Highlands.

§ 2. *Growth.*—This species attains the height of from twenty-five to thirty feet, when raised from the seed, and the best plants only allowed to remain, without transplantation. *

§ 3. *Propagation.*—The varieties producing the finest fruit are best cultivated from layers; and, for this purpose, dwarfs are propagated and preferred, and the different varieties thus continued.

In Kent, small plantations of dwarf-filbert trees are formed in this way for the supply of the London market with nuts. The trees are twelve feet asunder, and not allowed to rise higher than six or seven feet, and trained like gooseberry bushes, open in the centre. †

§ 4. *Soil.*—The hazel tree grows vigorously in a strong loam, or in any soil retentive and moist; and is ornamental on the sides of banks, in pleasure grounds, early in spring, when the catkins or male flowers, and the female gems with their bright red styles, are displayed.

§ 5. *Properties.*—The hazel tree is, in many situations, valuable for its fruit. It is useful in copses, not only for its fruit, but also for its shoots, when cut near the ground; which are

* See Hort. Soc. Mem. Vol. II. p. 400.

† See article Horticulture, in the Edin. Encyc.

sold for hoops, stakes, and other agricultural purposes. *

Sect. X.—*The* Holly. (*Ilex aquifolium*, L.)

§ 1. *Properties.*—The holly is one of the most beautiful, ornamental, and hardy of our evergreens; and grows in considerable abundance amongst the copse woods in the Highlands of Scotland, particularly upon the banks of Lochlomond. Besides the common green holly, there are many of its beautiful varieties which arrive at a great size, are peculiarly adapted to the decoration of the lawn, and claim a conspicuous place in all ornamental plantations. †

The timber of the holly is heavy, compact, and valuable. It is the whitest of all hard woods, and is chiefly used in inlaying and fineering: by

* The Constantinople, or Byzantine hazel, (*C. colurna*, Lin.) differs from the other species, in having a double calyx. It is a tree of the fourth class, and produces nuts which are twice the size of the common hazel nuts, and grows in large racemes. It seldom, however, bears fruit in this country.

There is one of the finest specimens of this hazel in Britain, in the Botanic Garden, Leith Walk, Edinburgh, twenty-five feet high, and fifty years old, (1816.) See Art. Horticulture, Edin. Encyc.

Wherever a copse is intended as a cover for game, near a residence, Mr Nicol recommends hazels in abundance to be planted as nurses.

† See Nicol's Plant. Kalend. p. 115.

turners, and for blocks used in printing cloth. Birdlime is made from its bark, after being fermented, and washed from the woody fibre.

§ 2. *Soil.*—The holly will grow in a variety of soils, from a light sand to a strong clay, and in wet gravelly soils, to the height of 500 feet above the level of the sea. A high, calcareous loam, is said to be its natural soil and situation.

§ 3. *Species.*—There are three distinct species of holly; one of Europe, one of Asia, and one of America. The last has been introduced into our gardens and shrubbries, making, with the common holly, two species, viz. the common holly, (*Ilex aquifolium*), and the American holly, (*Ilex cassine.*)

§ 4. *Growth.*—The European, or common holly, according to Marshall, will grow to the height of thirty or forty feet, with a proportional stem; frequently shooting up naked and silvery, six or eight feet high, and supporting a close, snug, elliptical head.

§ 5. *Value.*—A few of the holly trees in the plantation in Inch Lonachan, an island in Lochlomond, cut down several years ago, sold at half a crown per foot, by the girth measure, and all expenses defrayed by the purchaser. They were intended as blocks for the printing business, and yielded the proprietor, Sir James Colquhoun Bart. the sum of 70*l.* Sterling. They did not, probably, occupy above an acre of land. *

* Dumbartonshire 4to. Report, p. 85.

The greatest number of fine hollies we recollect to have

The proper season for transplanting the holly, is supposed to be the month of August, as well as for all evergreens.

Sect. XI.—*The* Hornbeam, *or* Ironwood Tribe. *

§ 1. *Species and Varieties.*—This tribe includes the two kindred genera, *Carpinus* and *Ostrya.* The common hornbeam, * of which there are two varieties, is a native of Britain. When raised from seed, it forms a first-rate tree, equalling the beech in magnificence; but the English nurserymen, having raised great numbers of them from layers, purposely for hedges; a bushy, dwarf progeny, has been the natural consequence, which has probably been the cause of the hornbeam having been rather neglected as a forest tree.

§ 2. *Soil.*—The hornbeam is a hardy tree, and is to be found thriving in many bleak situations, and in a variety of soils; but in more favourable situations, and particularly in loamy soils, † it becomes a large tree.

§ 3. *Properties.*—The timber of this tree is no-

seen, are at Gordon Castle, in the county of Banff. There are also some fine large variegated ones in the garden at Dunmore Park; and one uncommonly luxuriant and spreading, in the avenue at Airth Castle, Stirlingshire.

* *C. betulus*, Eng. Bot. t. 2032.

† As at Alva, Stirlingshire, and at Keith-Hall, Aberdeenshire. See Nicol's Plant. Kalend. p. 57.

thing inferior to the beech, and even preferable for mill-work. It makes good fuel, and affords excellent charcoal; it is well adapted for a skreen or fence, as it retains its leaves, like the beech, in a shrivelled state, during the winter. It produces good stakes for fences, and forms an excellent cover for game. *

The following description of the American hornbeam, † is given by Dr Yule, in his valuable paper formerly quoted. ‡ 'The American hornbeam is named ironwood, from the close, compact, and unusual specific weight of the timber. Indeed, the number of the concentric circles perceptible on a horizontal section of the trunk, or even branches, of a very small diameter, clearly shows the slow growth of this hornbeam; and the utmost height it attains scarcely extends to forty feet, under the most favourable circumstances. The great strength of the timber, however, strongly induces us to recommend it to be planted in North Britain; especially as its geographical range includes Lower Canada and Nova Scotia, although extending southwards to the middle States. The name, *Bois à levier*, indicates the acknowledged strength of the timber, being used for levers in removing the trunks of other trees.

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* As at Alva, Stirlingshire, and at Keith-Hall, Aberdeenshire. See Nicol's Plant. Kalend. p. 90.

† *C. americana*, Mich. Arb. For. p. 57.

‡ See Hort. Soc. Mem. Vol. II. p. 398.

'Those planted by Duhamel,' he adds, 'on 'his estate in France, are at this moment thriv- 'ing; some of them twenty feet high: and as 'they ripen their seeds, these might be easily ob- 'tained.'*

Sect. XII.—*The* Laburnum. (*Cytisus laburnum.*)

§ 1. *Varieties.*—The Laburnum is one of our hardiest, most useful, and ornamental trees. There are several varieties of it, although only two have been noticed by writers on the subject; the tree-laburnum (broad-leaved variety), and the shrubby. The tree, or Scots laburnum, is the only one worth propagating for timber. It is easily distinguished from the others, by its large, shining, trifoliate, light-green leaves, and elegant pendulous yellow spikes, occasionally ten or twelve inches in length,—when raised, as it always ought to be, from the seeds. The bark is also more glossy, the buds larger and bolder, and

* The only other species of hornbeam, as yet known, mentioned by Yule, is the *C. orientalis*, introduced by Miller, which grows much less freely than the American species.

Of the other genera, *Ostrya*, or Hop Hornbeam, two species are mentioned in the Kew List;—*Ostrya vulgaris*, of the south of Europe, with pendulous flower-spikes; and *O. virginica*, a species abounding in the middle States of North America, having the spikes erect. See Hort. Soc. Mem. Vol. II. p. 399.

the bunches of flowers are longer than that of the shrubby kinds. The one, however, by ignorance or inattention, is generally confounded with the others. It is therefore of particular importance, when timber trees are wished for, that the pods be gathered from the real tree-laburnum. *

§ 2. *Soil.*—The tree-laburnum is a native of Switzerland and Savoy, and grows freely in exposed situations, and indifferent soils. It is supposed to attain its greatest value in light loams, or deep sandy soils.

§ 3. *Properties.*—The timber of the laburnum is much valued † for its hardness, beauty of grain, and durability; and indeed is the most valuable, and high-priced, of any tree that grows in this country. Its wood is much prized for inlaying, and other purposes of the turner and cabinet-maker.

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* The seeds are taken from the drying loft in spring, beat out of the pods, and sown immediately.—*Nicol.*

† We are informed, (Nicol's Plant. Kalend. p. 91.), that 'there was a considerable quantity of laburnum timber sold 'at Brechin Castle, and Panmure, in November 1809, by 'public sale, at fully half a guinea per foot! In 1806, at another sale, a quantity was sold at 7s. 6d. per foot.'

The Black *Cytisus*, and other varieties of this species, being mere shrubs, do not require particular notice.

The writer of this Abstract, a few years ago, procured a few seeds of a *sweet-scented* species, from a friend; obtained through the medium of the then Lord Lieutenant of Ireland, which thrive well in good garden soil. He has not seen it characterized, nor has he ascertained from what country the seeds were procured.

SECT. XIII.—*The* LARCH TRIBE. (*Larix*). (spec. var.)

The Larch is the most important acquisition, in respect to timber, that has ever been made to this country. It is peculiarly calculated for the Highland districts; it is, beyond comparison, the quickest grower, and the most elegant and valuable of all the other species of trees reared in Scotland.

§ 1. *History.*—The common, or white larch, (*Larix pyramidalis*, Salisb. *), is supposed to be a native of the Alpine mountains, and was first introduced into North Britain by that distinguished patriot and philosopher, Henry Home, Esq. (Lord Kames), in 1734; † and soon afterwards, the grandfather of the present Duke of Athol (who has distinguished himself, by nearly finishing the plantation of 12,000 acres, principally of larch) planted a number of these trees in the lawn of Dunkeld, which, in somewhat more than

* Lin. Trans. 8th.

† Hort. Soc. Mem. Vol. II. p. 359. And Lamb. pin. t. 35. &c. This circumstance, respecting the introduction of this valuable tree into Scotland, has been rather incorrectly stated in the General Report of Scotland, Vol. II. Chapter 10th, having been taken from the Original Printed Sketch of that Chapter, drawn up by the writer of this Abstract; and which, from the new arrangement that took place, he had it not afterwards in his power to correct.

fifty years, attained nearly the height of one hundred feet; and, at five feet from the ground, a circumference of eight feet; a rapidity of growth which has been already proved by no means to diminish the density and durability of the timber, now found equally adapted to the purposes of naval and domestic architecture.

It is found in abundance in Carinthia, in the country of the Grisons, and throughout the whole extent of the Alps, often with a trunk eighty feet in height, perfectly straight throughout its whole length; and has been applied to the purposes of ship timber, both in Italy and Russia, for ages past. *

§ 2. *Soil.*—The larch possesses a remarkable facility of adapting itself to almost every variety of soil and exposure; and, with the exception of a low, stiff, humid, or deep rich soil, void of calcareous matter, there is scarcely any situation where the larch will not thrive. It seems, however, to grow most vigorously in soils of an inferior order, particularly in thin, gravelly, heathy, and calcareous soils.

§ 3. *Properties.*—The wood of this tree is possessed of many valuable properties; and its uti-

* According to Coxe, the vessels on the lake of Geneva are constructed of larch, being more durable than oak. In some parts of the Pays de Vaud, the houses are constructed of square blocks of this timber, which consolidate by means of the resinous exudations, and last for centuries.

lity is now generally known, and duly appreciated. It is probable that the larch will soon supersede the Scots fir, in a great measure, in this country, as it affords double the price, will arrive at a useful timber size in one half, or a third part of the time, in general, which the fir requires; and the timber of the larch, at thirty or forty years old, is, in every respect, superior in quality to that of the fir at a hundred years old. *

The timber of the larch is also much closer in the pores, and has fewer large knots than the common fir; and seems to vie with the oak itself in point of durability. It is useful in ship-building, in house-building, in husbandry, and in cabinet-making. It not only bears wet and dry equally well, but alternations of either, better than any other tree. It is therefore most useful in the construction of mill-dams, sluices, mill-cogs, gate-posts, &c. Its property of burning with difficulty (remarked so long ago as the days of Pliny), renders it peculiarly eligible for flooring; and, for subterraneous, and subaquatic purposes, it is amazingly durable. †

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* See Nicol's Plant. Kalend. p. 94.

† Pallas relates, that in Siberia, some burial places of an unknown nation, and of remote antiquity, still remain with beams and supporters of larch entire. The wood of the larch is almost incorruptible, either in the open air, or under water, as is clearly demonstrated at Venice, the greatest part of which city is built upon piles of larch wood, which are not

It further possesses the property of effectually resisting the worm; it is neither liable to shrink nor warp, when put up into work; and, when cut into thin slices, it is the best substance yet known for putting behind prints in framing. On account of these qualities, the wood of the larch is excellently adapted for painters' pallets. Before the use of canvass, it formed the tablets on which the immortal Raphael, and the famous artists of his time, eternized their art; and, on account of the fine polish of which it is susceptible, has been supposed to give to their colours a peculiar grace and brilliancy. *

only still fresh, (although they have remained there for many hundred years), but they have at length acquired such a degree of hardness, as in some measure to resemble iron, and to resist the edge of the best tempered tool. See Agricola's Letters on Planting, Scots Mag. Vol. XXXIII. p. 349.

'Witson,' (says Evelyn,) 'a Dutch writer on ship-building, 'mentions a vessel constructed of larch and cypress, being 'found in the Numidian sea, twelve fathoms under water. It 'was reduced to such a degree of hardness, as greatly to re-'sist the sharpest tool. Nor did it appear that any part of it 'had perished, although it had continued under water above 'a thousand and four hundred years.'

* The single fact, that Raphael, Urbin, and other celebrated artists of that age, painted many of their best pictures on larch wood, which exist till this day sound and entire, establishes not only its durability beyond the possibility of a doubt, but that it possesses the additional excellency of neither shrinking nor warping when made into work, nor of being liable to be attacked by the worm, during the course of several ages. Most of these pictures are now upwards of 300

The wood of the larch, cut into shingles of of about one foot square surface, and half an inch in thickness, is used in Switzerland for covering the roofs of houses; which, in the course of two or three years, by the oozing out of the resin, become impenetrable to rain.

The bark of the larch, too, possesses a considerable quantity of the tanning principle, nearly equal to that of oak, and is now extensively used for that purpose with good effect.

It is from the Larch and Silver fir, that the Venetian turpentine is extracted; but although it bears the name, very little of it is exported from the Venetian territories.* The true liquid resin of the larch, is obtained chiefly from France and Germany; that which is met with in the shops, is generally imported from New England. The inner wood of this tree yields a pure gum,

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years old; and it is obvious, that the smallest warping, or shrinking in the wood, must have cracked and destroyed the paintings; nor are any worm holes discovered on examining the back of the boards.

* The substance called Venice Turpentine, issues spontaneously from the bark of this tree, but is principally procured by boring a hole, about two feet above the ground, to near the heart of the tree. Into this orifice, a small pipe is inserted, and the turpentine flows into vessels placed for its reception. The middle aged trees are the most productive. A vigorous tree will yield 7 or 8 pounds, annually, for 40 or 50 years. For an account of the process, see Scots Mag. Vol. XXXIII. —also *supra*, p. 213.

scarcely inferior to that of Arabia; but appears to have been hitherto used only in Russia.

§ 4. *Annual Increase.*—The annual increase of the Larch tree, in circumference, at six feet from the ground, on an average of several years, from ten years old to fifty, has been ascertained, by actual admeasurement, to be, from one inch, to one inch and a half, according to the situation in which they are planted.*

In the Agricultural Report of Perthshire, Dr Robertson mentions, that, in the course of his Survey, he had seen larches which, at forty-seven years of age, had a diameter, at five feet from the ground, of thirty inches; and, consequently, circumferences of 94.2, or rather more than two inches annual increase from the first planting.†

In the seventh volume of the Transactions of the Society of Arts, &c. a detailed account is given of the dimensions of a larch of fifty-four years of age, growing at Blair Drummond, near Stirling, whose circumference, at six feet from

* Comm. to the Board of Agric. Vol. VI. Part I. p. 5, &c.

† The Lord Chief Commissioner Adam, in his paper on Plantations, (annexed to the fourth edition of the Kinross-shire Report), mentions, that 'on his estate of Blair in that 'county, he had measured many larches in 1794, planted in 'the year 1769, which were four feet and a half in circum-'ference, at the height of four feet from the ground; and 'some of those which were cut down in thinning, had in 'them about two-thirds of red wood; calculated for rafters 'and half couples,' &c.

the ground, was, at that age, 78 inches, or near one inch and a half annual increase from the first planting. In 1806, this larch measured, at the same height, 88 inches; having in 18 years gained only an increase of ten inches, or a little more than half an inch annually for the preceding 18 years.

One of the oldest larches in Scotland, now (1819) eighty years of age, on the Duke of Athol's lawn at Dunkeld, was found by actual admeasurement, in 1796, to be, at the height of three feet from the ground, ten feet in circumference; and nine feet in circumference, at six feet from the ground; being about two inches annual increase during the first 56 years of its growth.*

§ 5. *Value.*—From the annual increase above noticed, an acre of larches, at a medium, will, at the age of twenty or twenty-four years, contain two feet of wood each, which, at only one shilling a foot, is two shillings a tree; and for a thousand trees, (the number which should stand upon an acre), will amount to 100*l.*

It has been observed, too, that the larch grows well and readily, by the shedding of its seed.†

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* A larch tree, planted about sixty years ago, was some time since cut down, near the cathedral of Dunkeld, 110 feet high, and containing 160 cubical feet of wood.

† 'One of my plantations,' says Mr Adam, in his paper on Plantations already quoted, 'planted in 1763, contains a 'considerable proportion of larches. There were left in it

In short, experience fully justifies the conclusion, that the larch is equal, in every respect, to foreign timber; and, for many purposes, greatly superior. It may be reared much clearer of knots; it is much tougher; less liable to shrink; superior in colour; and, in point of durability, there can be no comparison. *

§ 6. *Different Species.*—It only now remains, in discussing the Larch tribe, briefly to notice the most valuable of the different species; as several distinct species have been confounded in our plantations in this country, which obviously require different situations as to climate, and evinces more and more the utility of an accurate distinction of character.

The different species of larch may most readily be distinguished by their cones. In the common species, the cones (*strobili*) are oval, and at least an inch long; the scales notched and open, and even bent somewhat backwards, in the mar-

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'large vacant spaces, to answer the purpose of ridings, and 'of bringing out the wood, when there should be thinnings.

'In those vacancies, there are many young larches growing most vigorously; and, as I am sure none were planted 'there, they must be self-sown from the seed of the adjacent 'trees. It is worthy of remark, too, that horses have been 'permitted to graze in that plantation, and the young larches 'bear no mark whatever of having been injured by them. 'Black cattle have been excluded.' See Supplement to Kinross-shire Rep. 4to.

* For remarks on the superiority of larch to foreign fir, see Pontey's Profitable Planter, 3d edit. p. 34, &c.

gin; circumstances carefully to be observed in purchasing or gathering them for use.

2. The Black Larch (*L. pendula*, Salisb.*) is much more tolerant of cold than the common kind, its native country being northward of the river St Lawrence in America, where it occupies forests for miles, attaining the height of eighty or a hundred feet. In this country, then, in planting the Black larch, it has been recommended to associate it with our native pine (*Pinus sylvestris*), in the more elevated parts of the country, as more nearly approaching its native geographical situation. †

The cones of this species are not only much smaller than those of the common white larch, but are oblong, and their scales incurved in the margin, and not open like the last. The leaves of this larch are likewise scarcely half the length of those of the common kind. The timber is more highly prized in America than any other of the coniferous tribe, and is used both for naval and domestic purposes. The cones should be imported from North America. ‡

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* Lamb. Pin. t. 36.

† In Forfarshire, we are informed, that there are thriving specimens of the height of 60 or 70 feet. See Hort. Soc. Mem. Vol. II.

‡ Ibid.

3. The Red Larch, * has the cones nearly of a spherical form, and only half an inch in length. This larch is a native of the most northern parts of Canada, is of course sufficiently hardy, and said to have been long since cultivated by the Duke of Argyle.

4. The Cedar Larch † differs from the two last mentioned species in possessing biennial or evergreen leaves; a property that renders it peculiarly ornamental in winter. In the Lothians, it attains the height of a middle-sized tree.

The cones of the Cedar Larch are much larger than those of the rest of this tribe, being three inches long, with a proportionate circumference: the scales of the cone are erect and truncated. These ought to be obtained, if practicable, fresh, from the Levant. The Cedar is worthy of being associated with the common Larch in the valleys of the Highlands, and other inland districts. ‡

The Larch is propagated from seed; and the general mode practised will be found described, Chap. V. Sect. iv. § 1. 2. &c.

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* *L. tenuifolia*, Salisb. *L. microcarpa*, H. Kew. described by Bartram, and figured in t. 37. of Lambert's work.

† *Pinus Cedrus*, Miller's Dict. *L. patula*, Salisb. 3. Lin. Trans.

‡ See Caled. Hort. Soc. Mem. Vol. II. p. 363.

SECT. XIV.—*The* LIME TRIBE. (spec. var.)

§ 1. *Species and Varieties.*—Of European Lime trees, two species are natives of Britain; *Tilia europaea*, Eng. Bot. 610, and *T. parvifolia*. Of the first there are two or more varieties, of which the red-twigged is the most remarkable for beauty. Both species, when raised from the seed, will grow to the height of eighty feet on a deep fresh soil. The diminutive size of those commonly observed in this country, is supposed to arise from being transplanted at an advanced age, or from being reared from layers, or even cuttings.

Besides the two European species, above mentioned, there are several American species of the lime, known and described; these are furnished with scales at the base of the petals, which in those of Europe are naked: such as the *T. alba*, and *T. pubescens*, (Vent. t. 3.) which do not attain the size of our native species.

The only American species of this tree which merits attention in this country, says Dr Yule, is, 'the *T. americana*, bunwood, or broad-leaved 'lime, (Vent. t. 2.) which in a deep and fresh soil 'attains the height of eighty feet.' The large size of the leaves, and elegant pendulous flowers, would render it highly ornamental; and there is no doubt of its being sufficiently hardy for this climate, as it exists in greatest abundance in the neighbourhood of lakes Ontario, and Erie, and rather diminishes in frequency towards the south. *

§ 2. *Properties.*—The common lime, (*Tilia europæa*) is to be found as a standard, or as an avenue tree, about most residences of note in the kingdom, affording a very complete shelter, and agreeable shade; and forms a fine contrast with the oak, the chestnut, the elm, and the sycamore.

The timber of the lime is not very valuable. It is chiefly used by the carver and the turner. It has been of late applied to the lining of carts, and to other purposes in husbandry. Its charcoal is often employed in the manufacture of gunpowder. †

§ 3. *Soil.*—The lime is a free-growing tree, and will succeed in almost any soil or situation, where it may with propriety be planted. It is, however, best calculated for situations near a residence.

SECT. XV.—*The* MAPLE TRIBE. (spec. var.)

§ 1. *Species.*—Fourteen distinct species of Maple have now been described by botanists, seven

* See Caled. Hort. Soc. Mem. Vol. II. p. 393.

† Nicol.

of which belong to Europe, and the rest to the continent of America.

1. The Sycamore, (*Acer pseudo-platanus*), which (as well as the *A. campestris*) is a native of Europe, and indeed generally reckoned a native of our own island.* It is a deciduous tree, and grows to a great height, and ample size; throwing out a wide-spreading top, and remarkable for the full and fine shade which it affords.

§ 1. *Properties.*—The Sycamore, or Plane, is among the most hardy of all our trees; affords more shelter than any other, and possesses the singular property of never showing what is called a weather side, even in the bleakest and most exposed situations. Though it has been but seldom planted in Scotland to a great extent, it appears to agree with a northern climate, and particularly near the sea. It is a finer tree, and much more hardy than the occidental plane of America, which frequently suffers in its shoots during the winter.

The timber of the sycamore is employed for various purposes of machinery and mill-work, by the turner, the cooper, and the cabinet-maker. In many parts of Scotland, sycamore timber brings a price next to the ash; and particular trees, for making rollers, and such purposes, have

* Lightfoot, Yule, and other botanists. The true Plane, (genus *Platanus*) is of foreign growth.

been sold as high as seven shillings and sixpence per foot.*

The value of the sycamore as a nurse plant, both in maritime and highly exposed situations, has not hitherto been sufficiently appreciated. It has been found to be extremely patient of the sea breeze; and, while most other species of forest trees are drooping around it, remains erect, bidding defiance to the noxious gale.

The wood of the sycamore, like that of the Sugar maple, gives out, in burning, a greater proportion of heat than that of most other trees; and the charcoal is preferable for the forge, to every other kind; and is said to possess a specific gravity one fifth greater than any other known charcoal.

It also abounds in saccharine juice, which might be converted into sugar and wine, as well as the ash-leaved, the Norway maples, and the Sugar maple of Canada and Nova Scotia. †

§ 2. *Soil.*—Most of the Maples require a deep fresh soil, to attain full perfection; but though they generally succeed best in a rich loam, they will grow in the most exposed situations, if the soil be tolerable. The timber is also found of great durability, on light, gravelly loams.

§ 3. *Growth.*—Several fine planes, about eighty years of age, may be seen growing upon the flats

* Nicol's Plant. Kalend. p. 102.

† See Appendix, (G.)

on the West Coast of Scotland, in Ayrshire, at Fullarton, and Auchenharvie. But at Kippen Ross, near Dunblane, in the county of Perth, there stands one of the finest trees of this sort any where to be seen. In 1783 it was 24 feet in circumference, immediately below where it branches off in the trunk, and about 18 feet round below that to near the ground, where it was about 20 feet round. It must now be much more, as it seems in perfect health, and stands in a favourable situation and fine soil. This tree has a most magnificent head, and probably about eighty feet high. *

2. The Norway Maple, (*A. platanoides*, Schmidt. Arb. t. 1, 2, 3, 4.) is another hardy species, valuable for similar purposes with the above.

3. The variegated kind is also extremely beautiful, and is admitted, together with the common species, in all polished and ornamented scenery.

4. To these we shall only add the Sugar Maple, *A. saccharinus*, (Mich. Arb. For. 2. t. 15.) equally hardy. This species is first perceived to the northward of lake St John in Canada, under the most rigorous cold in latitude 48°, nearly corresponding in temperature with lat. 67° in the north of Europe.

The Sugar Maple exists, however, in greatest

* In the Statistical Account of Scotland, Vol. VII. p. 329, the circumference of the trunk of this tree at the ground, is stated at 27 feet. It must now be more. MS. Comm. from the late Mr Shirreff.

vigour, and abounds most between lat. 43° and 46°, comprehending Canada, Nova Scotia, and Vermont. The wood of this species, like the rest of the tribe, although possessing considerable strength, is not durable under alternations of moisture and drought; but, when thoroughly dried and unexposed, it is very durable; takes a fine polish, becoming of a fine rose colour on exposure to light: and the wood being beautifully waved in its texture, is highly valued by cabinet-makers. This spotted wood is termed "Bird's-"eye Maple."

It is also well known that the Maple tribe abound with a saccharine juice, when tapped on the first rising of the sap in spring, before the buds begin to evolve; but this species, as the name implies, affords it much sweeter than any other known variety.*

SECT. XVI.—*The* MOUNTAIN ASH,† *or* ROAN TREE.

The Mountain Ash is the most alpine,‡ and perhaps the most beautiful and ornamental na-

* See Caled. Hort. Soc. Mem. Vol. II. For an account of the mode practised in extracting sugar from the Maple. See Appendix (G.)

† *Sorbus aucuparia*, L.; *Icosandria trigynia; Rosaceæ*, Juss. Eng. Bot. t. 337.

‡ It is said to grow at the elevation of near 2000 feet above the level of the sea.

tive tree we possess, both on account of its foliage, its flowers, and its fruit. *

§ *Soil.*—This tree shoots freely in almost any soil, particularly in such as are dry, rocky, or inclining to sand; is well calculated for exposed and elevated situations; and may be advantageously employed for the purposes of shelter.

§ *Properties and Uses.*—The timber of this tree has long been employed by tanners, † and wheel-wrights; and has lately been found useful for flooring, for cart-linings, herring-cask staves, &c. The wood is hard, heavy, and compact. Its poles and shoots are used as hoops, and its bark is employed for tanning. It is also an excellent coppice plant, grows rapidly, and proves a valuable nurse to slow growing trees on bleak situations. ‡ It is naturally propagated by the dropping of its seeds.

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* Roan-berries are still held in some esteem in the Highlands of Scotland, and in Wales.

† It has been observed, that the bark of the mountain-ash, of the birch, and of the willow tribes, may be disposed of to advantage, when situated in the neighbourhood of any great fishing establishment, as the bark of these trees is found to leave nets more soft and pliant than when barked with oak. Gen. Rep. Vol. II. Note, p. 211.

‡ Nicol's Plant. Kalend.

Sect. XVII. *The* Oak. (spec. var.)

Providence, with infinite wisdom, seems to have ordained that every country should abound in productions the most useful or salutary to its inhabitants. As this sea-girt island greatly depends upon the Oak for its commerce and protection, so upwards of seventy different species or varieties of this invaluable tree have been now described by botanists, which afford ample choice for a variety of soils and situations.

In this Section of our Abstract, we shall principally confine our notice to our two most valuable native species, *Quercus robur*, and *Q. pedunculata*, the latter of which is inestimable; * and conclude with some slight notices of a few of the most useful of other species, not so well known in this country.

§ 1. *Properties, &c.*—On the uses, properties, and virtues of the Oak, so universally known, it is unnecessary to enlarge. It is both valuable and ornamental in the highest degree; the pride of the forest, and the glory of the British Navy.

Many extensive tracts of oak coppice abound

* The *Quercus pedunculata* is distinguished from the *Q. robur*, by the marked circumstance of the acorns being placed on long fruit stalks, whilst those of the *Q. robur* are nearly sessile. Besides the superior utility and hardness of the timber, the pedunculated oak is in fact the most magnificent of the two British species. See Caled. Hort. Soc. Mem. Vol. II. p. 376.

in the Highlands of Scotland, which are cultivated and promoted chiefly for the production of bark for tanning leather; and which, under a regular system of management, yield an important addition to the income of the proprietors, and contribute to many useful purposes of domestic economy.

The plan happily adopted of late, too, on many estates in the Western and Northern Highlands, of reserving, at every cutting, a certain number of oaks of the finest form, and most promising growth, affords a fair prospect of our possessing, in a few years, even timber fit for naval purposes, in such abundance as to render us independent of the precarious supply of foreign countries.

The smaller timber of oak coppices is generally used for domestic purposes,—for building cottages and farm-offices,—for agricultural implements, fire-wood, and charcoal. *

The bark of the Oak, however, is justly regarded as most productive of emolument to the proprietor. The relative value which is usually assigned to the *timber* and *bark* of an oak coppice in the Highlands of Scotland, may be estimated by the following criterion—'that the *timber* pays 'for the labour of *cutting* and *barking*; and the '*bark* pays the original purchase, leaving the 'proper profits to the purchaser.' †

* See Gen. Rep. of Scotland, Vol. II. p. 204. † Ibid. p. 205.

§ 2. *Soil.*—The Oak is found in a great variety of soils, in lands both light and stiff, wet and dry; but attains its greatest perfection, and grows most rapidly, in rich black earth, and in a strong deep loam, on a gravelly or clayey subsoil, where its tap root has depth to penetrate.

In light, sandy, or gravelly soils of little depth, it grows slow, but firm in texture, and arrives earlier at maturity, though of inferior magnitude than on more retentive soils. *

Even in comparatively barren soils, where a red tilly clay forms both the surface and subsoil, and apparently void of calcareous matter, (a soil to which most other trees have an aversion), the oak flourishes with great luxuriance. This soil, if analyzed, would probably yield nothing more than water, red oxide of iron, silex, and alumine; and it seems difficult to ascertain what can be the food of the oak in such a soil. Indeed, oaks have been frequently observed to protrude themselves from the fissures of rocks, where no visible soil appeared, and to clothe the naked crag with wood.

§ 3. *Situation.*—Although in barren shallow soils, and in bleak exposed situations, the planting of oak as timber cannot be recommended, yet there is much land in the kingdom planted with inferior trees, that would produce the oak equally

* Nicol's Pract. Planter, p. 46.

well, and, at any given age, would be much more valuable.

Oak is, of all others, the tree best adapted both for ornament and utility, in an inland situation; because the bark yields a quick return, at every successive cutting or thinning, nearly equal to the value of the land on which it grows, and the timber serves the ordinary purposes of the country; whereas other timber may not find a ready market, if remote from water carriage. While the attention of gentlemen is directed to the adorning of their residences, no species of tree is so well adapted for this purpose, as that which springs from the stock, and is a permanent beauty. If ornament alone is the object of the proprietor, although other forest trees ought not to be excluded, the oak seems to deserve a preference, by being allowed to rise to its full stature. It is the longest-lived tree known in this part of the world, the yew alone excepted; and, in its aspect, imitates the boldness, grandeur, and duration of our hills. *

It frequently happens, also, that on farms of considerable extent, and variety of soil and exposure, small portions, of no great value for pasture or cultivation, might be appropriated, without any material lessening of the annual income of the farm, for entire plantations even of oak. But, should it be thought that an entire oak

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* Perthshire Reprint. Rep. p. 242.

plantation would be too great a sacrifice of the ground, a plantation of various other species of trees of a quicker growth, to be periodically cut as underwood, might be made, and the produce come in aid of the supposed disadvantage, while the principal object would be secured. *

§ 4. *Growth.*—The growth of a middle-aged Oak is generally from one inch to an inch and one third in circumference annually: between its twentieth and hundredth year it sometimes exceeds this measure, and in its second century falls within it. But as the solid contents of the shaft consist less in its length than in the square of its diameter at the girting place, a small addition to the diameter there, enlarges the square amazingly. †

An oak, in the first seventy-five years, has been calculated to grow one ton of timber, and in the next seventy-five, to produce about seven tons; and if allowed to stand for double this time, it would probably increase in a still greater proportion. ‡

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* See Bath Soc. Papers, Vol. IV. p. 318.

† See Do. Vol. VI. p. 50. For a Table showing the increase of six Oaks, in sixteen years, from actual admeasurement by Mr Marsham. See Trans. High. Soc. Vol. I. p. 197.

‡ An Oak felled by the Bishop of Sarum in 1758, and supposed, from its number of circular rings, to be 300 years old, contained 1045½ cubic feet, besides seventy-four feet of smaller timber; in all twenty-eight tons, which, at only 3s. per foot, is 240*l.* See Bath Pap. Vol. VI. p. 10.

§ 5. *Inadequate price allowed by the Navy Board for large Oak Timber.*—The naval advantages of oak timber, adverted to in the first Chapter of this Abstract, are generally known. According to the price which is now given for that commodity, however, either by the Navy Board, or by the East India Company, it is more profitable to fell oak-wood at fifty or sixty years' growth, than to allow it to stand for naval timber to eighty or an hundred, when the increase of the boles would not pay three per cent. per annum. If profit be alone considered, every tree of every kind ought to be cut down and sold, when the annual increase in value of the tree, by its growth, is less than the annual interest of the money it would sell for.

It appears, from Mr Waistell's ingenious and laborious calculations, * that the annual increase in the boles of trees, by their growth, ceases to be equal to five per cent. per annum, some time between forty-six and sixty years of age, according to the length or shortness of the

In addition to the large trees enumerated by Evelyn and Marsham, the great Oak at Boddington in Glocestershire, burnt down in 1790, in comparison of which all other trees were but children of the forest, deserves to be noticed. This tree, according to Marshall and Rudge, was more than eighteen yards in circumference at the ground, and at its smallest dimensions 12 yards. This venerable tree must have been planted prior to the Christian era!

* See Waistell's Tables respecting the Growth of Timber, in Trans. of the Soc. of Arts, &c. Vol. XXVI.

bole. But it is generally allowed that oak trees of a size fit for the Navy, require to grow from eighty to one hundred and fifty years, according to the quality of the soil, and the nature of the situation: and the same observation is also made in the Eleventh Report of the Commissioners appointed to inquire into the state and condition of the woods, forests, and land revenues of the Crown.

On public considerations, therefore, it has been matter of regret to some, and of alarm to many, lest our posterity should experience a scarcity of oak-timber for the use of the Navy; and various means of increasing its quantity have been recommended. In addition to these means, the making a much greater than the ordinary increase of price on timber of a large scantling, has been proposed.

It is said, that if the Navy Board would give eight or nine pounds a load for timber trees, containing one hundred cubic feet or upwards, instead of four or five pounds, every landed proprietor in the kingdom would have a reasonable motive for allowing his timber to stand, till it became of a size fit for the use of the Navy; whereas, according to the present price, it is every man's interest to cut it down much sooner; —a proposal certainly worthy of mature consideration. *

* See the late Bishop Watson's Preliminary Observations to the Westmoreland Report, &c.

To let oak timber stand to one hundred and twenty years of age, and sell it at the present prices, the loss of the growers would exceed double the whole value of the timber at sixty years of age. Nothing short of a sufficient price, therefore, will long command an adequate supply.

From the returns of the King's Forests, it appears, that through mismanagement, and inadequate regulations; * they do not, on an average, furnish above two thousand loads of oak timber annually for the Navy: whereas the annual consumption of the docks exceeds an hundred thousand; and, including the Commercial shipping, it amounts to 350,000 loads! †

The quantity of large timber, on private estates, is also diminishing with alarming rapidity; and it may be too late to commence offering reasonable prices for it, when no oaks remain of greater growth than sixty years. To have to wait the second sixty years, may bring upon the country evils exceeding all calculation. ‡

As there is not one-sixth part of the naval timber in Great Britain, that there was half a century ago, the small stock that remains will soon be exhausted, the docks must be dependent on foreign countries for supply, our expenses incalculably enlarged, and British timber will no longer ride triumphant on the ocean.

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* See Hints on the Royal Forests, Appendix (B).

† See the late Lord Melville's Letter to Mr Percival, on the subject of Naval Timber, published in July 1810.

‡ See Trans. Soc. Arts, &c. Vol. XXVI. p. 75.

§ 6. *Inducements to the Cultivation of Oak Timber.* All the timber for ship-building in Scotland is imported; and chiefly from England, and even from some of the finest counties in it,—from Hampshire, Yorkshire, Essex and Sussex: and if cultivating the oak is deemed worthy of the attention of the landholders in the finest counties in England, it must be much more so to the landholders in Scotland. * For, besides furnishing ourselves with materials for building ships, and tanning leather, and thereby rendering ourselves independent of our neighbours for these materials, the rearing of oak must be peculiarly profitable to the landed proprietor in Scotland, from the following considerations.

1*mo*. The freight from England, insurance, and other charges, amount to one half of the first cost upon timber, and nearly to one third upon bark; so that the Scots proprietors will have about forty per cent. more for their oak timber, than the landholders in England have.

2*do*. The immense extent of land in the Highlands and Islands fit for no other purpose, and which might be converted to good account, by being planted with timber trees. †

* See Scots Mag. vol. XXXIII. p. 625.

† There are no more than 5000 acres under woods and plantations in all the Hebrides; and were Islay, Mull, Bute, and the two districts of Skye, excluded, there would not be found one acre of wood of any description, for 2000 of their

3tio. The facility of enclosure, by means of lakes, rivers, bogs, precipices, islands, sea-coast, &c.

4to. The incalculable benefit which these mountainous regions would derive from the shelter afforded by woods, and the vast amelioration of soil and climate.

5to. The rise of rents to proprietors resulting from farm-steadings, fences, and farming utensils, now obstructed by the scarcity and high price of timber.

6to. The obvious facilities which abundance of timber, and of willows for hoops, creels, and other purposes, would yield to the fisheries, to the kelp manufacture, and to agriculture in general. *

7mo. The present scarcity and high price of timber in Scotland, and particularly in the Highlands, and Hebridean isles. †

8vo. And *lastly*. The great facility of trans-

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naked extent. The whole Long Island, with its numerous and populous dependencies, comprehending altogether about half a million of acres, contains not a *single* solitary acre of wood, which deserves the name of either copse or plantation. See Survey of the Hebrides, p. 324.

* Ibid.

† See Appendix (D). The scarcity of timber, even for the use of the farmer, is severely felt in the Highlands and Isles of Scotland. In Kintyre, for instance, we are informed, by the late Dr Smith, that it is brought sometimes from a distance of an hundred miles. Argyleshire Report, p. 140.

porting the timber from the place of its growth, to every part of the island of Britain and of Europe, by means of the different canals and railways, now in a state of progression; and the numerous lakes and rivers in which Scotland abounds. *

§ 7. *Divers other Species of Oak.*—1. The *Quercus muscosa*, or Mossy Cup Oak, which is chiefly found on the banks of the river Hudson, in the State of New York, thrives in this country, even in the poorest sandy soil. The acorns, which are of an elongated oval shape, are nearly enveloped by the cup, which, as in several other species, is covered with scales, whose points are generally bent backwards, terminating at the border of the cup in filaments. This tree has a fine appearance, although, from the scarcity of the specimens, the quality of the timber has not yet been ascertained. A fine specimen of this species of oak, is to be seen in the Botanic Garden, Leith Walk, planted by the late Dr Hope, Professor of Botany.

2. Several varieties of the *Q. ilex* have succeeded well in various parts of Scotland, as at Mount-Stewart, in the island of Bute, planted by the late

* This last circumstance is peculiarly applicable to the Hebridean Isles, no spot of which is above two English miles from the sea-shore; and scarcely any which is not within six miles of a good harbour. The same can be said of no other part of Britain or of Europe of equal extent. See Survey of the Hebrides, p. 323.

Earl; and some fine, large and beautiful specimens of the evergreen oak, occur also at Castle-Kennedy, the seat of Lord Cassilis, in Ayrshire. To these evergreen species, Dr Yule strongly recommends the *Q. virens* or lace oak (Mich. Arb. t. 11.), to be added to our collections. It was cultivated by Miller in 1739. This species would be an important acquisition on the sea-coast, as it is said that the sea-breeze is indispensable to its full growth.

3. The Quercitron, or Dyer's Oak, (*Quercus tinctoria*, Mich. Arb. t. 22.), has also been recommended, to be associated with the larch in the vallies of the Highlands, the great value of the bark in dyeing of yellow; rendering it interesting in an economical point of view. It is ascertained to grow freely in the neighbourhood of Paris. *

SECT. XVIII.—THE PINE TRIBE. *Genus Pinus.* †

One species of the genus Pinus is a native of this island (*Pinus sylvestris*, Scots fir or wild pine); and several others have been so long cultivated among us, that they may be considered as nearly naturalized: but the genus itself has hitherto been imperfectly understood, and the

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* See Yule in Caled. Hort. Soc. Mem. vol. ii. p. 378.

† Class and order, Monœcia monadelphia of Linné.

greater number of its species and varieties have been very insufficiently discriminated. *

Linnæus has enumerated only twelve species in the last edition of his Systema Naturæ; and the Hortus Kewensis, (though the subject is there treated better than in any former work), does not enumerate all the species and varieties that are now known, nor does it distinguish their characters correctly. Accordingly, Mr Lambert, one of the Vice Presidents of the Linnæan Society, in the year 1803, with a laudable ambition to supply the deficiency, and to promote the advancement of useful science, published a valuable Monograph on the genus Pinus, together with a collection of facts relative to the culture and uses of thirty-three distinct species. †

But even in this erudite and valuable work, there appears to us a deficiency of attention to minuteness of discrimination and accuracy of character. In a close examination of this family, we apprehend, that there may be discerned evident traces of several natural genera, hitherto com-

* 'It seems somewhat curious,' remarks Mr Don, (in his Memoir on the Varieties of Scots Fir, Caled. Hort. Soc. Mem. vol. i. p. 122.), 'that in Dr Smith's Flora Britannica, in Hull's 'British Flora, and in Withering's Arrangement; while per-'haps not fewer than six or seven varieties of some species of 'plants, not of the least known economical use or import-'ance, are enumerated;—not one variety of the *Pinus sylvestris* 'should be noticed.'

† See their designations, Appendix (H).

prehended under the general character of the genus Pinus. *

'The aspect of the proper pines,' as has been correctly remarked by Dr Yule, 'at once distin-'guishes them from the Spruces or Firs, with 'which they are closely related;' and these again, from the Larch tribe, by the form of their buds, and the structure of their flowers. A natural and marked distinction is pointed out, not only by the structure of the fruit, especially the truncated scales of the cones; but by the leaves of the pines, at least two together being included at the base in a circular sheath. †

I. Our native Pine (*Pinus sylvestris* L. ‡), of which there are several varieties, if not species, § very different in value, is so well known to afford timber possessed of all the requisites of strength and

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* In this Abstract, we have accordingly classed, what has generally been comprehended under the genus Pinus, under three distinct genera, viz. the Larch, the Spruce or Fir, and the Pine tribe; and in this, we are countenanced by a first-rate botanist, John Yule, M. D. F. R. S. Edin. See Caled. Horticultural Memoirs, vol. ii.

† Ibid. p. 366.

‡ 'Foliis geminis rigidis; strobilis junioribus pedunculatis, recurvis dependentibus; antherarum cristâ exiguâ.' Lambt.

§ This circumstance is said to have been first remarked by the late Earl of Haddington, in his small but valuable work on Forest Trees; and is also noticed by Mr Don in the first volume of the Horticultural Memoirs.

durability, and attains such a degree of perfection in the Highlands of Scotland, that it might be deemed superfluous to attempt the cultivation of any other: but the common variety of this pine has been found to be but ill adapted to the deeper and more fertile soil of our vallies, although it thrives well on mere sand, if dry at the bottom. * Few of these trees were planted in this country till towards the end of the seventeenth century. Since that period, they have been planted in abundance almost everywhere, but have not yet had sufficient time to arrive at full perfection. The fir is a tree that will grow 400 years. In Sweden, 360 circles have been numbered in a fir that was composed entirely of sound wood. The planted Scots fir is at present perhaps too much depreciated, because it generally consists of white, soft, perishable wood; but the defect is principally owing, not to soil or situation, but generally to want of age in the tree, and the careful selection of the proper variety. If the most valuable variety of the Scots fir, (afterwards to be described), is obtained from the nurseries, or raised from the seed, in the course of years that white wood will become red; and the planted fir, from time to time, will become more and more valuable in quality, and consequently be held in greater estimation. †

* See Caled. Hort. Mem. vol. ii. p. 367.

† See Walker's Essays on Nat. Hist. p. 33.

§ 1. *Properties.*—This species of fir raised in Scotland, is generally supposed to be equal to the foreign both in weight and durability, but is seldom so fine in the grain, and has a greater quantity of sap. From this tree is obtained what in London is termed Yellow deal, and in the country, Red, or Christiana deal; the red deal imported from Sweden being no other than a variety of Scots fir, the *Pinus sylvestris; var. montana.* *

It was the opinion of the late Professor Walker, (and has been since stated in the General Report of Scotland), that the Scots fir grows naturally only in the northern counties; but the fact is, that the roots of Scots fir trees are found in the bottoms of deep mosses in the border counties of Scotland, which must have grown there naturally at a distant period. This tree, if planted in a dry soil, or permeable subsoil, will thrive over all the kingdom, even to the height of 1500

* Not fewer than eleven distinct substances, enumerated by Lambert, are procured from the Scots fir alone. These are liquid resin or turpentine, extract of the juice, yellow resin, essential oil, common resin, black resin or colophony, tar, tar water, pitch, lamp black, and bark-bread; which latter, according to Linnæus, affords food to the Laplanders during a great part of the year. See Lambert's Genus Pinus. Folio. Valuable information respecting the natural history of this genus, or coniferous family of vegetables, may be found in the works of Evelyn, Duhamel, Hunter, Wangenheim, Lambert, and Yule.

feet above the level of the sea; and the more elevated the situation, the more valuable the timber produced.

The timber of Scots fir is so frequently and universally employed in this country, for the various purposes of agriculture and architecture, that detail is here superfluous.* One of the most important purposes for which this tree is at present employed, in Scotland, is, as a nurse or shelter for other timber, or such deciduous trees as may ultimately be intended to form the bulk of plantations. When they are designed for this purpose, the firs ought gradually to be thinned out before the deciduous plants grow too tall and weak.

§ 2. *Soil and Situation.*—The Scots fir possesses a wonderful facility of accommodating itself to almost every description of soil and situation, and may be reared with success on barren mountains, where nothing else but heath will grow. It has also been observed, that this species of the pine tribe grows best in glens, and the northerly sides of mountains; but whether this arises from being less exposed in such situations, to the south-

* A fine frigate of about 800 tons, launched in 1798, and (except the masts) built entirely of Scots fir, was lately in the British Navy. She was called the Glenmore, from the district which produced the wood of which she was built, which is said to have been *more* compact than foreign fir. Nicol's Pract. Plant. p. 28.

erly and westerly winds so prevalent in Scotland, or to other causes, seems not yet to be accurately ascertained. *

It thrives best in a dry sand or gravel; but never prospers on a stiff clay, nor can it be kept alive in any situation where its roots are much exposed to moisture.

It was correctly observed by the late Professor Walker, that 'it thrives on the thinnest and 'driest soils, on the poorest, exposed, moorish 'ground, overgrown with rein-deer moss: where-'ever there is short heath, growing above gravel 'and sand; sandy links on the sea-shore; like-'wise in mossy soil, less than two feet in depth, 'but bottomed rather with gravel than clay.' †

What immense tracts of country occur, in the western and northern counties, and Hebrides of Scotland, of the precise character that suits the propagation of Scots fir! ‡

In various situations, however, both in Scotland and England, where this tree, from analogy, might have been expected to thrive, it has completely failed; and that, too, in soils and exposures, where the larch, and some other species of the pine tribe, have been found to exceed expectation.

From the combined considerations, therefore,

* Farm. Mag. Dec. 1809.

† Walker's Economical History of the Hebrides, p. 236.

‡ Gen. Rep. Vol. II.

of utility and profit, the common species of Scots fir may be assigned a secondary place only, among the trees most deserving of culture in Scotland.

Wherever this species is planted however, a decided preference ought always to be given to seedling plants of Scots fir, which have been raised from the seed of the real natural red-pine of Scotland, or the Baltic provinces.

§ 3. *Valuable Varieties of the Scots Pine.*—It has already been remarked, that several varieties of the Scots fir have been distinguished by botanists, and that the kind most commonly cultivated is perhaps least deserving.

1. The *Pinus sylvestris, var. montana*, is a valuable variety, which yields the red wood so much esteemed: even young trees of this sort are said to become red in their wood, and full of resin at an early period.

Four other varieties have been lately described by Mr Don, * some of them remarkable and strongly marked.

2. The first of these, (which Mr Don reasonably conceives to constitute a distinct species, and which, from the disposition of its branches, he denominates *Pinus horizontalis*,) is distinguished by the horizontal direction of its branches, and a tendency to bend downward close by the

* Horticultural Memoirs, Vol. I. p. 124, &c.

trunk. The leaves are broader and shorter than in the common kind, serrulated, not marginated; and are distinguishable at a distance by their much lighter and beautiful glaucous colour. The bark of the trunk is smoother than in the common kind. The cones are thicker, smoother, and not so much pointed. This variety Mr Don considers as more hardy than the common sort, being easily reconciled to various soils and situations, and quickly arrives at a considerable size.

As this variety still retains all the good qualities ever ascribed to the Scots fir, Mr Don conjectures, that the fir woods which formerly abounded in every part of Scotland, and the trees of which, arrived at a large size, had been of this species or variety; and as the greater part of the fir woods of the present day, (at least one tree out of twelve), and which are so much complained of, are of the common variety, he naturally accounts for the supposed decline of the Scots fir in this country; by supposing, that as the common variety produces its cones much more freely than the other, the seed-gatherers, who were only to be paid by the quantity, and not by the quality, would seize upon the former, and neglect the latter. The evident remedy for this defect in our plantations of Scots fir therefore, is, the cultivating exclusively this well-marked and valuable variety.

3. Another remarkable variety (var. 3.) de-

scribed and recommended by Mr Don, quite distinct from both of the former, has lighter coloured leaves than those of the last, of a light glaucous hue, approaching to a silvery tint. Its branches, like the common sort, form a pyramidal head; but the cones in this variety have the appearance of being beset with blunt prickles, bent backwards. The leaves are serrulated, which at once distinguishes it from the common kind. It is also a good tree, and more common than the last, or second variety. *

§ 4. We conclude this section with noticing a few other valuable species of the Scots pine, which would undoubtedly succeed in this country.

II. The Maritime Pine. (*P. maritima*, L.) †

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* Mr Don has also observed a fourth and scarce variety of the Scots fir, with leaves somewhat twisted, and much shorter than the other kinds. It somewhat approaches the *Pinus banksiana* of Lambert.

Mr Don also informs us, that he has collected seeds of all the above varieties, and sown them in his grounds at Forfar; particularly all the cones he could possibly find of vars. 2. and 3., and means to raise them extensively, as the most effectual means of promoting a reform in this department of the nursery business. See Hort. Mem. Vol. I. p. 127. Mr Don will render an essential service to himself, and to his country, if he can supply the public demand with seedling plants of these valuable varieties of Scots pine.

† *Foliis geminis tenuissimis; strobilis ovato-conicis, glaberrimis, solitariis, pedunculatis.*

The great success which has attended the cultivation of the maritime pine in various bleak districts of France, and upon the sea coasts, should operate as a powerful encouragement to the forming plantations of it along the wastes of our native shores. It is not only capable of resisting the sea-air, but it screens other trees planted within the influence of saline vapours, and flourishes in pure quartzose sand, a species of soil, (if soil it may be called), which is usually condemned to hopeless sterility. The only tree of this species known to Mr Lambert grew at Sion House. A specimen of it may be found in Sherard's Herbarium. *

III. The Pineaster, or Cluster Pine, (*P. pinaster*. Lamb. t. 4, 5.) † This is a beautiful timber tree, of considerable value, and, of all others, (with the exception perhaps of the maritime pine,) best adapted for maritime situations. In the south of England, it has been found that the pineaster bears the sea-storm much better than any other of the pine tribe; and, on the sea-coast of Galloway and Ayrshire, where it has

* Important information respecting the natural history of this species of pine, may be found in a work, entitled, 'Observations on the Maritime Pine, by Malesherbes,' inserted in the Memoires sur l'Administration Forestière, published by Varenne Fenille. The cones of this tree might be imported from France.

† *Foliis geminis elongatis; strobilis verticillatis confertis, ovatis, sessilibus, pendulis, antherarum cristâ rotundatâ.*

been for a considerable time introduced, it thrives remarkably; and its valuable property of resisting the gales of the Atlantic, has been fully ascertained, and duly appreciated.* The late Earl of Galloway, who had the merit of introducing it into that district, planted some of them almost on the sea-beach, which are now large and flourishing trees.

The Pineaster is but of slow growth for the first two or three years, but afterwards grows rapidly, and appears to be peculiarly adapted for the eastern coasts of Scotland.

The best for this purpose is the American pineaster. Near the Capes of Virginia are seen large trees of this kind growing on the sea-shore; so near indeed, that large roots of old trees are observed about high-water mark, which must have been broken down by the billows of the Atlantic encroaching upon them. This tree also grows luxuriantly on the sandy beach upon the western coasts of France.

IV. The Red Pine of Canada, (*P. rubra*, Mich. Arb. t. 1., and *P. resinosa*, H. K. †)

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* MS. communication from the late R. R. Cunningham, Esq. of Auchenharvie, &c.

† '*Foliis geminis, strobilis ovato-conicis, sessilibus ternis; squamis medio dilatatis inermibus.*' Aiton first gave the name, *P. resinosa*, to this species, and has been followed by Lambert, and the Hort. Kew.; but the term is inapposite. See Hort. Mem. Vol. II. p. 367.

This species is quite distinct from the *P. rubra* of Lambert, which receives its name from the colour of the bark, is also a valuable species. One of its most distinctive characters is the uncommon length of the sheath of its leaves. From the high geographical range of this pine, it seems peculiarly adapted to associate with the *P. sylvestris* in this country. Mackenzie found it beyond Lake Superior in Canada. The timber is excellent, being closely grained, and durable.* Attaining the height of 80 feet, planks of 40 feet long are imported into different parts of Great Britain, and a considerable quantity of this timber is occasionally imported into Leith. Being generally free from knots, it is used for the decks of ships, and consequently well adapted to flooring and similar purposes. It has also been imported in the form of masts into this country. Like the *P. sylvestris*, it affords an inferior timber on a damp and unsuitable soil.†

V. The Swamp Pine, Georgia Pitch, or Long-leaved Pine, (*P. australis*, Mich. t. 6.; *P. palustris*, H. K.; and Lamb.),‡ notwithstanding the

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which is the Newfoundland Red pine, or Spruce fir, a variety of the black Spruce; for which see p. 268. of this Abstract.

* The main-mast of a 50 gun ship, the St Lawrence, was made of this timber, by the French, when in possession of Canada.

† Hort. Mem. Vol. II. p. 367.

‡ '*Foliis ternis longissimis; strobilis subcylindraceis muricatis; stipulis pinnatifidis ramentaceis persistentibus.*'

Only two trees of this species, of any size, were known to warmth of its native climate, Dr Yule supposes, would succeed in our sheltered valleys, and on the borders of inland lakes, as it grows freely near Bourdeaux, in the west of France, in situations scarcely more favourable.

The value of the timber, for strength and durability, is well appreciated in every part of North America; and it was lately imported at Liverpool, for the use of the Wet Docks, in planks from fifteen to thirty feet in length, by twelve or twenty inches diameter. These planks are rated 20 per cent. higher than any other American timber, with the exception of the Black Larch, and are much in request for all the purposes of carpentry.

This tree affords turpentine in great abundance; and the volatile oil, rosin, and tar, so much in demand in the various arts, are occasionally imported into this country. *

VI. The *P. strobus*, or Weymouth Pine, † has been long introduced into this country, and was first cultivated in England by Lord Weymouth, whence its English name is derived.

It abounds most in New York, New England,

Lambert; one at Kew, and the other at Lord Coventry's. See Lamb. Nat. Hist. of the Genus Pinus. 1803. folio.

* Upwards of 40,000 barrels of this tar were imported into Liverpool in 1807. See Hort. Mem. Vol. II.

† '*Foliis quinis; strobilis foliolongioribus, cylindraceis, lævigatis; antherarum cristâ gemina, subulatâ minimâ.*'

Nova Scotia, and Canada, where it withstands the sea-storm better than any other tree; and where it grows to the height of two hundred feet, on the best ground in the vallies, in the crevices of the mountains, and on the banks of rivers, to which the rains and melted snows carry down the richest parts of the soil of the highest lands.

This tree is of quick growth, elegant in appearance, and has been occasionally planted in North Britain. The blue-green of the pencilled leaves, of which five are included in each sheath, greatly adds to the picturesque appearance of this pine on the lawn in winter.

The timber is of a yellowish white colour, of a tolerable hardness, if not exposed; very fine, almost resembling the white cedar, and works straight, smooth, and shining; being well adapted for finishing, and inside work. The bark in old trees is abundantly impregnated with a whitish resin, which has a very agreeable odour.

The Weymouth pine, from the lightness of its timber, and the majestic size it attains, has been used for masts of ships; but it has been observed, that this lofty inhabitant of the forest is daily becoming more scarce, and the growth of centuries disappearing for ever. *

* See Hort. Mem. Vol. II. It is remarkable, observes Dr Yule, that the preservation of this pine was enjoined on the Colonies by several acts of the British Parliament.

The Siberian Stone pine, (*P. cimbra*), with some other species of considerable value, might also be noticed, did the limits of this Abstract permit.

Sect. XIX.—*The* Plane Tribe. (Genus *Platanus.*)

The two species of this genus in most estimation, are the Oriental, and the American Planes; but the former is generally preferred to the latter, and their leaves are larger, and more elegantly formed. We know as yet only three species of plane described as natives of Asia, viz. the Oriental Plane, (*P. orientalis*); the Maple-leaved, or Spanish Plane, (*P. acerifolia*); * and the Wave-leaved Plane, (*P. cuneata.*) In their native region, they grow to an amazing size.

1. One of these, the Oriental plane, figured by Du Hamel, grows freely, according to Yule, under the requisite circumstances of soil and shelter, in the vallies of Scotland. There is a fine specimen of this tree, (*P. orientalis*), in the Edinburgh Botanic Garden, about fifty feet in height, and of a proportionate circumference. The timber of the Plane, so far as it is known in this kingdom, very much resembles the Sycamore.

* This tree grows as freely as the Oriental, and attains a greater height. The *P. cuneata* grows less freely, and in exposed situations scarcely attains the size of a tree. Hort. Mem. Vol. II.

2. The American plane, or Button-wood, (*P. occidentalis*, Catesb. Carol. t. 50.), the only other species of plane deserving of notice in this country, like the first mentioned species, requires a deep and moist soil; as on the banks of rivers, or inland lakes. *

The wood of the American plane, when dried, is of a dull red colour. It takes a fine polish; but being apt to warp, the use of it is chiefly confined to bed-posts, and similar articles of furniture. These trees are, from their rapid growth and fine aspect, highly ornamental in parks, where the soil is not too thin and dry. In utility, however, the timber is said to be inferior to that of the Sugar maple. †

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* The late General Washington measured a tree of this species, in an islet of the Ohio, which, at five feet from the ground, measured forty feet in circumference; giving a diameter of about thirteen feet. T. André Michaux measured one of still larger dimensions, and of full growth, affording an appearance in magnificence approaching to that of the Oriental species, recorded by Pliny to have accommodated the Consul Licinius and eighteen of his suite with lodging during the night. See Hort. Mem. Vol. II. p. 389.

† Ibid. A severe frost in June 1809, destroyed most of the largest American planes in England, and particularly in the neighbourhood of London, whilst the Asiatic kind escaped without injury; a sufficient proof of their comparative hardiness.

The American plane, however, is said to thrive better in a moist soil than the Eastern plane, and will even endure partial inundations. Nicol.

SECT. XX. *The* POPLAR TRIBE. (Genus *Populus.*) spec. var.

§ 1. *Species and Varieties.* Of this tribe, some of which are indigenous in North Britain, there are at least five distinct species, viz. the Common or Italian Poplar, *P. nigra.*

2. The Abele, or White Poplar, *P. alba.*
3. The Aspen, *P. tremula.*
4. The Balsam, *P. balsamifera.*
5. And the Virginian Poplar, *P. heterophylla,* and several varieties.

§ 2. *Properties.*—These trees, though in general classed among aquatic plants, are, notwithstanding, valuable for timber; and, when their astonishingly rapid growth is taken into consideration, they become worthy of more attention than they seem to have obtained. The Abele, and Lombardy poplar, not being subject to the ravages of the worm, are found peculiarly fitted for beams, rafters, and roofs, when kept dry; for the flooring of granaries; as well as an excellent substitute for mahogany, in every article of furniture.* The timber of the former is esteemed the most valuable and durable, takes a fine polish, and is often employed by the cabinet-maker.

* See Bath Papers, Vol. VI. p. 24.

The timber of the Black Italian Poplar is said to be little inferior. Its bark is a strong astringent, and a good tan.

The wood of the Aspen, or trembling poplar, is much of the same quality, but coarser in the grain. It abounds on the borders of the Highland lakes and rivers; forms a very specious tapering tree; and its foliage is interesting in all its stages, from the light green of summer to the bright yellow of autumn, and the vivid red of incipient winter. *

§ 3. *Soil and Growth.*—The Abele, or white, and the black Italian poplar, are the two species most deserving of culture in this country, and generally affect the same soil, a deep humid marsh, where they arrive at their greatest magnitude.

They are supposed to reach maturity in about eighty years. † Miller mentions a poplar which grew to forty feet in height, and four in circumference, in ten years! 'I have some of the true Abele, or *P. alba*,' observes Mr South, ‡ 'which 'are now forty feet long in the shaft, and six 'feet four inches in circumference, at five feet 'from the ground; their contents exceed two 'tons of timber each; and I judge them to be 'fifty years old.' || A black Italian poplar has

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* Gen. Rep. Vol. II. † Walker's Essays, p. 50.

‡ Bath. Pap. Vol. VI.

|| A Lombardy poplar, now growing below Catterhouse,

been known to gain thirty-two feet in height in nine years, or three feet and a half per annum.

The poplar tribe are very easily propagated: they will grow from cuttings, sets, truncheons, &c. *

Sect. XXI.—*The* Robinia Tribe.

1. Amongst the forest-trees apparently deserving of more general culture in Scotland, may be ranked the Robinia pseud-acacia.

The late Mr Cockburn of Ormiston first planted this species as a forest tree in the park of Ormiston Hall, Haddingtonshire, where soil and situation were rather unfavourable. These now equal in height and diameter most of their native associates.

§ 1. *Properties.*—This tree is scarcely inferior in beauty, and, in the value of the timber, is said to be superior to the Laburnum. The timber is close-grained, hard, and finely veined; and, in America, more valued by the cabinet-maker than

in Dumbartonshire, on the Duke of Montrose's estate, measured by Dr Graham, was found to be twelve feet in circumference at the ground; and nine and a half at six feet from the ground; and its height appeared to be at least an hundred feet. Gen. Rep. Vol. II. The age of the tree seems not to have been ascertained.

* See Marshall's Plant. and Rur. Orn. Vol. II. p. 275.

any other native timber whatever. Being nearly incorruptible, it is equally useful for posts and gates,* which, when formed of this wood, have been known to remain fresh for nearly a century.

The finely pinnated leaves, and pendulous white odorous flowers, (when produced), add greatly to the beauty of this species of the Robinia; the value of which is known but to few in this country.†

SECT. XXII. *The* WALNUT TRIBE. (*Juglans*, L.)

1. The common Walnut-tree, (*Juglans regia*, L.; *Monœcia Polyandria*; *Terebinthaceæ*, Jussieu), is a native of Persia, introduced to us from France at a distant and uncertain period. In many parts of England, where large and old trees of it are very common, it regularly ripens its fruit; but, only in fine seasons, the fruit comes to perfection in Scotland. It is a plant, however, of beautiful and fragrant foliage, highly ornamental, without regard to its fruit; and, considering the size it

* See Pursh's Flora.

† Yule, in Hort. Mem. Vol. II. There are other two species or varieties of this family, mentioned by Yule, the *R. glutinosa*, and the *R. hispida*; but the first is little known, and the last is only a hardy and beautiful shrub. See Hort. Mem. Vol. II. p. 414.

For the different periods when trees of exotic growth were introduced into Scotland, see Appendix (I).

attains to, and the usefulness and value of its timber, it claims the most particular attention of the planter all over the kingdom.

§ 1. *Soil.*—The Walnut-tree thrives well in all soils where there is a considerable proportion of loam, provided they be dry, and the situation somewhat sheltered.

§ 2. *Properties.*—The timber of the Walnut is too valuable to be applied to the usual purposes of timber trees, but is always employed either in cabinet-work, or for gun-stocks. Indeed, so great has been the demand for it, for many years past, from the Birmingham gun-makers, for the latter purpose; and so great a price has been paid for it, that but comparatively few Walnut trees are now to be met with in the kingdom. In the parish of Arlingham, Glocestershire, there are more perhaps than in many other parishes combined; so abundant, indeed, is the fruit, that it has become an article of commerce, and vessels are laden with walnuts for Scotland, at Arlingham, as low as 4s. or 5s. a thousand. Even at this price, the produce of a tree is highly valuable, as 20,000 are not considered an extravagant calculation for a large tree. *

* At Beddington Park, in Surrey, the ancient seat of the family of Carew, about 50 walnut-trees, (and not above half that number full bearers), have been let at 30*l.*, 40*l.*, and 50*l.*, according to the crop; and it is supposed, that in a good season, the tenant clears 50*l.* by the bargain. Beddington was noted, in Queen Elizabeth's time, for the finest Orangery in England. See Forsyth on Fruit Trees, Note, p. 281.

§ 3. *Value.*—'The price of good walnut-tree 'is from 2s. 9d. to 3s. 6d. per solid foot.' *

§ 4. *Species and Varieties.*—Besides the common Walnut-tree, above noticed, there are at least other four species, several of which are sufficiently hardy for our northern climate, viz. the Black Virginia Walnut; the Hickery, or White Virginia Walnut; and the Pensylvania Walnut; and of these there are many varieties.

This tribe may also admit of subdivision, on the principles of the natural arrangement: 1. Those whose buds are naked, like those of the Walnut: 2. Such as have their buds covered with scales, as in the Hickery. This is considered to afford a more certain distinction than the simple or compound form of the spikes. †

2. Of the above, the Black Virginia Walnut, (*J. nigra*, Mich. Arb. t. 1.), as being the most valuable, ought certainly to be added to the common species in our native glens.

This tree is sufficiently hardy, grows taller, and more freely than the common walnut; and the value of its timber, which is very highly appreciated in America, is supposed also to be superior. When properly dried, it strongly resists putrefaction, and is occasionally used at Philadelphia for knees in ship-building; but the great demand for it is in ebenistry, or inlaid work, on

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* See Glocester Reprint. Rep. p. 245, &c.

† Hort. Mem. Vol. II. p. 375.

account of the fine polish it assumes, and indisposition to warp or crack. It is preferred to every other wood for musket-stocks, and is applicable, like that of the common walnut, to most of the purposes of the cabinet-maker. In order to obtain the good properties of both species, it has been proposed and recommended to graft the common on the stock of the American walnut. *

If the importation of mahogany should by any means be obstructed, this species might become a very valuable tree in this country. It is strongly recommended by Evelyn, Miller, Hanbury, and Yule, and flourishes in a dry sound loam of a medium texture. † The walnut-tree will grow at 3000 feet above the level of the sea, as may be seen at Ardvorlich, in Perthshire.

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* See Caled. Hort. Mem. Vol. II. p. 374.

† Several varieties, according to Mr Neil, (art. Horticulture, Edin. Encyc.) are cultivated for fruit in this country, particularly the round and the oval walnut, the large walnut, and the tender shelled.

The Pacane walnut, (*J. olivæformis*), which is cultivated in the vicinity of Paris for its fruit, Dr Yule recommends to be tried here, as it is sufficiently hardy, and the fruit very delicate. Michaux proposes to graft this on the stock of the Black Virginia walnut, as it is of slow growth. That intelligent naturalist, Mr Knight, by the inarching of a branch of a bearing tree, the quality of whose fruit is known, upon a common stock, in the way long ago recommended by Mr Boutcher of Edinburgh, has procured plants which proved fruitful in three years.

SECT. XXIII.—*The* WILLOW TRIBE. (*Salix*, L.) var. spec.

As there is much ground in Scotland, better adapted for the growth of willows than for any other crop, and as no other species of plantation yields so much profit in so short a period, great advantages might be derived from a more extended cultivation of this numerous tribe. They affect the same kind of soil with the poplar.

§ 1. *Species and Varieties.*

Of this class, (*Dioecia Decandria*, L.) there are many species, and upwards of an hundred varieties have now been noticed, from fifteen to twenty of which are cultivated in Britain; the larger, for hoops, dishes, mill-cogs, &c. and the smaller, for basket and wicker work.

As there is no genus of trees equally numerous, nor any genus of plants so copious, and yet stamped with so little diversity of character, the

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The walnut is propagated from the nuts, which, as Mr Neil informs us, 'are ready in October, and are gathered by beat- 'ing the trees with large poles. They may be kept through 'the winter, by mixing them with dry sand or mould to fill 'up the interstices; and covering them with earth, in the 'manner of potatoes.'

If the season be dry, however, we apprehend a better method probably is, to sow the nuts in drills in the autumn.

For more particular information on this subject, see 'Forsyth on Fruit Trees,' &c.

willow tribe necessarily require, more than almost any other, the most ample and accurate discrimination. The unmeaning names of authors, their imperfect and confused descriptions and figures, their slight and inaccurate characters, and the vast number of species; their numerous and nameless varieties, and the different phases belonging to the different sexes of each species, all conspire to render it the most difficult and inextricable genus in the vegetable system.

Caspar and Bauhinus, first began to distinguish and to describe the willows by their degree of growth, whether trees or shrubs; by the figure of their leaves; the nature of their flowers and fruit; and had the peculiar merit first to discern, that, in each species, there was a fertile and infertile individual. *

1. *Tree Willows.* The different species of the Willow tribe, which grow to the size of a tree, and the most worthy of cultivation for timber, are the following:

The common White, or Huntingdon Willow, (*Salix alba*, L.); the Bedford Willow, (*S. russelliana*, L.); the Red-twigged Willow; the Crack Willow, (*S. fragilis*, L.); the Grey Willow, (*S. cinerea*, L.); and the great round-leaved Sallow, (*S. caprea*, L.)

Of these, the three first are the most conspicuous; and the first, or Huntingdon Willow, though

* See Walker's Essays on Nat. Hist. &c. 1808, pp. 406–7.

the most common, is perhaps also the most valuable for timber.

§ 1. The Huntingdon Willow, (*S. alba.*) This species is very generally known, much esteemed in England, grows to a great size, and its timber is useful for many different purposes.

§ 1. *Soil.*—The most natural situation for the willow, is in low, moist ground, by the sides of rivers, brooks, and lakes, though this species will grow and thrive well on higher and drier grounds; and perhaps no other tree affords so quick a return for the trouble and expense of planting.

§ 2. *Properties.*—The timber of this kind of willow is used in turnery; by the cooper; for boarding, and mill-work; the shoots and poles serve for making hoops and handles; and the twigs are employed in wicker work. *

The wood is white, soft, and takes a very smooth polish; and its bark, as well as that of the Bedford Willow, is of considerable value for the purpose of tanning.

It may be kept as a pollard, and will yield, annually, a luxuriant growth fit for fire-wood. To this purpose it is applied in the neighbourhood of Huntingdon, (from which it has received its name), and other parts of England, where fuel is scarce. It is a valuable coppice-wood, on account of its rapid growth, and may be also profitably cultivated as a basket willow. †

* Nicol's Plant. Kalend. p. 105.

† See Walker's Econ. Hist. of the Hebrides, Vol. II. p. 261.

Above all, it proves an excellent nurse to other plants placed in humid situations, as it outgrows all other trees, and is peculiarly well calculated to resist the baleful influence of sea-storms, as has been verified by experience on the west coast of Scotland. *

These obvious properties of the Huntingdon Willow, seem to have escaped the notice of the majority of planters in this country; for although individual trees are to be found, either growing detached, or interspersed through plantations, yet they are nowhere to be seen in rows or belts, for the purpose of protecting other trees from prevailing winds: though for this purpose, it seems highly probable that they might vie even with the pineaster and maritime pine, on the sea coast, where the soil is favourable for their growth; and they possess the advantage also of being cultivated at less expense.

§ 3. *Growth.*—In twenty-eight years, the Huntingdon Willow has been known to rise fifty-eight feet in height, with a large trunk; but though a quick grower, it is but short-lived, arriving at maturity in about forty years. †

* MS. communication from the late R. Reid Cunningham, Esq. of Auchenharvie, Ayrshire, March 1810.

† A tree of this sort, and about that age, at Prestonfield, near Edinburgh, was seventy feet high, and thirteen feet in circumference, four feet above ground, according to the late Professor Walker; who remarks, that we have no tree that affords so much wood in so short a space of time; it is therefore said, that 'it will buy the horse, before the oak buys the saddle.'

2. The Bedford Willow, (*S. russelliana*, L.), so much esteemed in the South, and which grows to a great size, has been but little attended to in this country, although its timber is also useful for various purposes. *

3. The Red-twigged Willow, also forms a large tree, and has a fine silvery foliage. Several trees of this species may be seen growing at Brucefield nursery, near Dunfermline, Fifeshire, sixty feet high and upwards. They are said to grow as rapidly, and to produce as good timber as the Huntingdon. †

4. The Sallow, (*S. caprea*, L.) is chiefly valuable on account of its charcoal, forming an essential ingredient in the manufacture of gunpowder; and accordingly, plantations of it, formed for this purpose, have been found very profitable.

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* There are a few large trees of this sort, Mr Nicol informs us, about Edinburgh, particularly at the village of Canonmills. Nicol's Plant. Kalend. p. 68.

† Ibid. It is deserving of notice, that there is a peculiar variety of the *Genus Salix*, spread over a great many parts of the county of Stirling. It seems to answer exactly the description of a variety of Willow, mentioned by the late Dr James Anderson, in his Essays on Agriculture and Rural Affairs, entirely different from the Babylonica or Weeping. The largest are on the property of Mr Graham of Airth, which have attained a great size, and with their pendent branches, are magnificent objects; and in a windy day, have a most beautiful appearance. There is a tradition among the common people there, that this variety was introduced from Holland many years ago.

2. *Shrub, or Basket Willows.*

Amongst such a numerous genus of plants as that of the Willow tribe, many of the species and varieties of which are but imperfectly known, and more inaccurately described, it would be impossible in a limited Abstract to comprehend the whole: All that we can attempt, therefore, is to give a short description of the most valuable of those that are generally cultivated, and held in most estimation; and refer for particulars to the most approved publications on the subject.

Of the following, about one half are natives of North Britain; and most of the others either indigenous to, or naturalized in the osier holts of England: viz.—

§ 1. *Species and Varieties.*

The *Salix acuminata, alba, amygdalina, aurita,* or new kind, *caprea, decipiens, forbyana, fragilis, helix, lambertiana, mollissima, nigricans, pentandria, purpurea, rubra, russelliana, spaniard* (by basket-makers), *stipularis, triandria, viminalis, violacea,* and *vitellina.*—Of these in their order:

1. The long-leaved Sallow, (*S. acuminata*), which is not a common species in Scotland, produces numerous shoots, which in the second year form good rods. The leaves are about two inches long, and one inch broad; dark green above, and cottony underneath. *

2. The Common White, or Huntingdon Wil-

* See Appendix to Nicol's Plant. Kalend. by Sang, p. 560.

low, (*S. alba*), noticed above as a tree willow, is also cultivated for hoops, poles, and stakes.

3. The Almond-leaved Willow, (*S. amygdalina*), a native of the north and west of Scotland, is said to be but an indifferent osier; though it is much cultivated and wrought up by the basket-makers, and is esteemed as a useful and profitable variety in the southern parts of the kingdom. Its leaves resemble those of the almond-tree.

4. The 'New kind,' (supposed to be the *S. aurita*),* has been deemed by Mr Sherriff, and other experienced cultivators, as the most valuable for basket-making. This kind has brown bark, and green shining serrated leaves, smooth on both sides; and its yearling shoots fluted longitudinally near the extremity. It is a fine grower, and bears

* The Rev. Dr Graham of Aberfoyle, in the 10th Chapter of the General Report of Scotland, (Vol. II. note, p. 263.) supposes this species of willow, to be the *S. forbyana* of Dr Smith's Fl. Brit.; but there is no good reason for this supposition. The *S. forbyana*, or basket osier of Dr Smith, described under the name of *S. fissa*, in Dr Martyn's edition of Miller's Gardener's Dictionary, has its wands of a yellowish ash colour, smooth, flexible, and tough; and its leaves alternate, in foot-stalks, from two to three inches long, somewhat serrated, dark green above, and of a pale bluish colour underneath. But the 'New kind,' cultivated by the late Mr Sherriff, bears no resemblance whatever to the *S. forbyana*, which is probably a female plant. The flowers, as well as the bark of what is denominated the 'New kind,' are fragrant; and the only known species it bears a striking resemblance to, is the *S. stipularis*, or auricled osier.

cutting every year better than almost any other sort. Its wood is remarkably white, smooth, and sattiny, when peeled. It is also very tough, less liable to have its leaves eaten by the small green beetle than osiers, and also by another insect near half an inch long, that adheres to the under side of the leaf, leaving nothing but the woody fibres. 'Indeed,' says Mr Sherriff, * 'I have never seen 'this sort suffer from disease or insects. The 'flowers, too, are fragrant, long and slender, of 'a deep yellow, and have a pleasing appearance.' This kind, so much esteemed by Mr Sherriff, was a male plant; and he states, that when the leaves first made their appearance, they resembled a mouse's ear; from which circumstance we presume it may be the *Salix aurita*, and have accordingly given it that appellation; in which we are countenanced by the late intelligent Mr Sherriff.

5. The Round-leaved Sallow, (*S. caprea*), has been already noticed as a tree willow, the charcoal of which is the chief ingredient in the manufacture of gun-powder.

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* MS. communication from Mr Sherriff, 13th July 1810. The introduction of this species into this country is thus described by Mr S. 'From all that I can learn, the whole of 'that sort, provincially here called "New kind," have ori'ginated from a few plants I got from London, and some I 'noticed, which a kitchen gardener had planted after coming 'from England, tying some plants or fruit-trees sent by a 'friend. This sort is perhaps the best of any, for split, or 'skene work.' MS.

6. The Purslane Willow, or Cane Willow of the late Dr Walker, (*S. decipiens* of Hoffman ?), as described by Sang, (Nicol's Plant. Kalend.) produces very beautiful shoots, with a fine lively bark, like some sorts of cane. It forms a good basket osier, grows sometimes to a large size, when it much resembles the Crack Willow, *S. fragilis*.

7. The Basket osier, Fl. Brit. (*S. forbyana*), is one of the best willows for the finer sorts of basket-work; but, though a native, not much known in Scotland. *

8. The Crack Willow, (*S. fragilis*), is a good osier, frequent in willow plantations. The shoots and twigs are flexible and tough; the leaves are about four inches long, and an inch and a half broad, deeply serrated. †

9. The Rose Willow, (*S. helix*, Fl. Brit.; *S. monandra* of Hoffman.) This is a common, but imperfectly described species. Its numerous, slender, and purplish twigs, make very good fillings for fine basket work.

10. The Boyton Willow of London, (*S. lambertiana*, Fl. Brit.) or packthread willow of Edinburgh, resembles the Rose Willow, and is remarkable for the flexibility of its twigs, which are much used for basket fillings in England. Its leaves are shorter, and have shorter leaf-stalks,

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* For a more particular description of this willow, see note, p. 336.

† See Nicol's Plant. Kalend. edited by Sang, Appendix I. p. 562.

than the last mentioned willow, and it has perhaps the hardest wood of any other willow known in this country.

11. The Velvet Osier, (*S. mollissima*), is a useful species, indigenous to many places of Scotland, as well as England, and deserving of more general cultivation. It is readily distinguished by its leaves being very smooth and green above, and very soft and silky beneath. Its shoots are long, very numerous, but not tough; and are distinguished from many others by their forming a large bend at their insertion into the stool. When allowed to remain for two years, they make excellent rods. *

12. The Dark Broad-leaved, or Black Willow, (*S. nigricans*), is seldom observed in the willow plantations of Scotland, though it is occasionally to be found in the osier holts of England. Its wands being so apt to break, it is said not to be worth cultivating. †

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* See Nicol's Plant. Kalend. App. p. 560.

† The following singular account of a Black Willow, which produced flowers in winter, we extract from the late Mr Sherriff's communication, above referred to, (p. 337.) 'There 'are several useful sorts (willows) cultivated here, which I 'shall have pleasure in sending you a few cuts of, to compare 'with those in your neighbourhood which are most esteemed.

'I had a Black Willow, which was said to have come from 'Russia, some few years ago. I paid two shillings for a sin'gle plant or cut, which I put into a large earthen pot, and 'sunk it to the brim close to a garden wall with an eastern 'aspect. It had stood four years in this pot, when, last win-

13. The Sweet-scented, or Bay-leaved Willow, (*S. pentandria*), is also a native of Scotland; but its shoots are more used in Yorkshire, for making the larger sorts of baskets, hampers, &c.* It is a lower and more bushy plant, than that called the 'new kind,' and has much larger and broader leaves, which are also fragrant, when bruised. It is probably a female: We do not recollect its flowers.

14. The Bitter-purple Willow, (*S. purpurea*), or Crown Willow, of London? is not common in Scotland, but is also used in Yorkshire for the finer kinds of basket work. It is tough, splits remarkably well, and is the species (we presume) alluded to by Mr Sherriff, as in so much request at the Navy Victualling Offices. †

'ter (1810), it put forth more than a score of flowers, first 'green, then pink or purple, then covered with a white down. 'The plant began to flower in December, and continued till 'the first of March. I take this,' he adds, 'to be the plant 'so common in all shrubbries now-a-days, and that its flow-'ering in winter proceeded from the roots being suddenly 'checked in the pot, after occupying the whole soil in it. This 'might promote the formation of flower buds, from the growth 'of wood being so suddenly stopped. The fact, however, is 'certain; and I refer to Mr Patrick Neil, one of the most re-'spectable and scientific botanists in this city, for your satis-'faction. I have not seen this willow flower anywhere else.' MS. commun. by the late Mr Sherriff.

* See Nicol's Plant. Kalend. App. p. 562.

† See p. 220. of this Abstract. In the General Report of Scotland, Vol. II. p. 263, this species is termed '*brown*

It is however dusky, when peeled, and subject to disease, many of the yearling shoots becoming as black as ink, and quite brittle. The leaves of this species are dark green, sharp-pointed, serrated on the edges; and being, as well as the bark, very bitter and astringent, are never attacked by vermin. *

15. The Green Osier, (*S. rubra*), though not a common, is an excellent basket-willow. The shoots are long, tough, smooth, and of a grey colour; the leaves, narrow and long, from three to four inches, bright green on both sides, and serrated.

16. The Bedford Willow, (*S. russelliana*), has already been noticed as a tree, and is also cultivated for hoops, poles, and stakes.

17. The Willow, provincially termed 'Spaniard,' by basket-makers, is also an esteemed variety. It grows fully freer in moist soils even than the 'new kind,' (*S. aurita*), but is neither so tough, nor smooth and white when peeled. It also tapers more, is apt to grow somewhat waved as it were, and does not split so well.

18. The Auricled Osier, (*S. stipularis*), is a good willow, and is thus described by Sang. † 'The two-year old shoots make excellent rods

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'willow;' an error, which has arisen from misquoting my MS.

* Mr Sherriff's MS. Comm.

† See Nicol's Plant. Kalend. App. 1. p. 558.

'for baskets, cradles, bird-cages, &c., and the 'yearling shoots are used as fillings. The shoots 'are long, nearly equal in thickness throughout 'their extent, and somewhat downy, or hoary, 'particularly at the extremities.

'The leaves are alternate, with foot-stalks, 'long and narrow, somewhat notched on the 'edges, green and smooth above, woolly below.

'The stipulæ, or leaf-scales, are conspicuous 'and remarkable, resembling a pair of ears; and 'both the English and botanic names have re-'ference to this part of the plant.'

19. The Long-leaved triandrous Willow (*S. triandria*), is also a native of Scotland, and is common in osier plantations. Its stools afford excellent shoots for basket-work, long, slender, pliable and tough; they are smooth, of a brownish colour, and fluted longitudinally towards the extremity. The leaves are long, and closely and strongly serrated. When permitted to grow up, this species attains the size of a tree; and the male flowers, or catkins, are very ornamental in the months of April and May. *

20. The Common Osier (*S. viminalis*), is the most frequent species in willow plantations, and it is naturalized in many parts of North Britain. The leaves are long, waved at the edges, but not serrated; shining green above, and silvery beneath. The shoots grow very long and straight,

* See Nicol's Plant. Kalend. App. p. 559.

are tough, and well adapted for the larger sorts of baskets, hampers, and crets, and also for hoops. Several well marked varieties of this species occur in osier plantations, and are distinguished by different names. *

21. The Violet Willow (*S. violacea* of Don's Cambridge Catalogue), is but an indifferent willow, and better calculated for ornament in the shrubbry, than for use. Like the Black Willow, its shoots are brittle, and readily snap. This willow was lately introduced from Russia.

22. The Yellow, or Golden Willow, (*S. vitellina*), is becoming more common in Scotland, and is highly ornamental. It produces handsome shoots, of a yellow colour, and shining, well adapted for basket-work. The leaves are nearly sessile, or have only a very short foot-stalk, minutely serrated, smooth and shining above, and somewhat of a bluish tint, and silky beneath. †

This species, together with the *Salix alba, amerina, helix,* and *viminalis,* are all originally of southern extraction, and have been propagated from the willow plantations of the Romans, in Italy, in the course of ages, over all the northern countries in Europe. ‡ The

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* See Nicol's Plant. Kalend. App. p. 558.

† Ibid. p. 561.

‡ As the genus *Salix* is diœcious, seedlings are seldom seen; it may therefore be mentioned as a curiosity, that a thicket of volunteer seedling willows, arose a few years ago, from earth thrown out of a drain of several feet in depth, cut

S. amerina was first planted at Mellerstain in 1746.*

§ 2. *Treatment of Willow Plantations.*

It is essentially necessary that plantations of osiers and willows should be efficiently drained, and kept free of weeds; as the shoots not only grow finer and fairer, but much tougher, from a free circulation of air. After some years also, if the plants are about eighteen inches from each other, every alternate plant may be taken out; which promotes the vigorous growth of the remaining half. And as strong rods are always wanted for what the basket-makers call *sticks*, it would tend much to accommodate purchasers, and also to renovate the vigour of the stocks, to allow a certain portion (say one-fourth) of a plantation, to remain for two or three years, to be turned to that purpose; or for hoops made up in the Dutch way for small casks, as half-barrels, firkins, ankers, &c.; in which way, the late Mr Sherriff asserts from experience, that an acre will pay as much in one cutting as it does in three, to the basket-maker.

The wood of the willow, as has been already

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through a part of the wood at Dunmore Park, in Stirlingshire. We never met with any but these, except in the Botanic Garden of Edinburgh. How long the seeds from which the former sprung lay latent in the soil there, and by what means deposited, will scarcely ever be ascertained.

* See Appendix, (I.)

remarked, is extremely durable, light and tough. It is particularly excellent for field-gates; one gate of willow will last longer than two of pine; and its growth is more rapid than any other tree, perhaps, which stands the open air in this country.

§ 3. *Propagation.*—All the willow tribe may be propagated by planting the cuttings, which may be performed at any season of the year; though the most eligible is in the winter, or early in the spring, before they begin to put forth their shoots. The cuttings should be of the last year's wood, should be in height in proportion to their thickness, and ought to be planted in an upright position. *

* See Marshall's Plant. and Rur. Orn. Vol. II. p. 359.

The late Professor Walker, in his posthumous Essays on Natural History, &c. recommends a sloping position; but this seems to be a matter of indifference.

For farther, and more minute, information on the formation and management of osier and willow plantations, see a valuable paper, by Mr Phillips, on the Choice and Planting of the proper kinds of Osiers and Willows for Basket-makers, in the Transactions of the Society of Arts, &c. Vol. XVI. p. 129. Another by Mr Sherriff, Vol. XXI. also inserted in the Farmer's Magazine for May 1805: And a very useful paper on the same subject, by Mr Sang of Kirkcaldy, in Nicol's Planter's Kalendar, Appendix, 1. pp. 545–562.

SECT. XXIV.—*The* YEW. (*Taxus baccata*, L.)

§ 1. *History.*—The Yew tree is indigenous in many parts of Scotland, particularly in the islands of Lochlomond, in Dumbartonshire, and in the island of Bernera, adjacent to the Sound of Mull.* It is reared in several other places with advantage, and is deserving of more general culture. It reaches a great size.

§ 2. *Soil, &c.*—The Yew is a hardy tree, and is found growing naturally, in high and bleak, as well as in low, sheltered, shaded situations; and in a variety of soils, from a light sand to a strong clay.

§ 3. *Properties.*—The timber of the Yew is valuable, tough, and durable. It is much used in ebenistry, and for the uses of the turner.† When properly trained, it forms an effectual and permament screen.

§ 4. *Value.*—Mr Marshall mentions a number of these trees having been cut down in the neighbourhood of Boxhill, in Surrey, of a large size,

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* The late Sir Duncan Campbell cut a yew, upon that island, of a vast size. Its precise dimensions were not preserved, but the timber of it deeply loaded a six-oared boat; and was sufficient to form a large elegant staircase in the house of Lochnell, which was afterwards burnt. Walker's Essays.

† Evelyn enumerates its uses. See his Sylva.

and sold to the cabinet-makers at very high prices. He mentions one tree in particular, which was valued at an hundred pounds Sterling, and the half of which actually sold for fifty pounds: and that the least valuable trees were cut up into gate-posts, which are expected to last for ages.

There is no species of wood planted in Scotland that brings so high a price as Yew and Laburnum. *

§ 5. *Growth.*—Inch Lonachan, an island in Lochlomond, contains several thousand large yews; a plantation of that kind of wood unequalled perhaps in Europe. The largest at present known in North Britain, is at Rosedoe-house, the seat of Sir James Colquhoun, Bart., which measures twelve and a half feet in circumference, and is very tall. Mr Pennant, in his Tour through Scotland, and others, have left upon record the magnificent yew, in Fortingall church-yard, the ruins of which girted fifty-six feet and a half!

Such are the trees which appear to be most deserving of culture in Scotland, with the soils and situations best adapted to each kind: the Larch, Oak, Ash, Elm, Beech, Birch, Scots and Spruce Firs, Sycamore, Poplars, and Willows, &c., though the demands of commerce, and the wants of each

* See Walker's Econ. Hist. of the Hebrides.

particular district ought always to be kept in view. To the above might indeed have been added a variety of other kinds, both useful and ornamental, deserving the attention of the Scots planter, had our limits permitted.

We conclude this Chapter, with a few observations on the different species of trees best adapted for plantations on the sea-coast.

Sect. XXV.—Of Plantations on the Sea-coast.

Maritime situations are in general inimical to the growth of timber; hence, it has been presumed, though without foundation, that the sea-air is prejudicial to the growth of trees. On the contrary, we find that in hot, and even in temperate climates, trees grow luxuriantly even on the margin of the deep, and receive no injury from the sea-air. In several maritime situations in this country, the apricot and peach, by having a wall interposed between them and the sea, flower early in the spring, and duly ripen their fruits, though living in the sea-air; but on the unsheltered beach on the outside of that wall, the hardiest trees of the forest are blighted and stinted in their growth. It is not, therefore, on account of the sea-air, or any peculiarity of soil, that the difficulty of raising trees on the east coast of Scotland is occasioned; but from other causes, such as the influence of climate, blight, frost, mildew, and the strength and frequency of the east and north-east winds from the German ocean.

§ I. *Causes.*—1. *Climate.* The influence of climate on the growth of trees, is every where perceptible. From this cause too it is, that trees in general grow more freely on the western, than on the eastern coasts of Scotland. On the west coasts, the frosts are less frequent and intense; the prevailing south and south-west winds, though otherwise hurtful, bring much warm moisture which is favourable to the growth of trees; and they are in a great measure free from the blasts of the east and north-east, with which the eastern shores are so much annoyed.

On the western coast, every plantation will be most prosperous, when sheltered from the south-west; and on the eastern shores, when screened from the north-east. There is no natural growth of wood, and it is even difficult to raise trees by art, on most of the coasts of Aberdeenshire; but on the west coast under the same parallel, and in situations as much exposed to the sea, the natural woods are healthy and vigorous. *

2. *Frost.*—Sudden transitions from heat to cold, and from cold to heat, are extremely injurious, and generally fatal, to the vegetable tribes. When their fluids are chilled by frost, and converted into ice, their bulk is greatly enlarged; and the expansion sometimes takes place with such extraordinary violence, as to rend them in pieces. Hu-

* See Walker's Econ. Hist. of the Hebrides, vol. ii. p.196.

midity is the principal cause which renders frost fatal to vegetables; hence it is not so much the degree of frost which proves injurious to plants, as those frosts, though less severe, which happen when they are full of moisture; hence also the difference between the severe frosts in winter, and those which occur in the spring and autumn on trees, plants and vegetables.

Frost is also observed to be more fatal in its consequences to trees and plants in low situations, subject to fogs and mists, on the sea-coast, and on the margin of rivers and lakes, and more particularly, if rapidly succeeded by bright sunshine. Trees planted on the eastern coast of Scotland, in exposed situations, frequently receive injury from this cause. In the spring season, when the young plants have recovered some degree of sap, a cold wind from the German ocean, accompanied with intense frost, distends and ruptures their vessels, and, when suddenly exposed to the beams of the morning sun, the mortification and death of the plant is the inevitable consequence.

3. *Mildews*,—proceeding from the same remote cause, are also frequent and highly prejudicial, to the growth of trees on the eastern coast. The woods on the western coast being in a great measure exempt from this enemy, are found, whereever the land is properly enclosed, to spring up luxuriantly, while, in the eastern, they are scarce, dwarfish, and sickly.

4. But the principal cause of the difficulty of raising trees on the eastern coasts of Scotland, is the strong *east* and *north-east* winds from the German Ocean.

The mere strength of wind, whether it blows from land or water, proves destructive to vegetation, and that even in the most genial climate. By a West Indian hurricane, the whole vegetable luxuriance of the islands is often blasted in a single night. The sea spray and moisture may also prove prejudicial; but in all the land-locked bays, and arms of the sea, on the west of Scotland, where the shores are screened from violent winds, the growth of trees, even by the sea-side, is as fresh and vigorous as in other places.

In a situation nearly insulated, and exposed to the Friths of Moray and Dornock, and to the wide German ocean, large plantations are raised as thriving as any in the kingdom. *

That sea-air, therefore, is more obnoxious to trees in general, than to grain, or the herbage that may grow under them, is quite inadmissible. The fact is, it is the force of our prevailing winds, which are increased and chilled by passing over a vast expanse of water, which contributes to stint the tree more than the grain or herbage, on which they cannot act so forcibly, nor injure so much by friction or reverberation. †

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* See Agricultural Report of the Northern Counties, p. 106.

† See Nicol's Pract. Plant. Note, p. 27.

§ 11. *Remedy.*—1. *Shelter.* Wherever trees are to be planted on the sea-coast, situations naturally sheltered should be first chosen. In every narrow glen and dell, forest trees will grow vigourously, though they would scarcely live beyond the verge of the shelter which such situations afford.

In situations where the bank rises high, the best mode may be to plant in the face of it, considerably within the level of the summit, in order to afford a screen for the trees within, till they rise to a sufficient height;—and, where it is flat, to adopt the method of planting in belts or zones, beginning as near as possible to the margin of the water, and planting the first or external rows very close at about thirty inches distance, employing stout, healthy, well-rooted plants, of not more than twelve or eighteen inches growth. *

Another means of affording shelter is, by enclosing and planting in large masses or clumps when one tree will aid or protect another. It is also of importance, in such exposed stuations, to avoid wind-waving, that the tree be planted obliquely, with its apex or top inclining to that wind from which most injury is to be dreaded. It will in a short time recover the upright direction. †

* Nicol's Pract. Plant. p. 29.

† 'The proper time' (as recommended by Mr Beattie of Moffat, in his MS. Essay on this subject) 'to plant firs of

When these methods are cautiously practised, there is scarcely any situation so unfavourable, where plantations will not thrive, provided plants be chosen adapted to the peculiar nature of the soil and situation. On the western shores of Scotland, and in many of the Hebridean isles, natural woods and plantations, when tolerably thick, and carefully managed, raise their heads aloft, and bid defiance to the gales of the ocean. *

2. A judicious selection of trees and plants, suited to the nature of the soil, climate, situation, and exposure. Different trees, it is well known, affect different soils. In the same climate, a fruit or forest tree will thrive in one soil, and fail in another. This fact appears to have been generally known at a remote period.

> 'Fraxinus in sylvis pulcherrima, pinus in hortis,
> Populus in fluviis, abies in montibus altis.'

A correct knowledge of this essential particu-

'every species, on the eastern coast of Scotland, is during 'the month of August. Having then made their growth for 'the season, when put into the ground at this period, they 'will have begun to fix their roots, and to draw nutriment 'from the soil, before the severe easterly winds set in to 'blow.' Mr Beattie also judiciously recommends seedling plants of two years old to be put thickly into the ground, with a small sharp-pointed instrument, like a gardener's dibble, tipped with iron, or what has been denominated 'the Diamond dibble,' by Pontey and Nicol.

* See Trans. of the High. Soc. of Scot. vol. i. p. 170.

lar, is absolutely necessary, to plant with advantage and profit, but more particularly on the sea-coast. *

§ III. *Species of Trees best adapted for Maritime Situations.*

It has been abundantly proved from experience, that some species of trees thrive much better than others, when exposed to the air and gales of the sea, as the Sycamore and Pineaster on our own coasts, and the Norway Maple on the shores of Scandinavia.

In the preceding part of this Chapter, the following species of trees have been pointed out, as peculiarly well calculated for planting on the sea-coast, viz. the Alder, the Huntingdon Willow, the Larch, the Maritime Pine, the Pineaster, the Scots Elm, the Scots Fir, the Sycamore, and the Yew. †

After the above, may be placed the Abele, the Ash, the Beech, ‡ and the White-beam, for re-

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* The late Professor Walker, in his 'Economical History of the Hebrides,' formerly quoted, happily illustrates this proposition, by adducing the Spruce-fir as a melancholy example. See pp. 266–7, Note.

† See a particular description of these trees, under their respective heads, pp. 248, &c.

‡ It is affirmed, that there is a Black birch in Norway, peculiarly well adapted for the sea-coast, and which neither the sea-breezes, nor even the sea-spray injures. In the Danish Islands of Zealand, &c. the Beech abounds even on the sea-shore.

sisting the destructive influence of the sea-breeze. To these species, the *Quercus virens*, or Lace oak (Mich. Arb. t. 11.), from North America, ought to be added. This tree was cultivated by Miller, so long ago as 1739; and the sea-breeze is said to be favourable, if not indispensable, to its full growth. *

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* The *Tamarix Gallica*, or French Tamarisk, and the *Tamarix Germanica*, together with the flowering Elder, or Bour-tree, have been strongly recommended for the purpose of fencing plantations on the sea-coast, as being highly ornamental, and forming an admirable shelter. The former, has been introduced into the Island of Skye, with success, by Sir James M'Donald, Bart.; and it is presumed, that the second, being a hardy shrub, would stand the frosts of our northern climate.

CHAP. V.

OF THE FORMATION OF WOODS AND PLANTATIONS.

In forming woods or plantations of trees for timber, fencing and draining are of primary importance: much, also, depends upon properly adapting them to the particular nature of the land, its being in a suitable state of preparation for their reception, and the planting being performed at a proper season, in a perfect manner, and at proper distances, according to the nature of the trees, soil, and situation.

SECT. I.—FENCING.

An article of essential importance, in raising plantations with certainty and success, is to have the ground previously secured by substantial fences, from the intrusion of all kinds of live stock. The species of fence must in a great measure depend on the nature of the situation, and the facility of procuring materials; but in all cases that will admit of it, a quick-hedge, and in hilly districts, a dry stone fence, (Galloway dike), are to be preferred.

The dry wall, however, where situation and climate will permit, should only be considered as a temporary fence, erected for the purpose of raising quick under its shelter, which, in a few years, if properly attended to, will become a complete and permanent division of property; and its sides will soon become thick, close, and impenetrable. After eight or ten years, the wall may be removed, and the stones applied to the erection of buildings, making roads, drains, bridges, or other necessary purposes. *

The expense will necessarily vary according to the form or magnitude of the land to be enclosed, and when the ground intended for such improvement adjoins to lands already fenced, to fresh-water lakes, or to the sea-coast, the amount of expenses will be greatly diminished. And in soft, mossy soil, at a distance from stone, a ditch, six feet wide, with cuttings of willow planted in the face, ought to be preferred. †

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* See Bath Pap. Vol. XI. p. 11.

† On the moor plantations which have been carrying on for several years past, upon the Duke of Montrose's estate, the following cheap species of fence is much used. 'An 'earthen dike or mound of about three feet broad at the base, 'and fifteen inches broad at the top, the height of about four 'and a half feet, and the ditch from which the earth which 'forms this mound had been taken, runs along its base on the 'outside, and adds at least three feet more to the height; the 'ditch is at least five feet wide at top, and serves materially at 'the same time to drain the outskirts of the plantation. Thus

Such plantations, when judiciously designed, executed and enclosed, will have an immediate tendency to shelter the stock from the inclemency of winter storms, and the fervid heat of the summer sun; and while they adorn the country, they meliorate the soil, and moderate the rigour of our northern climate.

Sect. II.—Draining.

Wherever the ground to be planted is wet or boggy, an effectual draining of the land must be had recourse to, by digging deep drains through all the hollow places, that all superfluous water may be carried off, before the operations of sowing or planting commence; and where circum-

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'there is a height of fence given of about seven and a half 'feet. It is obvious that this kind of fence requires constant 'attention, and frequent repairs.' See Gen. Rep. Vol. II. p. 281.

Another elegant species of Fence, well adapted for the purpose, on steeps and precipices, where stone or turf walls cannot be reared, or near gentlemen's seats, where they might be deemed disagreeable objects, is, that of a *Wire fence*, as lately adopted in Etterick Forest, by the Honourable Capt. Napier. Strong stookings of wood, iron, or cast-metal, are driven into the ground, about ten or twelve feet distant, and four or five bars of wire (No. 7.) run through the stookings, or firmly attached to them by small keepers. This fence may be executed at 4s. 6d. per rood, or about half the expense of a stone wall; and will, with occasional repairs, last an age.

stances will permit, it is advisable to carry the drains round the exterior of the plantation, to prevent their being choked up by the roots of the trees, to the serious injury of the timber.

It has been recommended by Mr Blaikie, that, when the drains must of necessity be made inside, 'they should be cut as deep as possible, and 'the bottoms well filled with stones or rubbish, 'above set bricks or stones.'

Covered drains, however, are attended with serious expense, and necessary only on low grounds, where the descent is inconsiderable, and where the cut must be deep. On higher grounds, which may be chosen for extensive plantations, open cuts of about eighteen inches broad, and from six to ten inches in depth, may be sufficient, which are carried in every direction in which the water will run. *

Sect. III.—Clearing the Ground.

The only other preparatory steps, besides fencing and draining, where necessary, is, clearing the ground, and burning off rank heath, furze, &c. Wherever the land is covered with broom, furze, brambles, thorns, rank heath, &c. which would inevitably choke the young plants rising from the seed, they must be removed, by cutting

* See Gen. Rep. of Scotland, Vol. II. p. 282.

them over close to the ground, and burning them on the spot. The ashes will furnish an useful manure. *

SECT. IV:—SOWING THE SEEDS OF FOREST TREES.

The next point that demands the attention of the planter, is the manner of sowing, raising, or providing the young trees.

This may be done in three different ways.

1*st*, By sowing the seeds in the ground, where the trees are intended to grow.

2*d*, By raising the plants from the seed, in a detached piece of ground, as a nursery. And,

3*d*, By purchasing the trees from nurseries in the neighbourhood.

In regard to the first of these modes, that a variety of trees may be raised, by sowing the seeds on the spot where they are to grow, has been sufficiently evinced by numerous and successful experiments, both in England and Scotland, as well as in various other countries.

* Mr Nicol recommends, that where plants are to be put into the ground by pitting, to begin in May, to pit what is intended to be planted in November; in June, what is to be planted in December; and in July and August, what is to be planted in January and February. By this method, he is of opinion that the mould, and even the turf that is taken from the pit, undergoes a fallow, and is, of course, better able to nourish the plant. Pract. Plant. pp. 89–90. 2d edit.

And though many seeds and plants must necessarily be lost, and several years elapse before the trees make a figure, yet they are afterwards found to rise firmly from the root, are not so easily injured by high winds, produce more valuable timber, and, in ten or twelve years, surpass in growth the larger and more expensive plants. *

It is therefore necessary, in order to preserve the quality of the timber, to follow nature, and to sow the seed where the tree is finally intended to grow.

The planting of acorns, in the Forest of Dean, in Glocestershire, and other Southern counties, to the extent of many thousands of acres, has been successfully practised for the last fifty or sixty years. † Among the plantations at Gartmore, in Scotland, there are many promising young oaks, which have sprung from the acorn, dibbled into soil altogether unimproved. ‡ And in the General Report, an account will be found of Sir Archibald Grant having sown Scots fir upon heath, without any farther expense, which has been found to answer extreme-

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* See Hunter's Evelyn, Vol. I.

† See Glocester Rep. p. 244. Acorns were planted by Governor Hutchinson at St Helena, between 60 and 70 years ago, from which oaks have grown to the size of ten or twelve feet in circumference. See Edin. Encyc. Vol. X. p. 697.

‡ Mr Stewart of Grandtully, in Perthshire, has raised considerable oak-woods from acorns sown in pits, instead of plants from a nursery. See Stat. Acct. Vol. VI. p. 360.

ly well; and that ash keys, beech mast, and the seed of laburnum, are all successfully dibbled into uncultivated ground. *

The species of grounds best adapted for planting in this manner, by sowing the seeds, and of which there are extensive tracts in Scotland, are those which are partially covered with brush, or natural wood; and those large tracts of waste, or bare soils, partially clothed with short heath, moss, or moor fog, of various descriptions, where the different seeds are not liable to be choked in their nascent state.

§ 1. *Preparation of the Seeds.*

Great attention is necessary in selecting the seeds of the different plants that are to be sown, particularly those of the oak and beech.

1. *Oak.*—The best acorns produced in Scotland, are supposed to be those procured from large thriving trees at Hamilton, in Lanarkshire; but, in general, those procured from the South of England are found to be greatly superior. † The same is the case with the seed of the beech, and some other plants, which, being natives of a more southern climate, do not produce seeds in Scotland sufficiently strong for raising vigorous plants. ‡

The acorns should be chosen from tall, straight,

* See Gen. Rep. Vol. II. p. 269.

† Dr. Walker's Hebrides, p. 280.

‡ Gen. Rep. Vol. II. p. 270.

thriving trees; and the most clean, weighty, and bright acorns, are always the best. When they are gathered in the month of November, or as soon as they fall, it is necessary to keep them very carefully during the winter, previous to their being sown, spread thin on a boarded floor, in a state neither too moist nor too dry, till sown in February or March; for by being late sown, they escape the attacks of many enemies, as rats, mice, birds, insects, &c.

2. *Larch*.—The seeds of larch, and of all the pine genus, are produced from the cones, which are generally gathered in November, and kept in a dry situation till spring, when they are thrashed out, to extricate the seeds; but a preferable mode is that practised by Sir Archibald Grant of Monymusk, and others, who are of opinion, that 'the seed of the larch in this climate is not ripe till 'the end of February, or the beginning of March.' In this conviction, their rule of preparation is the following: 'Put the cones for sixty hours on 'a tyle-kiln, with no more heat than what you 'can bear with your hand on the tyle; never 'thrash, but riddle out the seed, and then water 'it, and put it in a heap till the wing comes off, 'then spread it out to dry.'

In the view that, upon general principles, the seed of any vegetable, which has been introduced from a distant climate and soil, will gradually degenerate, at least, as to perfecting healthy seed;

—it is highly advisable, to import the seeds of larch and others, from their native Alpine regions.

The decided preference due to the seed of the white larch of European origin, before the American seed of the black larch, is now generally understood, by experienced planters in this country; and also that which is due to the Scots fir, raised from seed of the real Memel red pine, and that of the rich native pine of Scotland.

3. *Ash.*—Ash-keys, (or pods containing the seed), are procured from straight, well-proportioned trees, between Christmas and the middle of February, and preserved in the following manner. When the ash-keys are collected, prepare a hole in the ground, about three or four feet deep, lay a bed of sand, a few inches deep, at the bottom of the hole; upon which place a layer of ash-keys about two inches thick, cover them with sand about the same thickness, to preserve the keys from heating; and then proceed with alternate layers of the keys and sand, till the hole is full. They may be allowed to remain in this state till the beginning of the month of March in the following year, when they should be taken out for sowing, when the keys will be found in a swelled state ready for vegetation.

Other trees, such as elm, beech, birch, &c. and all the coniferous, or pine tribe, may be raised from the seed on similar principles with those above enumerated; and for which, useful directions will be found, (which it is unnecessary here to detail), in the Encyc. Britan. 4th Edit. Art. Agriculture;—Glocest. Rep.;—Hunter's Evelyn;—Marshall's Plant. and Rur. Orn. vol. ii.; —Trans. of the Soc. of Arts, &c. vol. xxv.;— Trans. of the High. Soc. of Scotland, vol. i.;— and Nicol's Plant. Kalend. (§ 2.)

§ 2. *Season for Sowing the Seeds of Forest Trees.*

The most eligible season for planting acorns, is either in the months of October, November, or March, though the latter is generally preferred; and the proper quantity, when sown by themselves, from two to three bushels per acre. But where a great quantity of seeds of different kinds are to be sown in one season, some must be planted early, and some late; in porous dry soils, the months of October and November are supposed to be the most suitable either for planting or sowing the hardier sorts of trees; and the early spring season, from the middle of January to the beginning of April, for humid soils, with the less hardy species of seeds and plants. Both excessive wet, and excessive drought, are injurious. It is therefore equally improper to sow or plant when the soil is either in too dry, or in too moist a state, and particularly when covered with snow.

The proper season for sowing seeds of larch, and Scots fir, is in the month of March;—ash, plane, beech, &c. in the months of October and November, or early in spring. Lime, birch and elm, may be propagated either by layers, or from the seeds, which are ripe in October; and poplars, and willows, may also be propagated from cuttings of two years old, or from the bottom of the first year's growth.

§ 3. *Method of Sowing the Seeds of Trees.*

1. *Plantations of Oak.*—It has been generally considered the most eligible and economical method to raise Oaks from the acorn, by sowing them at once where they are finally to remain, and never to transplant, or in any way disturb the saplings intended for timber. *

Having made a careful survey of acorns that are perfectly sound, and in good preservation, in order to form a plantation solely of oaks for timber, the cheapest and most expeditious method of sowing the seed is, by detached parties of two men working together. The ground being prepared and marked out, the first, prepared with a light mattock, † (with one end about four inches broad, and twelve or thirteen inches long from the centre, for paring the surface;—and the other

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* The practice, however, of transplanting, and heading down young oak trees, has been applied by Mr Forsyth, with singular efficacy. See 'Forsyth on Fruit Trees.' The ash, also, may be cut down when planted, with advantage.

† The use and value of this tool, on rough, heathy, stony soils and precipices, is well known and properly appreciated in many of the Southern Counties. For a description and drawing of a similar instrument, see Pontey's Profit. Plant. Nicol, &c.

end a pike about seventeen or eighteen inches in length), pares off about a foot square of the surface with the broad end of his instrument, and then loosens the soil in the pit with the other. The second, furnished with the seeds, follows; and sets two or three acorns, with a setting pin, or iron-shod dibble, near two inches deep, and covers them with the soil and inverted turf, while the first proceeds to the preparation of a second pit. This simple process continues to be repeated at two or three feet distant, as the planter may judge most expedient, till the whole is finished.

The plantations may be thinned in a few years, and the young trees which are removed, transplanted with success, always leaving the best plants; and the same operation may be repeated at regular intervals, till the oaks stand at twenty or thirty feet apart.

Previously to planting acorns, where the land intended for their reception is of a better quality, it ought to be loosened by deep trenching, and, if grass ground, the first spit placed at the bottom of the trench. If the land be in a state of tillage, wheat, pulse, or oats may be sown, according to the season.

It is of importance also, that the whole quantity of ground intended for plantation, should be divided into annual sowings, that, when the whole is completed, the falls or hags may follow each other in regular succession. When the grain is sown, a careful selection of acorns, perfectly sound, and in good preservation, should be planted in drills, at the depth of two inches in a heavy loam, but three inches in a light sandy soil, and carefully covered with mould. In situations that do not admit of regular drills, the operation may be performed, by paring off the surface with the mattock, and setting the acorns with a dibble, as lately practised in the forest of Dean, where, within the last forty years, nearly 3000 acres have been planted chiefly with oak; though not with the same certainty of success.*

2. *Mixed Plantations.*—It is of very immaterial importance, whether the seeds of different trees be sown in distinct groups, or in indiscriminate mixture, provided in the latter case the most profitable and flourishing kinds only are ultimately retained.

Where it is practicable and desirable to raise the most valuable kinds of timber, it has been suggested, that, exclusive of the nurses, and a few firs to enliven the borders, six kinds may compose the mixture; to plant two oaks for one elm; two elms for one beech; two beeches for one ash; two ashes for one birch; and two birches for one sycamore.† But where a coppice of underwood is desired, beech and sycamore ought to be excluded.

* For the method of planting Acorns, in the Forest of Dean, see Rudge's Report of Glocestershire, p. 244, &c.

† See Nicol's Pract. Plant.

In moor, waste, and mountainous districts, instead of planting the whole hill at once, the lower part, where the soil is commonly best, should be first planted with seeds suitable to the situation, in the manner above described; and these trees allowed to remain, until they were able to afford a degree of shelter to those that are to be planted higher, and so on progressively, to the summit. If this mode was more generally adopted, we should not so frequently behold in such situations, flourishing plantations at the bottom, and nothing on the top but a few blasted trunks. *

In forming plantations on grounds of the above description, the exterior part should be sown with the hardiest seeds, and those best calculated for nurses; as the seeds of red pine, and spruce fir, intermixed with hazel-nuts, sloes, haws, and holly-berries, with the seeds of alder and birch, at two feet distant; and, advancing from the outside, dibble in beech-mast, ashen and maple keys, hornbeam, and sycamore, at three or four feet apart; and in the interior, oak, larch, chestnut, &c. as the seeds can be procured, and as the planter may deem most proper, at the distance of five or six feet, increasing the distance gradually towards the interior of the plantation.

In belts, stripes, and all narrow plantations for

* The most effectual remedy, perhaps, in addition to the directions above given, is to employ small, well-rooted plants, when that mode of forming plantations is practised.

shelter, in a bleak situation, where a variety of seeds are sown, the margin on all sides should either be planted at not more than two feet distance, and the interior at three or four: or acorns for undergrowth mixed, to check the progress, and retard the velocity of the wind.

In the most sheltered situations, in a deep, rich soil, six feet will be a sufficient distance to allow the plants room to grow, until thinning becomes useful.

The species of seeds most particularly deserving attention for waste and moor lands, are, in general, those of oak, ash, elm, beech, birch, sycamore, larch, and other kinds of fir;—and for moist, marshy, peaty or boggy soil, willow-cuttings, six inches long, to be set four inches in the ground, and two out, intermixed, if necessary, with poplars and spruce firs.

In preparing, and sowing the sides of precipices, gullets, banks, &c., the mattock, above referred to, is found particularly useful for removing stones, working down the soil to form levels to retain the moisture for the seeds and plants, and to allow the roots and fibres to extend themselves.

In heathy soils, and in all the different varieties of surface which occur in such grounds, the method is precisely similar, as on rocky ones; the heath being struck off as thin as possible, the soil deeply stirred, and left in the pit. *

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* See Pontey's Profit. Plant.

Where the ground is soft, permeable, and free from stones, the seeds may be planted in the common method, with two cuts of a spade; the acute angle of the turf being raised to receive the seeds, and the sod pressed down. 'In this way, 'two men will plant a thousand pits in a day.*

Sect. V.—Raising the Plants, or purchasing them from Nurseries.

Having noticed the various circumstances necessary in the forming of plantations, by simply sowing the seeds on the spot where they are intended to grow; the next point that demands attention, where a different mode is pursued, is, the raising of the plants from the seed, in nurseries, or purchasing such as may be wanted. The former of these methods is generally preferred, where plantations are to be made on an extensive scale, and the plants are found to succeed better when they are put in immediately after being removed from the nursery; but on a small scale, the latter method, that of purchasing from sale nurseries, will be found the most economical.

Wherever nurseries are attempted, it should be on good land, that the young trees may carry off a stock of health and strength, to enable them to live in a poorer soil. An opinion, the reverse

* High. Soc. Trans. Vol. I. p. 200.

of this, that young trees should be selected from nurseries, the soil of which is poorer than that into which they are transplanted, has been maintained; and it has also been argued, that all nurseries should be made on land similar to that proposed to be planted; * but happily such opinions are now generally exploded. It has been proved, that a 'plant once weak, is for a long 'time so, and unless removed into a more genial 'soil, will always remain weak;' and that young trees raised in a good soil, are in every respect the strongest, most luxuriant, and the fullest of root; and, by consequence, are more likely to thrive into whatever soil they are transplanted, whether better or worse, than that from which they came; than others are, whose growth had been weaker, and whose roots are fewer. The roots of such young trees, when transplanted, will always be able to find nourishment, even from the poorest land, because they have more mouths to collect it; always making allowance for the circumstance, that certain soils are peculiarly adapted to particular plants.

For a nursery of the above description, the spot which may have been occasionally occupied as a kitchen garden, has been strongly recommended by Mr Nicol and others. The pulverization and mellowness afforded by the previous growth of various culinary crops, bring the land

* Loudon, Nicol, &c.

into the most suitable state for the raising of young trees, and at the same time clear it the most effectually from vermin, as grubs, insects, &c. *

The method practised by the Earl of Breadalbine, in his extensive plantations of firs and forest-trees, appears to be judicious. After thinning out the larch and Scots fir, particularly the latter, he plants oaks and other forest trees, which are transplanted from the seed bed, for at least one year, into good land, in a climate about half way between the nursery and the ground into which they are to be ultimately planted. This mode ensures a strong root and a hardy plant, both which are essential to the success of the plantation.

Probably the best mode that can be adopted, is to have a sheltered and centrical situation set apart for a nursery, for rearing all the different species of trees intended to be planted, in the immediate vicinity of the plantations, which will be found to answer better than those which are purchased from nurserymen at a distance. In general, the plants are raised too near each other in their nurseries, and not being always removed in due time, the roots are seldom so good as those reared in the manner above described.

Trees, that have been in the nursery two or three years, according to their kind, will in ge-

* Nicol's Pract. Plant. p. 64.

neral be found the most advantageous for timber; and firs, of from fifteen to twenty inches in height, are to be preferred, even in the most favourable soil and situation, to those of a larger growth.*

The seminary, as recommended by Marshall,† should consist of a spot of fine light earth, and the seeds to be sown in beds a quarter of an inch deep. In the spring, when the plants appear, they should be refreshed with water in dry weather, and carefully kept clean of weeds during the whole summer. By the autumn, they will not have shot more than an inch or two; and in spring, they should be pricked out into beds three inches asunder. The spring following, they must be removed from these beds with great care, and planted in the nursery ground, three feet asunder in the rows, and two feet distance; and here they may remain till they are fit to be planted out finally, which will be about the second or third year after.‡

SECT. VI.—PREPARATION OF THE GROUND.

The land intended for planting, after being fenced and drained, is prepared for the recep-

* See Dickson's Pract. Agricult. Quarto. Vol. II. p. 608.

† Plant. and Rur. Orn. Vol. II.

‡ The less transplanting, however, in the nursery, the better.

tion of the plants, either by the plough, the spade or the mattock, according to circumstances. As the great object is to afford the roots of the plants room to grow without obstruction, two furrows, where the land has been in tillage, with an equal number of harrowings, will be sufficient to render it fit for the reception of the trees.

Stiff heavy clays, with only a few inches of vegetable mould on the surface, require to be dug or trenched two spits deep, to admit the roots, which operation ought to be performed, if possible, a year before planting, that the soil may be exposed to the sun, the air, and the frost. The expense attending this process has been calculated at eight pounds per acre. Where the land is in lea, a crop of oats has been recommended to be taken the season before planting.

In sands and other light soils, in steep situations, and others where the plough cannot be employed, the most general mode is by pitting. The pits are generally made about three feet wide, and eighteen inches deep, where the soil will permit, at four feet asunder, which will take about 3000 trees to an acre, and cost nearly two guineas per acre for digging the pits. *

As this method has been found both tedious and expensive, a more usual mode, practised in

* Trees planted in trenched ground are very apt to be wind-waved, and do not thrive so well as those put into the natural surface.

Scotland, and when the plants are small, equally efficacious, is the following: Two persons are employed, one to execute the work, and the other to carry and put in the plants. A labourer, with two cuts of his spade, raises up, and folds back, an angular piece of turf; and after the subsoil has been moved and loosened by a trowel or mattock, so as to enable the tender fibres of the root to penetrate the soil, the plant is inserted, its roots properly separated in one of the cuts, and the piece of turf replaced and trodden firmly down. *

Where the soil is neither stiff nor hard, there is a simpler method of planting Scots firs, and other small plants, than by pits. A man with a spade strikes it into the ground, and bends it backwards and forwards, till the aperture is large enough to receive the root of the plant; when another labourer, with a basket containing the plants, sets one in, and with his foot presses it firmly together. Many thriving plantations have been done in this way; and besides expedition, this mode is not so apt to produce the growth of rank weeds in this soil, as pitting. But there are many situations in Scotland, particularly in the higher districts, so stony and precipitous, that the plough cannot possibly be used, and where the usual method of pitting, and

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* See a method somewhat more complex, adopted by the Duke of Montrose, described Gen. Rep. Vol. II. p. 283.

even slitting, with the spade, are found too expensive, and often impracticable; hence recourse has been had to dibbling, and sowing, which, with some kinds of plantations, have been found to answer.* In such situations, the mattock, formerly noticed, recommended by Pontey and Nicol, is worthy of attention.

Great care should be taken not to strangle the plants by setting the roots too deep, a very common blunder; two persons are always necessary to prevent this, one to hold the plant at the proper depth, and the other to fix the root with the spade.†

Sect. VII.—Distance and Manner of Planting.

The season for planting the different species of trees,‡ being similar to that for sowing the

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* See Chap. V. Sect. IV.

† See Farm. Mag. Dec. 1809. When the young trees are carefully removed from the nursery, they should be arranged in proper proportions, when intended to be planted in mixture; the bruised extremities of the fibrous roots cut off; and the plants distributed at the pits, for the planters, immersed in tubs, containing a mixture of earth and water, of the consistence of pap, to prevent the roots getting too dry, previous to their being put into the ground.

‡ The best season recommended for the planting of many trees of the ever-green kind, such as the Weymouth pine, Spruce, Silver, and other firs, is in the latter end of July, or

seeds, described in Sect. 4th of this Chapter, the other points to be considered, previous to the business of planting out the trees, are, the distance and manner of planting, and the most advantageous method of intermixing them.

§ 1. *Distance.*—It is impossible to lay down determinate rules in a matter in which there are necessarily so many varying circumstances to be taken into account, that the practice must vary accordingly. The great end in view, is to admit sufficient room for growth, and free circulation of air.

Mr Nicol, who has attended minutely to this part of the subject, directs, that for bleak and exposed situations, from thirty to forty inches may, in general, be considered as a good medium distance, varying according to the depth and nature of the soil; and in more sheltered situations, where soil is found above six inches in depth, from four to five feet will be a proper medium, varying the distance according to circumstances, and the natural form of the respective trees; the Pines, Firs, and Larches, for instance, requiring less distance between them than the Oaks and Ashes.

In forming extensive plantations, we have already recommended sowing the seeds where the trees are intended to grow, in preference to trans-

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in the following month, when the weather is moist and cloudy. See Dickson's Pract. Agric. Vol. II. p. 612, &c.

planting, which is always more or less injurious. The same principles would seem to point out the propriety of sowing or planting thick, in imitation of Nature herself, and to remove the least valuable plants gradually, as circumstances point out; always allowing them to grow closer together in the most exposed situations.* In belts, stripes, and all narrow plantations for shelter, lying in a bleak situation, the margin on all sides should either be planted at not more than two feet apart, and the interior parts at three; or undergrowth of oak mixed, to check the progress, and retard the velocity of the wind.

For the most sheltered situations, in a deep, rich soil, six feet will be a sufficient distance, to allow the plants room to grow, until thinning becomes useful. It is generally conceived, 'that 'he who plants too thin, with the idea of saving 'trouble in thinning, deviates as widely from the 'right path, as he who thins none at all;' and that 'thick, rather than thin planting, is the 'safer side to err on.'†

In the Duke of Portland's extensive plantations, where trees of various sizes are planted in an irregular manner, Mr Dickson informs us, that the number upon an acre is usually about 2000. Sir Archibald Grant considered double

* See Caled. Hort. Mem. Vol. II. p. 420.

† Nicol, &c.

that number of firs and larches requisite to fill an English or statute acre. The late Bishop of Landaff, whose authority on this point is so justly entitled to respect, recommends only about 1200 plants to an acre. The number, however, must in a great measure be regulated by the species of plants, the elevation, the soil, and exposure.

§ 2. *Manner of Planting.*

Plantations, in Scotland, are generally divided into two sorts:—those made in large bodies, upon considerable districts of ground, in order to supply the want of natural forests; and those made in the form of belts, or clumps, in order to procure shelter for enclosures.

1. *Large Plantations.*—This sort, in general, consists chiefly of Scots firs, larches, and spruce firs; but they have been sometimes (of late years particularly) intermixed with oaks, beeches, birches, and other species of deciduous trees, which, however, are too often permitted to be suffocated, through want of early and judicious thinning.*

The shelter which the trees mutually afford to each other, in plantations of this kind, must essentially contribute to their vigour and growth.

The following are generally allowed to be the most proper nurses in raising plantations of this

* See Lord Meadowbank's Instructions for Foresters. 1815.

description. For every situation in Scotland, and in all soils, the larch, Scots and spruce firs, obtain a decided preference. In high exposed situations, the birch,* and mountain ash, are justly admitted for the sake of variety;—in humid soils, the Huntingdon willow, and the Lombardy poplar, deserve to be preferred; and in maritime situations, the elm, alder, sycamore, pineaster, and maritime pine, have been found most 'patient of the sea-breeze.'

2. *Belts, or Clumps of Planting.*—In bleak and exposed parts of the country, these prove both useful and ornamental; not only meliorating the climate, and affording shelter for stock, but also furnishing valuable thinnings and prunings from their annual produce, and greatly improving the appearance of the country.

A very general error, however, seems to prevail, particularly in elevated situations, in the original formation of these belts or verges; being much too narrow. They ought to vary in breadth from fifty to an hundred feet, according to the exposure, and value of the soil; which would afford space for planting such a number of trees as would, by the mutual shelter which they afford to each other, promote their respective growths, and protect them against the blasts which are so

* Birch will bear to be removed, as well as the Scots fir, with safety, at the height of six or seven feet, when intended for nurses to other timber.

severely felt in these elevated regions.* In the view of effecting shelter, an important object in this northern climate, it has been recommended to make the general direction of such belts of planting from south-east to north-west. Whilst we are of opinion, that circular clumps may, in a country scarce of wood, be both useful and ornamental, yet, where they abound, they appear stiff and formal, and are attended with much greater expense, than that practice, which is daily becoming more general, of planting the corners of enclosures, to which there are great inducements: two-thirds of the space being already enclosed; and the soil being in general rich and fertile, such plantations, though upon a small scale, essentially promote the beauty of the country, at little or no expense.†

The propriety of hedge-row timber has been already particularly alluded to, in a former Chapter of this Abstract.

3. With regard to the manner or form, in which trees should be disposed in plantations,

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* See Commun. to the Board of Agric. Vol. II. p. 1.

† Though we are perfectly aware of the hostile opinion of the late Mr Arthur Young, on this subject; yet, from the best of all tests, experience and practice, we are disposed to approve of it. This plan was originally recommended by Dr Falconer in the Staffordshire Report, and afterwards in the original printed Sketch of the Xth Chap. of the General Report of Scotland, London, 1811, drawn up by the writer of this Abstract. See Frontispiece to do.

different opinions have been entertained; some recommending to plant in equidistant rows, and others in a different manner.

We are disposed, however, to adhere to the recommendation we ventured to hazard in the printed sketch of the tenth Chapter of the General Report of Scotland; viz. in imitation of nature, to plant in the angles of hexagons, with a plant in the centre of each hexagon. *

SECT. VIII.—MANUAL OPERATION OF PLANTING, OR MODE OF PUTTING THE PLANTS INTO THE GROUND.

Supposing that the ground intended to be planted has been prepared for the principal trees, either by the plough, the spade, or the mattock; and the distances at which to plant being pointed out by the pits; the best practical method of performing the operation, is by two persons, one to execute the work, and another to hold the plants,

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* It has been demonstrated that 'the closest order in 'which it is possible to place a number of points, upon a 'plain surface, not nearer than a given distance from each o'ther, is in the angles of hexagons, with a point in the centre 'of each hexagon.' Hence it follows, that this method of planting trees, is the most economical, because the same quantity of land will contain a greater number of trees, by fifteen per cent. when planted in this form, than any other. See Farm. Mag. Vol. VII. p. 409.

The mould in the pits being well stirred, one of the labourers places the plant upright in the pit, with all the fibres of its roots extended, about an inch deeper than it had stood in the nursery, while the other throws in the loose mould, and then proceeds to the preparation of a second pit, leaving the former to set the plant erect, and close the mould around it. In stiff soils, this last operation should be performed in a light manner; but in loose sandy soils, the earth should be pressed as close to the plant as possible. *

On steep situations, the trees should be planted at the lowest part of the pit or opening, and leaning towards the declivity. The largest young trees, or hard wood, should always be first planted, and the work ended with the nurses, or those of the smallest size.

During the first three months after planting, great attention is necessary to have the trees well secured against the wind, by frequent examination, and making the earth fast about their roots. When the plants are tall and top heavy, a stake should be sent firm into the pit, at the same time with the plant, so that they may be properly tied up together; as, when the stakes are driven into the ground close to the trees after being planted, the roots are liable to be injured. † As the sea-

* See Dickson's Pract. Agric. Vol. II. p. 613.

† See Blaikie's Farmer's Instructor.

son advances, the trees will put forth new roots, sufficient to hold themselves securely. *

* One of the greatest obstructions to the growth of trees, is wind-waving, or the shaking of their roots by the wind. To obviate this, it has been attempted to plant the tree obliquely, with its top inclined to the prevailing wind, and with great success. In five years from the time of planting, they will come into the upright direction. See App. to the Kinross-shire Report, 4to. Edit.

CHAP. VI.

ON THE SUBSEQUENT MANAGEMENT OF WOODS AND PLANTATIONS.

HAVING detailed the various circumstances necessary in the formation of Woods and Plantations, either by simply sowing the seeds on the spot where they are intended to grow; or, by pitting, slitting, or dibbling the young plants; we now proceed to offer a few remarks on their general management. The proper weeding, or cleaning, filling up, thinning and pruning plantations of timber and underwoods, is a most essential part in the general system of managing that valuable description of property, and consequently requires very peculiar attention. *

* See Trans. of the Soc. of Arts, &c. Vol. XXIV. p. 76.

Sect. I.—On the Management of Plantations.

§ 1. *Weeding.*—The first operation after the process of sowing, or planting, should be, to cut down the tall growing weeds, heath, or grass, repeatedly, during the first summer after the plants appear, and once during several succeeding seasons. Where this operation cannot be performed by the sickle or a short scythe, it is preferable rather to pull up the weeds by hand, after rainy weather, than to use the hoe, which often injures the young plants, where they are thick sown or planted. *

§ 2. *Filling up Vacancies.*—The following winter or spring, after the seedling plants appear above ground, the whole plantation should be carefully gone over, and all the vacancies filled up with fresh seedlings from the nursery. The same process may be repeated the following season.

§ 3. *Thinning, and Heading down.*—As to thinning, probably the best general rule that can be given, is, to thin early, and gradually, and to take nature for our guide; being more so-

* The practice of planting potatoes, turnips, or other crops, between the rows of young trees, for a few years, (where the land is fit for it), has been experienced to be beneficial, particularly for young oaks.

licitous to clear away unhealthy and useless trees, than to observe regular distances. The thinnings should be continued annually for the first three or four years; afterwards biennial thinnings may be substituted for annual ones; and these again succeeded by triennial selection, until the trees have sufficient space to arrive at full maturity. *

With regard to plantations of forest trees, they ought to be occasionally examined after the third season from planting, not only for the purpose of thinning, but also for heading down, or removing such plants, as may appear necessary; and shortening those branches that seem to contend with the principal leader, to nearly one-third of their length, to strengthen and invigorate the main stem. All that is afterwards necessary, is, that of properly thinning the strong top and side branches.

In mixed plantations, the nurse trees, particularly the pine tribe, should be first gradually thinned out, beginning with those of the most inferior kinds, few of which should be allowed to remain after fifteen or twenty years; because the pine being only a tenant for life, when once cut down, falls, to rise no more; but the forest tree, if due attention be paid to the fences, gives an estate in fee simple, rising again and again from the root; and the older the root, the more vigorous the growth.

* See Blaikie's Farmer's Instructor.

Where fir trees are employed for nurses, their roots, after being felled, decay in the ground, and thereby furnish a new support to the soil, invigorate the trees intended for timber, and, by affording them an enlarged space in earth and air, contribute to their growth. The trees thus thinned out, are converted to posts, rails, paling, firewood, and other useful purposes. They may also be transplanted, if necessary, to other plantations, when forward woods are desired, and planted at thirty or forty feet distance, to serve a second time as nurses. In this case, they may be raised with balls of earth attached to their roots, when the ground is moist, and will seldom fail. *

In situations and circumstances where the firs have overshadowed and choked the forest-trees, (of which there occur frequent instances, when the Scots fir has been used as a nurse), the following mode has been successfully practised, particularly at Blair Adam in Kinross-shire. The firs may be cut out in patches, thereby forming vacuities of 40, 50, or 60 feet diameter, and leaving a thick fringe of firs round these open spaces. The choked forest-trees being thus relieved from the noxious drop of the overshadowing fir, will rise rapidly, and the rapidity of their growth will be much increased, by stubbing or heading down the choked tree.

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* See mode of planting adopted by the Earl of Fife, described in the Annals of Agriculture, Vol. IX., and in Trans. of the Soc. of Arts, &c.

When the forest trees in those apartments rise to be out of danger from wind or climate, and themselves to constitute a shelter, then the surrounding firs may be cut down; and the forest trees, sheltered by their neighbours, will then grow up, and the whole gradually become a wood of forest trees.

Even gentlemen, who are now possessed of fir wood only, may, by the same means, gradually obtain forest timber; by clearing out centrical spaces in their fir plantations, and planting them with forest trees.

§ 4. *Pruning.*—By the professed gardener, it is universally understood that judicious pruning invigorates the tree, and that trimming off the side branches, makes the upright ones shoot the stronger, and *vice versa;* and that, by cutting out the dead and decayed parts of the wood, the tree is kept alive, and invigorated. This equally applies to the management of plantations and timber groves, which require particular attention in this respect. The lower boughs, and such as appear to be unhealthy, should be cut off close to the tree, as smooth as possible, and at an early period; carefully preserving and encouraging the leading shoot, and preventing it having a competitor; and at midsummer following, all such sprays as have been put forth from the sides of the wounds, should be stripped off with the hand; hence sound clean wood is formed over it to the outside: but when this precaution is neglected, the accumulation, or growth of the tree, encloses the dead bough, and produces what is termed a dead knot, and thereby materially lessens the value of the timber. When the trees are allowed to acquire thirty or forty years' growth, before being subjected to amputation, the consequences are generally fatal, the tree decays and dies.

One principal object in the general management of plantations of timber, is to afford them a due proportion of air and shelter; hence they ought to be continually undergoing weedings, and thinnings, and prunings, to prevent the branches of any tree from touching or overhanging those of another, thereby giving the trees soil and air to grow strong, which is the only way to make them useful. *

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* John Borthwick Esq. in Farm. Mag. Dec. 1809, p. 479. 'There is a fir plantation,' says Mr B. 'under my eye, about ten years old, which was very thriving, until spring 1808, when it was nearly destroyed by the snow. The trees had been originally by far too thick planted; they had also been neglected to be thinned, and consequently grew quite impervious. Accordingly, the snow falling upon them, could not get to the ground; and, collecting on the top branches, (which being evergreens are always thick and bushy), left a vacuity below. The weight of the snow accumulating, soon overpowered the trees and crushed them to the ground: some of them that were not crushed, were bent; others were completely stript of their branches in a most singular manner, and left sticking up in the air, here and there, like so many poles.' And who, that has lived long in Scotland, has not witnessed similar causes producing similar effects?

The rule adopted by the intelligent conductor of the extensive plantations of the Duke of Montrose, we are informed, is the following. 'The 'plantations are wed, thinned, pruned, and all 'useless branches lopped off, every two years af-'ter the fifth year from their being planted.' *

In pruning fir plantations, the following rule has been recommended by Mr Salmon. 'The prun-'ing to commence when the trees are five years 'old, or when there is discernible five tier of 'boughs and the shoot; the three lower tier of 'boughs are then to be taken off.' † After this first pruning, the trees are to be let alone for four or five years, the pruning then to be repeated, and at every succeeding five years, till the stem of the tree be clear to forty feet high; after which, as to pruning, it may be left to Nature. ‡

Indeed, irreparable mischief is often inflicted, by excessive pruning, in the rearing of young timber; as is evinced at Duddingston Park, near Edinburgh, where the belts of wood have not only all the lateral branches cut off from the trunks, but completely cleared of all the underwood, and the winds allowed free access in every direction. The same error is observable on the

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* See Gen. Rep. of Scotland, vol. ii. p. 296.

† To remove only the two lower tier at once, we apprehend, may perhaps be generally most prudent. *Est medium in rebus.*

‡ See Salmon in Trans. of the Soc. of Arts, &c. vol. xxiv. p. 74. For Tables for Pruning, see Bath Pap. vol. xii. p. 237—8.

banks of the Tweed, above Melrose, where even the Larches, and Scots firs, are carefully mangled.* The season for pruning, is from the latter end of September to the beginning of April; and the tool to be used, the saw, or a light hedgebill.†

Sect. II.—Of the Management of Natural Woods and Coppices.

§ 1. *Division into Annual Hags or Cuts.*—The more extensive proprietors of the natural woods in Scotland, which are particularly cultivated in the Highlands, are in the general practice of dividing them into regular portions to be cut annually, by which a regular revenue is afforded to the owner. In this way the whole is gone over, every twenty, or twenty-four years. Such is the mode practised by the Duke of Montrose, the Earl of Moray, Sir James Colquhoun, and other proprietors of extensive tracts of coppice-wood, in the Highlands of Scotland.‡

§ 2. *Thinning.*—In the thinning and management of coppice and underwoods, care must be

* See the late Lord Meadowbank's Instructions for Foresters, p. 91.; and Nicol, &c. The larch and silver fir ought seldom or ever to feel the knife.

† For the removal of moss and ivy, see Chap. VIII. Sect. 9.

‡ Stirlingshire and Gen. Rep.

taken not to remove, or to transplant too many seedlings, in one season. When the young plants first appear, much attention is necessary to keep them clean, by hand-weeding in the rows, and cleaning the earth of the trench round them with a hoe, once a month during the summer.

In October, the rows require to be inspected and thinned by pulling up every alternate plant, attention being always had to remove those that are weak or crooked, and leaving the tallest and straightest. This operation of thinning, must be repeated every year about the same time, and in the same manner, until the trees are about thirty feet distant from each other.

The following regulations, regarding the thinning of Oak coppice-woods, are observed on the estates of the Duke of Montrose, one of the most extensive proprietors of natural wood in Scotland. 'These woods are thinned for the *first* time, at 'the age of four years, when a proper number of 'the most promising stems are left for reserves. 'A *second* thinning is given at the age of seven 'years; and a *third*, at the age of twelve or four'teen years.' * As the trees which constitute the majority of the coppice woods of Scotland, have a general tendency to throw out a profusion of suckers from their stools, immediately after being cut; which, without regulation, would very soon choke each other; particular attention is

* See Stirlingshire Rep.

necessary to the thinning process at that period. To thin the suckers that proceed from the stools of the oak and the ash, the first season after they are cut, to reserve the most promising, and to weed out and remove the barren wood, is a necessary and important operation in the system of the general management of the natural woods of Scotland.

§ 3. *Protection from Cattle.*—In the improved management of coppice woods, it is a general regulation, carefully to protect those that are recently cut from the bite of cattle and sheep, by proper fences, for several years; in which case, the young shoots of the very year in which the coppice is cut, attain to a great height. * The pernicious system of suffering cattle to feed in young woods, under the idea that, after they are of a certain age, they cannot be injured, ought by all means to be avoided. There is nothing so destructive. If it be profitable to plant new woods, it is certainly much more so to protect them that are already planted, to fill them up where thin, and to restore them when in a state of decline. The expense is not only lessened by the saving of new fences, but the profit is greatly increased, by the rapid growth of the wood, when planted in situations already sheltered by other trees and plants. †

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* Gen Rep. vol. ii. p. 225.

† See Bath Pap. vol. vii. p. 7.

§ 4. *Heading down.*—When the underwoods consist of other species of trees, besides oak, such as alder, ash, birch, poplar, &c. the most approved plan is to cut them down to within two or three feet of the ground, at the end of three years after planting, in order to strengthen the roots, and induce the plants to send forth more shoots.

The proper time for heading down young trees is in the spring, when the oak bark will run, and quickly cover over the wounds.

§ 5. *Pruning.*—The third season after planting being expired, the general pruning should commence, by cutting off close to the leading stem all the lateral shoots of the first year. This should be repeated annually, cutting off one year's growth, till the plants are arrived at thirty or forty feet. This method of raising oak, either for timber or reserves, may at first view be deemed expensive, and troublesome; but the future produce will much more than repay all the additional trouble attending it.

Those woods, where the oak grows well, may be gradually, and advantageously converted into groves of that timber, by rearing up oaks, either from maiden plants, or stubs. By this means, the underwood will be considerably reduced in value, after two or three falls; but the accumulating value of the Oak timber, will more than counterbalance it. *

* See a minute detail of this profitable practice, in Warwickshire 4to Report, Note, p. 41.

Moderate and gradual pruning, is the great and principal object to be attended to; and the best season for this purpose, is the month of March and the beginning of April, just before the juices of the tree begin to ascend, which constitute the best salve for healing their wounds. The worst season for pruning, is supposed to be the end of harvest, and winter; when the wound, particularly in fir and resinous trees, infallibly becomes gangrened. *

The impropriety of the old custom in pruning, of leaving snags, or stumps of the branches projecting from the tree, is now carefully avoided by cutting clean and close to the stem. In short, the two great objects of the proprietors of wood, the greatest possible quantity both of timber and bark, is to be obtained by *moderate* and gradual pruning.

§ 6. *Filling up.*—In all natural woods and coppices, many vacant spaces of greater or less extent occur, which it is advantageous to fill up, after cutting, with such plants as are most suitable to the soil.

In general, after a hag is cut down and enclosed, larches are dropped or planted in the vacui-

* See Gen. Rep. vol. ii. p. 238. A tolerably accurate idea of the management of coppice woods, in the southern part of the kingdom, may be deduced from the method pursued by J. Raymond Barker, Esq. of Fairford, on the Cotswold district, in Glocestershire, as described by an intelligent surveyor, Mr Rudge. See Glocest. Rep. p. 246.

ties; and acorns are dropped in such soils as appear suitable to the growth of oak.

'Another method of thickening oak-woods, 'which has been tried with success, is by layers. 'The rods which would be removed in thinning 'or weeding, are, at any period of their growth, 'from the second to the sixteenth year, bent 'down to the ground, secured in a horizontal po'sition by forks, and buried in the sod at proper 'intervals.' *

In woods where saplings rise in great numbers spontaneously, their growth should be encouraged; and, in general, it is considered advisable, not to cut off such saplings as are intended for underwood, birch plants excepted, until the second cutting of the wood, when they will throw out shoots strong enough to fight their way, and keep pace with the surrounding underwood. †

SECT. III.—OF THE TIME AND MODE OF CUTTING TIMBER AND OAK COPPICE WOOD.

§ 1. *Period of Cutting.*—The proper age for felling Oak timber, is generally supposed to vary

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* Dumbartonshire Rep. p. 157.

† If oaks, chestnut, beech, or any deciduous tree, grow crooked, it has been directed to make incisions with the point of a knife from top to bottom in the hollow part. By this means, the tree will increase in bulk more in those parts than in any other, and again become straight and handsome.

from one hundred to one hundred and fifty years from their first planting. This, however, depends upon a variety of fortuitous causes; and the only certain criterion, by which a good judge can never be deceived, is the appearance of the trees themselves, which infallibly indicates the periods of their maturity and decay.

In woods intended for timber trees and underwood, the first cutting may be regulated by the following circumstance. Whenever the oaks appropriated for timber are in danger of being drawn up too slender for their height, all the rest should be cut over a few inches above the ground, though the wood may not have reached its most profitable state. *

The practice of cutting coppice-wood varies in different districts, from seven to thirty or forty years, according to the nature and quality of the soil and climate, the growth of the trees, and the purposes to which the wood is to be applied; but

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* New-planted coppices, Mr Davis remarks, (Bath Pap. vol. x. p. 310), should be cut at ten years' growth, for the first two rounds, and the number of timber trees reduced gradually at every cutting, by stocking off the unhandsome ones for underwood; while the young plants which spring up spontaneously should be encouraged for a future supply of timber. If there are one or even two handsome shoots on a stool of an oak that has once been cut for underwood, they may still be very profitably left for timber, as trees of that description will grow much quicker, and be quite as good as real plants, provided the stool of the root be young and sound.

the most common, as well as the most advantageous period for cutting coppice-wood, is probably from fifteen to twenty years.

In the extensive woods of Buckinghamshire, consisting chiefly of beech, the practice is not to cut till from twenty-five to thirty, or even thirty-five years, by which means they consist almost entirely of successions of young trees. Without having recourse to regular falls, the trees of a proper growth are annually singled out, and cut so as to pay the proprietor a clear profit of from about fifteen to twenty shillings per acre.

In Herefordshire, where the woods consist principally of Oak, they are felled at from eighteen to twenty years' growth; and, in other southern districts, where ash, alder, and sallow are more prevalent, at from twelve to fourteen or fifteen years. In the cutting, one standard is generally left to each lugg, or forty-nine square yards.*

In the Highlands of Scotland, natural woods, of which the Oak generally forms a considerable part, are, on account of the bark, usually cut every nineteen or twenty years.

In the county of Perth, where there are more Oak woods, and perhaps of greater value, than in any other county in Scotland, the copse of oak

* See Herefordshire Reprint. Rep. p. 96. The proper time at which standards, in woods, ought to be cut, is, when the trees, by dropping, begin to hurt the underwood below. See Comm. to the Board of Agric. Vol. IV. p. 261.

is cut only once in twenty-four or twenty-five years. A few spare trees, of the most promising appearance, and of the best figure, are left at proper distances, from one cutting to another, and sometimes for three or four cuttings. *

Only the Oak, Larch, Mountain-ash, and Willow, are peeled in Scotland. Opinions are divided, respecting the age at which bark becomes most proper for tanning. It is supposed, by those most conversant in the business, that in these districts, bark, at 25 or 26 years of age, would be superior for the purpose of the tanner, and more profitable to the proprietor, than at 20.

As the growth of a tree in one year, between 20 and 30, has been supposed to be as much as any two, at an average before 20; it follows, that at the age of twenty-six, there will be one-third more bark than at twenty, and, the timber being then fit for husbandry utensils, a great deal more valuable. The proprietor, however, counts upon the interest of the money lost by this delay, and prefers cutting his timber at nineteen or twenty years of age. †

§ 2. *Season of Cutting.*—The time appropriated for felling timber, is generally the winter season, when labourers can most easily be spared from other rural employments, from the month of November to the month of March.

* See Perthshire Reprint. Rep.

† See Dunbartonshire 4to. Rep. p. 82.

The proper season for cutting a tree, is when it has least sap, which is precisely in the middle between the time of shedding the leaf and that of budding; in that interval it is tough, and fittest for every useful purpose. When cut in the sap, the wood is short, and apt to split with drought. *

But for Oak, and where the wood is to be barked, the month of May is deemed the most eligible, as it then generally *runs* the best; that is, the vegetable juices or sap ascending under the bark, renders it easy to disengage it from the wood: and, for underwood, 'the older the wood 'is, the later in the spring it should be cut.'† The common regulation, in the Highlands of Scotland, is to bind the purchasers to finish their cutting by the tenth day of July, (a month too late), ‡ under the penalty of forfeiting what is left standing.

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* See Lord Kaimes's Gent. Farm. 6th edit. p. 265. Fir cut in the summer, will become full of mushrooms in a twelvemonth afterwards.

† Mr Crutchley, (in his Report of Rutland), remarks, that all underwood should be cut as soon as the leaf is off, and not more than four inches from the ground, which would greatly invigorate the spring shoots; as, he says, woods so cut and managed, in the course of twelve years, will net more by two pounds an acre, than if cut high.

Draining of woods is another improvement strenuously recommended by the same writer, from which much benefit would arise, by making open gripes to carry off the water.

‡ See Gen. Rep. Vol. II. p. 219.

It was long ago observed by Mr S. Pepys, in a paper published in the Philosophical Transactions, * that the best time for felling oaks for ship-building, was after having taken off the bark in the early spring, and having suffered the new foliage to put forth and die. For, by the pullulation of the new buds, the saccharine matter in the sap-wood, or alburnum, is expended, and it then becomes nearly as hard and durable as the heart-wood; being both less liable to decay, or to be penetrated by insects; which was a curious and ingenious discovery at that time, though the theory was not well understood, the truth of which has now been established by the experience of a century. †

§ 3. *Method of Cutting Coppice Wood.*

In the operation of cutting Oak coppice wood, in order to ensure a sound and perfect growth, from the stools, great care should be observed, to cut the stems issuing singly from the ground, close by the surface; and those that spring from old stools repeatedly cut, should be taken off close with the saw, or a sharp axe, leaving the centre of the stub a little higher than the edges, to prevent water lodging upon and injuring the stem. ‡

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* Vol. XVII. p. 455.

† See Darwin's Phytologia.

‡ There is, however, a wide difference of opinion on this part of the subject. Some proprietors of large tracts of wood, and even professed woodmen, have cautiously prohibited strip-

§ 4. *Reserves, or Standards.*

In cutting coppice woods, it is an established practice, to reserve a certain number of trees or

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ping the bark off oak nearer than six inches from the ground, about which spot they suppose the tree to be felled; whilst others wish to have the bark stripped as near the ground as possible, provided that in so doing there is no part of the root laid bare. The following ingenious remarks on this point, by the late Samuel Hayes, Esq. of Avondale, Ireland, in some interesting details on the operations of planting, and the management of woods and coppices, appear to be decisive. 'It must be evident to any person,' he observes, 'who will give himself the trouble of examining the growth of a shoot from an old stock, that so long as the sap has a portion of bark to ascend through, the shoot is not forced out, but at last makes its appearance at some inches above the ground, on the side of the old stub, and often in a horizontal position; where, if several weak ones are thus produced, they form an unsightly tuft of almost useless brushwood; but, if one, by superior strength, or by the others being pruned away, shall take a lead, it must be by bending upwards at its base like a breast-quick in a ditch; with this difference in favour of the latter, that the one depends immediately on its own roots, whilst the young oak has nothing to depend on but the shell of the old stub, which in this situation generally becomes rotten within side, and daily less and less able to give that support which the increasing weight of the young tree is daily more in need of. From this circumstance, it happens, that we so often find some of our tallest young oaks, from ten to fifteen years' growth, lying flat on the ground in our coppices, slipped off as it were from the old stool, at the spot from whence they were produced: whereas, if the bark had been stripped quite to the ground, and the tree then cut as low as possible, with a sharp axe, standards, of the most promising appearance, to become timber at a future period.

In the Highlands of Scotland, where coppice wood is generally cut about the age of twenty-four years, between three and four hundred trees of that age are reserved at the first cutting; and that number gradually reduced at every successive cutting, till the remainder are applicable to naval and domestic purposes. Dr Walker remarks, that 'from twenty to forty may be finally left to the acre; and that the choice should be in favour, not of the tallest, but of the young trees that are of the thickest stem, that are most vigorous, and that branched or feathered nearest to the ground.' *

In leaving reserves from stools, four or five shoots should be left at the *first* thinning; at the *second*, remove two or three of the worst; and afterwards, having fixed on the best, on each stool, cut off those that remain.

'leaving the centre of the stub a little higher than the edges, 'the young shoots must have sprung up like suckers, quite 'free from the original stem, and often at six or eight inches 'distance from it; their buts being sufficiently low in the 'ground to enable them to strike roots for themselves, and 'standing at such a distance from each other, that their 'growth may be perpendicular for several years without in-'terference, and consequently till they arrive at such a size, 'that the worst may be felled for useful purposes, and the 'best reserved with nearly the same advantage as if it had 'been a seedling produced from the acorn.'

* Hebrides, p. 300.

By this simple method, fine timber fit for naval purposes, may be obtained in little more than half a century, from our native woods, in great abundance; and by the same method, coppice-wood may, at pleasure, be converted into forests of large timber. *

Sect. IV. Of the Time and Mode of Barking Oak.

§ 1. *Season of Barking.*—The operation of barking oak trees, is also performed early in spring, as soon as the facility of detaching the bark appears; because the process of the germination of the buds injures the bark, whether the tree be cut down or not, as the buds even expand their foliage on new-felled trees as they lie on the ground. When the sap-juice residing or ascending in the vessels of the alburnum, becomes more liquified by the warmth of the spring, or is mixed with more moisture, and propelled upwards with great force, by the absorbent vessels of the roots, it oozes out in some degree between the alburnum and the bark, and thus the bark be-

* See Gen. Rep. of Scotland, Vol. II. p. 228.
'The most effectual way,' it has been remarked, 'of making an acre produce the greatest possible quantity of timber, 'is, to leave the reserves thick, to prune them high up, and 'to leave a small top.' Ibid.

comes so much more readily separated from the sap-wood. *

§ 2. *Mode of Barking Oak in Scotland.*

The high price now given for oak bark, renders it an object of importance that the operation of peeling or barking be performed in an efficient and economical manner.

In this process, three different classes of people are employed; the hagmen or cutters, the carriers, and the barkers, each furnished with suitable instruments. † By the latter, chiefly consisting of women and children, the bark is removed from the tree in long shreds, and transported by the carriers to proper situations to be dried. It is regularly turned once or twice a day, according to the state of the weather; and, after being gradually dried, is either piled up under cover, or stacked and carefully thatched in the open fields.

* See Darwin's Phytologia.

† For the information of those who may be strangers to the operation of barking oak, and other species of timber, the process, as described by Mr Nicol in his 'Practical Planter,' will be found in the Appendix. See App. (K.) For an account of the mode of charring wood in Scotland, see also App. (K.)

CHAP. VII.

OF FRUIT TREES, AND THE MANAGEMENT OF ORCHARDS.

SECT. I.—OF THE DIFFERENT KINDS OF FRUIT TREES CULTIVATED IN SOUTH AND NORTH BRITAIN.

THE planting of trees, for the purpose of producing fruits of different kinds, in many districts, forms a considerable part of the profits of the planter. This is the case in Devonshire, Kent, Herefordshire, Worcestershire, and other cider counties of the South, and in the Vale of Clyde, and the Carse of Gowrie, in the North.

The apple and pear trees which form the orchards in the South, are well known not to be the natural production of any particular soil or climate; the one being a variety of the *pyrus malus*, or crab; and the other derived from the *pyrus communis*, or common wild pear. *

The native wild crab is subject to considerable diversity in the appearance of its leaves, and in

* See Knight's Essay on the Apple and Pear, 8vo. 2d edit. Ludlow, 1801.

the colour, shape, and flavour of its fruit. By selecting and cultivating the fairest and the best of these, all the valuable varieties have been produced, and, by repeated propagation, have been preserved for the time. This principle was well known to the ancients, whether they applied it to the apple or not.

> ' Quare, agite O, proprios generatim discite cultus,
> Agricolæ, fructusque feros mollite colendo.' *

Normandy, and other parts of the Continent, have occasionally furnished the Southern counties with several of these artificial varieties. †

The Cider apple-trees are divided into old and new sorts; the old are esteemed the most valuable, and are those which have been long introduced; such as the Styre, Golden-pippin, several varieties of the Harvey, the Brandy-apple, Redstreak, Wood-cock, Moyle, red, white, and yellow Musks, Dymock red, Ten Commandments, &c.

The modern varieties derive their appellations from such various and capricious causes, that a correct list cannot be formed; in several instances the same fruit bears a different name even in the same parish. A regular and scientific classification of the whole would be a valuable acquisition to our rural economics. ‡

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* Virg. Georg. lib. 2.

† See Hereford Reprint. Report, p. 75.

‡ A list of nearly 300 different kinds and varieties of apples, held in most estimation in the South, will be found in

The Perry Pears held in most estimation in the South, are the Squash, so called from the tenderness of its pulp; the Oldfield, the Huff-cap, the Barland, the Sack pear, and the Red pear. Of more common sorts, the Longland is the most valuable, and, for the general use of the farmer, perhaps the best of any.

Most of our best fruits, particularly apples and pears, were introduced into Scotland by ecclesiastics in the days of monastic splendour and luxury, during the 12th, 13th, 14th and 15th centuries; of which many traces still remain, as at Jedburgh, Melrose, Newburgh in Fife, and other parts of the country, of venerable trees, some of them abundantly fruitful, and others in the last stage of decay.

The apples and pears principally cultivated in England, are but very little known in Scotland, if we except the Carlisle codlin, golden pippin, nonpareil, ribston pippin, and a few others.

The varieties of orchard apples and pears, held in greatest estimation in the Southern districts of Scotland, as on the banks of the Jed, of the Teviot, and the Tweed, are the following:

Apples. The Fullwoods, Golden Custard, Hawthornden, Strawberry, Queen of England, Thorle, White Custard, and the Leadingtons.

Pears. The Auchan, Bergamot, Bonchretien,

Forsyth's Treatise on Fruit Trees, and Dickson's Pract. Agricult. Vol. II. &c.

Crawford, Drummond, Green Chisel, Green Yair, Jargonelle, Lady lemon, Muirfowl egg, Warden, Winter Citron, and Lammas.

On the banks of the Forth, the favourite apples are, the Fair Maid of France, Green Fulwood, Hawthornden, Orthodox courpendu, Oslin pippin, and Thorle: the pears are, the Crawford, Grey Auchan, Muirfowl Egg, St James's, and Yair.

The sorts of apples chiefly cultivated in the northern districts, are, pearmains, redstreaks, calvilles, codlins, golden rennets, jennetings, Kentish filbasket, monstrous rennet, nonsuch, early golden pippin, ribston pippin, royal russet, transparent, Hawthornden, Yorkshire green, lemon pippin, oslin, Queen of England, cat's head, and courpendu.

The pears are principally the Swan egg, bergamots, bonchretien, jargonelles, crassane, green chisel, auchan, or grey gudewife, little musk, beurrés, and Lammas.

The cherries are Kentish, May-duke, and morella, with the gean, or brandy cherry.

The plums are the green gage, the magnum bonum, and the black perdrigon. *

Such are a few of the most valuable fruit-trees cultivated in the orchards of Scotland. Though

* See Gen. Rep. of Scotland, Vol. II. p. 174. For a list of the principal Apples, Pears, &c. cultivated in the Clydesdale, and in the Carse of Gowrie Orchards, see Appendix (L).

some are exclusively occupied with apple trees, the greater proportion are mixed orchards, containing apples, pears, and plums; a few cherry-trees, together with small fruits, or gooseberries and currants, as undercrops.

The limits of this Abstract only permit us to notice, more particularly, a few of the more valuable varieties of the apple and pear, before proceeding to the consideration of the formation and general management of orchards.

The Apple-tree (*Pyrus malus, var. sativa*, L.) belongs to the class Icosandria, order Pentagynia, and natural order Rosaceæ of Jussieu. Many of the cultivated kinds have been imported from the continent at different periods, and many others have been raised from the seed in this country.

The following selection of a few of the finer kinds of apples and pears, are adapted either for the garden or the orchard, and are generally good bearers.

APPLES.

Codlins; Carlisle, Keswick, Kentish, and Royal,	Nonpareil,
Hawthornden,	Pippins; Carlisle, Keswick, &c.
Jenneting, or June-eating,	Rennets; Grey, Golden, &c.
Margaret,	Royal russet.
Margill,	

1. The different varieties of codlins, are chiefly baking apples. The Carlisle codlin possesses the

peculiar property of being fit for use at an earlier period of its growth than any other apple, making an excellent tart, when no larger than the smallest plum. When it is about the size of a large nutmeg, it may be made into apple marmalade, or a dried sweetmeat, which rivals the finest Portugal plum. When fully ripe, in the beginning of October, it is not only much admired for baking, but is reckoned a good eating apple, and will keep till January or February, if duly attended to. The tree is hardy, a great bearer, and not liable to disease; and, if propagated by slips, suckers, or layers, it yields fruit in the first or second year. It thrives without any particular attention, and may be planted nearer together than most other kinds of apples.

The best, though not the usual mode of propagation, is, by slipping off small branches, which, near their junction with the stem, put out a kind of excrescence with half-formed roots, similar to the Bur-knot, or original apple. Full-grown trees of this species, will yield from ten to twelve Winchester bushels of fruit, worth from 8s. to 9s. per bushel.

The Carlisle Codlin, though hardy, requires some degree of shelter and a good loamy soil, which should be frequently manured to produce large crops.

The Keswick Codlin has never failed to bear a crop since it was planted in the Episcopal garden at Rose Castle, Carlisle, upwards of twenty years ago. The tree is a very copious bearer, the fruit considerably larger than the Carlisle codlin, and of fine flavour; but does not keep beyond the beginning of December. It flourishes best in a strong loamy soil.

Both the Carlisle and Keswick Codlin have answered uncommonly well, planted singly or as standards, in Roxburghshire, in Dumfries-shire, in Galloway, and in Fife. *

2. The Hawthornden, or White Apple of Hawthornden, derives its name, from the romantic seat of the poet and historian Drummond, in Mid-Lothian. It is a good summer apple, but does not keep long: it is a free grower, and bears quickly and plentifully; but short-lived, generally showing symptoms of decay, when twelve or fifteen years old. It is well calculated for a temporary tree either in the garden or orchard, and is much employed for this purpose.

3. Jenneting, or June-eating, is a small fruit, but very early ripe. It is perhaps inferior to the Oslin, Margaret, and some other early apples; but no one, observes Mr Neil, possessed of a healthy jenneting tree in full bearing, would willingly part with it.

4. The Margaret or Magdalene Apple, is an

* See Mem. of the Caled. Hort. Soc. vol. i. p. 377. These trees may be had from all the nurseries in Scotland, and in the north of England; the price from 9d. to 1s. each; and they may be planted at any time from October to March inclusive.

early fruit, and of good flavour, but, like the Hawthornden, does not keep long. The tree is of middling size, and generally productive.

5. The Margill is esteemed a very good late apple, fit for the dessert in the month of January.

6. The Nonpareil is one of the best apples known, and the chief of the russet tribe: it is rather a flat-shaped fruit, with a sharp, pleasant, high-flavoured juice. It is scarcely ripe till the end of November; but it will keep till May. The tree grows to a large size; and in a good soil, such as a hazely loam, it bears freely.

The Scarlet Nonpareil ripens more freely than the former; and the fruit becomes larger, and more smooth and plump, being at the same time highly charged with the flavour of the Nonpareil; it is in season in January and February. *

7. Pippins. The Nonsuch is a well known pippin; the tree is rather subject to the canker, but it generally bears more or less every season.

The Aromatic pippin receives its name from its fine flavour; the side next the sun is of a bright russet colour, the other side yellowish; it is an excellent apple for about three weeks in September, but does not keep much longer. The tree is of low growth.

The Newton pippin, and Spitsenberg apple, are two American sorts, which have of late years be-

* See Edin. Encyc. Art. Horticulture.

come favourites in some parts of this country. The former was introduced from Long Island, New York, and is a beautiful and excellent apple. The Spitsenberg is also a very good fruit, with somewhat of the pine-apple flavour; the tree requires a sheltered situation, and a good soil. *

The Oslin, or Arbroath pippin, (Orzelon of Forsyth), is a very good apple, excelled in flavour only by the Nonpareil, over which it has the advantage of ripening in a worse climate. It is particularly described by Dr Duncan senior, in the first volume of the Caledonian Horticultural Memoirs, who gives it the appellation of the 'Golden Original Apple.' By professional gardeners in the neighbourhood of Edinburgh, it is styled the Mother Apple, and in different parts of England, it is denominated the Bur-knot Apple.

It is easily and rapidly propagated by slips. The Doctor mentions, that of fifty branches, (each including a knot or bur), detached early in the spring, and planted in the garden of Mr Peacock, at Pilrig, near Edinburgh, more than one half blossomed the same year, and produced ripe fruit in the autumn, and promised to form permanent fruit-bearing trees. This apple has been from time immemorial cultivated at St Andrews, and Arbroath, where there were formerly magnificent monastical establishments, by whom, Mr Neil supposes it was introduced from France.

* See Edin. Encyc. Art. Horticulture.

The Oslin, or Original Apple, has not the property of being a keeping apple. It is used with greatest advantage immediately when it falls from the tree, at which time very few apples are superior to it, either in appearance, in flavour, or in taste. From its beautiful yellow colour, when fully ripe, Dr Duncan thinks it not improbable, that it is the *Aurea mala*, so much esteemed by the Romans, in the days of Virgil; * and he adds, that 'a fertile imagination may carry it to 'much more ancient times, and suppose it to be 'the Golden Apple which grew in the Garden of 'the Hesperides.' †

The Ribston, the Golden, and the Balgone pippins, all produce small, but beautiful and excellent fruit, though they are fully better calculated for the garden than the orchard.

The Holland, and Kerry pippins also, together with several new varieties propagated by Mr Knight, such as the Downton, the Yellow Ingestrie, and the Wormsley pippins, and Hughes's New Golden pippin, have all deserved a high character. ‡

8. Rennets.—The Grey rennet, (*Reinette grise*), is a middle-sized fruit, of a deep grey colour next the sun, and on the other side intermixed with

* 'Quod potui, puero, sylvestri ex arbore lecta
Aurea mala decem misi.' VIRG. *Ecl.* 3.

† See Mem. Caled. Hort. Soc. vol. i. p. 241.

‡ See Edin. Encyc. Art. Horticulture.

yellow; it is a juicy saccharine apple; ripens in October, but does not keep long.

The Golden rennet, (*Reinette dorée*), is a good apple, ripening by the end of September, fit either for the table or the kitchen, and keeping till February.

The Canadian rennet, (*Reinette de Trianon* of the French), is a large fruit, of a yellow colour, with a tinge of red: and also keeps till February.

9. The Royal russet, or leathercoat russet, is so named from the deep russet colour of the skin: the tree grows to a large size, and bears very freely. It produces a large fruit, of an oblong figure, broad towards the base, fit either for the table, or for baking. It keeps till the month of April.*

Pears.

The Pear tree (*Pyrus communis*, L.), is naturalized in some parts of Britain, and figured in 'English Botany,' t. 1784. The date of the introduction of the earliest cultivated varieties is not known: for most of them we are supposed to be indebted to France and the Netherlands.

Pears are distinguished according to the season in which they become fit for use, into summer, autumn, and winter pears. Summer pears must

* See Edin. Encyc. Art. Horticulture, vol. xi. p. 211.

be used as they ripen, none of them keeping more than a few days: autumn pears do not keep much more than a fortnight; and winter pears are gathered in dry weather, before being fully ripe, and kept, some for several weeks, and others for months, before they are used. *

The few following are supposed to be among the best kinds either for the garden or orchard, at present cultivated in Scotland.

Summer Pears.

Green Chisel,
Green Yair,
Jargonelle,
Longueville,
5. Muscats, August, Little, &c.
Red Muscadelle,
Summer Bergamot,
Summer Bonchretien.

Autumn Pears.

Auchan,
10. Autumn bergamot,
Brown beurré,
Gansel's bergamot,
Swiss bergamot,
Muirfowl Egg.

Winter Pears.

15. Aston-town pear,
Elton pear,
Holland bergamot,
Poire d'Auch,
Swan Egg,
20. Wormsley bergamot, &c.

1. The Green Chisel, or Hasting pear, as described by Mr Neil, † is of a whitish green, when

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* See Edin. Encyc. Art. Horticulture, vol. xi. p. 211.
† Ibid.

ripe; has a very thin skin, flesh melting and sugary; but when too ripe, mealy.

2. The Green Yair, or Green pear of the Yair, is of Scottish origin, and is supposed to have derived its name from an ancient seat on the banks of the Tweed, near Selkirk. The tree is a copious bearer, with small green fruit, sweet and juicy, but deficient in flavour.

3. The Jargonelle, (*cuisse Madame* of the French), is a well known fruit, generally cultivated, either against walls or as dwarf standards. The pulp is sweet, juicy, and has a slightly musky flavour. It ripens in August, but does not keep long.

4. The Longueville, is very generally diffused over Scotland, where many aged trees of this species exist in the vicinity of ancient monasteries. It is accounted a good summer, or early autumn fruit. The Longueville of Jedburgh, in Roxburghshire, is supposed by Mr Neil to be a particular variety, the fruit possessing the quality of keeping for many weeks: the trees at that place are very old, and evidently the remains of orchards or gardens belonging to the rich religious establishment which once flourished there. *

5. Muscats.—The August muscat, Royal muscat, Hanville, or Poire d'Averat, is one of the best summer pears yet known. It is a roundish flat pear, shaped like a bergamot; skin smooth,

* See Edin. Encyc. Art. Horticulture.

of a whitish-yellow colour, juice richly sugared and perfumed. The fruit is produced in clusters, and a great bearer. *

The Little muscat is of a longish shape, of a yellow colour, except next the sun, where it is red. It is ripe in August.

6. The Red Muscadelle, or La bellissime, is a large beautiful fruit, of a yellow colour, with red stripes; melting, and of a rich flavour, when not too ripe.

7. The Summer Bergamot, or Hamden's bergamot, is a round, flattish pear, of a fine greenish-yellow colour; the pulp melting, and the juice highly perfumed.

8. The Summer Bonchretien, is a large oblong fruit, with a smooth thin skin, of a whitish-green colour, but red next the sun; full of juice, and of a rich perfumed flavour. It succeeds as a standard, only in favourable situations in the south of England.

Autumn Pears.

9. The Auchan, is an excellent pear, of Scottish origin, and received its name from an ancient seat in the parish of Dundonald, in Ayrshire. The tree is a free grower, a plentiful bearer, and well calculated for a standard. The fruit is sweetish, with a peculiar and rather agreeable flavour. The kinds denominated Summer Au-

* Miller, Neil, &c.

chan, and the black or winter Auchan, are small late varieties, said not to be worth cultivating. *

10. The Autumn, or English Bergamot, is a smaller fruit than the summer bergamot; the flesh is melting, and the fruit richly perfumed. The tree is a free grower, and a great bearer.

11. The Brown Beurré, or Red beurré, is a large and long fruit, of a brownish-red colour next the sun; melting, and of sharp rich juice, slightly perfumed. It is one of the best Autumn pears, but requires good soil and shelter, and flourishes best with a good aspect on a wall.

12. Gansel's Bergamot, is an English pear, raised from the seed of the Autumn bergamot, by the late General Gansel, at Donneland Hall, near Colchester, and is nearly allied to its parent. In good situations the tree thrives excellently as a standard; and if the fruit be gathered in the middle of October, it is in perfection about the middle of November. †

13. The Swiss Bergamot, is a round fruit, with a tough skin, of a greenish colour, striped with red; melting and full of juice, slightly perfumed; and a copious bearer.

14. The Muirfowl Egg, is a Scots pear of good

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* See Edin. Encyc. Art. Horticulture.

† Ibid. Gansel's Bergamot, when budded, or grafted on the Swan-Egg pear-tree, yields fruit of a very superior quality.

quality; ripens in September, and keeps for a considerable time. The fruit from standards is high-flavoured.

Winter Pears.

15. The Aston-town Pear, is a native of Aston-town, in Cheshire; its branches have a tendency to twist round in growing upwards. The young shoots are pendent, and the blossoms produced chiefly at the extremities. The leaves are small and oval. The fruit somewhat resembles the Swan-Egg pear; is of a greenish colour, spotted with russet; when ripe, is melting and high-flavoured. It is in perfection early in October, but does not keep.

16. Among English pears, the Elton, (figured in the London Horticultural Transactions, Vol. II.) though not much known, is deserving of more general attention. It ripens from the middle to the end of September, and is described as uniting much of the fine flavour of the bergamots, with the melting softness of the beurrés. The original tree stands in an orchard of seedling pears at Elton, in Herefordshire, about a hundred and fifty years old, but still healthy. *

17. The Holland Bergamot, is a good pear, of a greenish-yellow colour; tender and high flavoured: it must remain on the tree till the approach of frost, and keeps till May.

* Edin. Encyc. Art. Horticulture.

18. The Poire d'Auch, as described by Forsyth, resembles the Colmart, but fuller towards the stalk, and without exception the best of all the winter pears. *

19. The Swan-Egg is a good winter pear, for use in December. It is egg-shaped, of a green colour, thinly spotted with brown; melting, and abounding with a pleasant juice. On standards, the fruit acquires a very high flavour.

20. The Wormsley bergamot, is a new pear, among other varieties raised by that celebrated horticulturist Mr Knight, from the blossom of the autumn bergamot, stripped of its stamina, and dusted with the pollen of the St Germain. It is a good melting pear, and the tree grows freely on any ordinary soil, and has the advantage of being very hardy. The fruit remains on the tree till the end of October, and is in perfection about three weeks afterwards. †

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* Forsyth on Fruit Trees, &c.

† For a minute and copious description of most of the finer sorts of apples, pears, and plums, &c. adapted to the garden in Scotland, see Mr Neil's excellent Treatise on Horticulture, so often referred to, Edin. Encyclop. Vol. XI. Part I.

To those who have small gardens or orchards, and room only for a few trees, Mr Forsyth recommends the following kinds as the most useful and profitable, and which will furnish a regular succession of fruit.

SUMMER PEARS.

The Green Chisel; the Jargonelle; the Musk; the Summer Bergamot; and Summer Bonchretien. 1

SECT. II.—OF THE FORMATION AND MANAGEMENT OF ORCHARDS.

The rearing of extensive orchards in Scotland, is comparatively but a late improvement, and hitherto principally confined to the Vale of Clyde, (especially betwixt Lanark and Glasgow), and the Carse of Gowrie.

In the formation of an orchard, the primary requisites that demand attention, are, the nature of the soil, subsoil, situation and shelter, &c.

§ 1. *Soil and Subsoil.*—The nature of the soil, at the first formation of an orchard, is an object of essential importance. The various soils distinguished by agriculturists and horticulturists, consist of the simple earths of the chemists, particularly argil, silex, and lime, mixed in different proportions. A mixture of clay and sand, is called loam; and, according as the one or other of these earths predominates, the soil is denominated a clayey or a sandy loam. When oxide of

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AUTUMN PEARS.

The Autumn Bergamot; Brown Beurré; Doyenné, or St Michael; Gansel's Bergamot; Orange Bergamot; and Swan's Egg.

WINTER PEARS.

The Bergamot de Pasque; Chaumontelle; Colmar; Crassane; L'Eschasserie; Poire d'Auch; St Germain; and Winter Bonchretien.

iron prevails, and renders the clay hard, and of a dark brown or red colour, the soil is termed ferruginous loam, or more generally, till. These two species of soil are all that require particular explanation in this place; as, the nearer the soil approaches to a good loam, it is the better adapted to most kinds of fruit-bearing trees; and the more nearly allied to till, the worse.*

The soil best adapted to most kinds of apple-trees in general, is a deep and rich loam, when under the plough: in this, the trees grow with the greatest luxuriance, and produce the richest fruit. The best sorts of pears also, prefer the rich loam to every other.

Fruit trees of different descriptions, therefore, but particularly the apple and pear, if planted in the drier sorts of deep, strong, loamy soil, in situations not too much exposed, will generally be attended with the greatest profit and success: but they have never been found to succeed in a cold, wet bottom; the roots no sooner reaching the till, than the top evinces a stunted appearance, and they never do more good.†

* While the nomenclature of soils remains so imperfect as it now is, there seems no propriety in enlarging on the different varieties. Some judicious remarks on the principles on which they should be distinguished and named, may be found in the Agricultural Report of Ross and Cromarty, drawn up by Sir George Mackenzie, Bart. See Edin. Encyc. Art. Horticulture.

† Mr William Smith, in carrying on the investigations for

Herein consists one great excellence of the orchard grounds on the Clyde. They consist either of shelvy banks, which are always dry below, or of fine loamy mould, on the flat banks of the river, which are free, porous, and not too retentive of moisture. In this, and their very favourable exposure and shelter, they have deservedly attained to a high reputation.

Some apple trees however, the Styre, and Golden pippin, in particular, form exceptions to the general rule, and flourish most in a hot and shallow soil on a lime or sand stone. The inferior kinds of pear trees, also, will even flourish where the soil scarcely produces herbage. *

Though much depends on adapting the trees to the soil and situation, yet it cannot be denied that every tree seems to have its favourite soil, and in this respect requires to be gratified; and even the same species of trees, engrafted on the same kinds of stocks, are often seen to produce fruit different both in quality and quantity, in the very same soil and exposure.

When, therefore, the cultivator has discovered the varieties most congenial to the soil and situa-

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his large Map of the Strata of England, &c. discovered, among other things relating to vegetable products, that all the chief cider districts, and the sites of all the best apple orchards, were on the same stratum of red marl, which stretches across the island from Dorsetshire to Yorkshire. Gen. Rep. Vol. II.

* See Herefordshire Reprint. Report, p. 77.

tion, it will be his wisest plan to encourage them, by multiplying grafts of them on his other and less productive trees, or by forming new additional trees of those successful sorts. Where the soil is shallow, and the subsoil bad, it is by following this plan only that large crops of apples can be regularly procured; the new wood of the grafts bearing for a few years, and then giving place to other grafts. *

In selecting a spot for an orchard, the subsoil requires particular attention; as no excellence of culture or management can compensate the want of a dry comfortable bottom. Whenever the roots of a fruit-tree reach a cold and wet till, the top becomes stinted, and the tree sickens and decays.

§ 2. *Situation and Exposure.*—Steep and sloping banks, with a south, south-east, or south-west exposure, and screened from the north and north-east winds, are in general best adapted for orchards; the declivity rendering effectual draining comparatively easy. The most flourishing and productive orchards in Scotland are situated on the steep banks of the Clyde and the Jed. † It is a general rule, that there should be no tall trees on the south side of a garden or orchard immediately contiguous, as, during winter and

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* This is the plan successfully followed by Mr James Macdonald, gardener to his Grace the Duke of Buccleugh, at Dalkeith Park.

† Edin. Encyc. Art. Horticulture.

early spring, they intercept the rays of the sun, at a time when every sun-beam is valuable.

§ 3. *Shelter* is another primary consideration in the original formation of an orchard. If plantations exist in the neighbourhood of the site intended, advantage may be taken of them, taking care to keep at a reasonable distance from them, so as to guard against the evil of being shaded. If forest-trees do not exist previously on the territory, screen plantations must be reared as quickly as possible. Larch, sycamore, spruce and Balm of Gilead firs, from their rapid growth, have been recommended for this purpose.

The late William Harvie, Esq. of Brownlee, to whom the Vale of Clyde is chiefly indebted for its valuable orchards, transmitted us, in 1810, a detail of his general practice in the rearing of fruit-trees on elevated ground, on the banks of that river, of which the following is an extract. 'The first thing is to enclose and shelter, with a 'belt of planting at least fifty feet wide, twenty-'five feet to be planted at first, and in twelve or 'fifteen years afterwards, the remaining twenty-'five, when the first planted trees begin to get 'thin of branches near the roots; a close screen 'being thus secured for a much longer period, 'than if all the trees had been planted at once.' *

* Excellent instructions for the formation of screen-plantations, as well as for the regulation and management of forest-trees in general, may be found in 'the Planter's Kalendar,' by Nicol and Sang.

§ 4. *Trenching, Draining, and Manuring.*—To prepare the ground for the young fruit-trees, Mr Harvie recommends trenching the ground, during the winter, eighteen or twenty inches deep, and pointing in well rotten dung early in summer, (or early in spring if intended for potatoes or turnips the first season), that it may be completely incorporated with the soil before the falling of the leaf; at which time, if the ground be tolerably dry, the young trees ought to be planted: if not, this ought to be delayed till the spring. *

If wind-waving is to be dreaded, the pits may be made only from six to ten inches deep, and the trees *bulked* with eight inches of earth, and bound to stakes. By this practice, also, the roots will naturally follow the good surface earth; whereas, if they are planted in deep pits, the roots penetrate the prejudicial subsoil, to the eventual injury of the trees, by canker and other diseases.

Wherever it is found necessary, the ground in-

* A mixture of horse and cow dung is generally preferred for fruit-trees. Horse dung is deemed best for stiff land, and cow dung for light land; but compost is preferable to either. A compost of tree leaves, or other vegetables, shell or lime marl, dung and good earth, which has lain twelve months in the heap, and been twice turned over, has been much recommended as manure for fruit-trees. Even the compost ought not to be too rich.

tended for rearing fruit-trees ought to be as thoroughly drained as circumstances will permit.

§ 5. *Selection of Trees.*—The great secret in raising a profitable orchard, consists in the judicious selection of good bearing trees, and for this, there can be no better rule than experience; for the tree that suits one soil and exposure, will not answer another. 'Let all the 'kinds be planted,' (observes the Reverend Dr Fleming of Hamilton, who is possessed of the most correct practical knowledge of the management of orchards in the Vale of Clyde); 'let all 'the kinds be planted that are supposed to be 'best both for the quality and quantity of fruit; 'you will in due time observe which are to be 'the most productive; and whatever kinds fail, 'out with them immediately as cumberers of the 'ground, and plant more of the best bearers in 'your collection in their room.'

'It is upon this principle chiefly that the va'lue of the Clyde orchards has quadrupled in 'the course of the last twenty years. No intelli'gent proprietor allows room to any kind of trees 'that turn out to have bad fruit, and more espe'cially that are not productive. For though 'some trees have a general character for good 'bearers, and are on that account always to be 'preferred in the first selection, yet in particular 'cases we are deceived by them; and therefore, 'though it should be with reluctance, out they 'must with other unproductive brethren.'

'You will hardly believe me, when I tell you, 'that the same tree is sometimes a good bearer 'in one part of the Vale, and bad in another, 'though the climate, soil and exposure, are to all 'appearance similar. This is one of the facts in 'the arcana of fruit-trees that remains to be in'vestigated and explained. But undoubtedly 'there must be, in the particular situation, some '*differentia per se* that is yet unexplored, for I 'am unwilling to believe Nature capricious in 'her operations.' *

Whatever be the cause, the effect above-mentioned is certain, for we often observe different kinds of fruit, both in quality and quantity, from different trees of the same species growing in the same orchard. No certain rule, therefore, can be given for the choice of the kinds that can be applicable to every situation. † The best, probably, that can be given, is to observe carefully what kinds thrive best in similar soils and situations, and to cultivate these, whether apples or pears, or any other kinds.

Young trees, three years grafted, are generally preferred, about three or four feet high, with clean stems. They should be grafted on true healthy crab stocks, as those on free stocks, or

* MS. communication from the Reverend Dr Alexander Fleming, Hamilton, 1810.

† Leadingtons, Carse of Gowries, Dumbarton pippins, and Glass Apples, have been found to produce copiously on dry poor ground.

seedlings of common apples, are said not to grow so large or regular, nor continue so long in vigour. *

It is a general rule among orchardists in Scotland, that one-half of the fruit-trees should be autumn, and the other winter fruit, that they may appear in the market all the year round. Another advantage is derived from cultivating both early and late varieties, that if the blossom of one be destroyed by frost, or cold east wind, the blossom of another kind, either earlier or later, may escape. †

Fruit, in a manufacturing country, is now a valuable commodity. Though the crops are precarious, yet, in general, they bring good prices; and this circumstance, independent of agricultural improvements, has very considerably enhanced the value of Scotch orchards. Hence the cultivation of fruit-trees is now very minutely attended to, and no man but an *ignoramus* or a sluggard, allows a bad bearer in his orchard.

§ 6. *Distance and Manner of Planting.*—It is judiciously observed by Mr Knight, that the distance between each row, as well as the space be-

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* See Gen. Rep. Vol. II. p. 184. It is a frequent custom in England to plant stocks, and, when these have stood two or three years, to cleft-graft them with scions of the various kinds of fruit-trees wished for. This mode is seldom practised in Scotland. For Grafting, see § 12. p. 441.

† See Gen. Rep. Vol. II. p. 189.

tween each tree, must depend on the situation and soil. When the former is high and exposed, the trees should be closely planted, to afford each other protection; and when the latter is poor and shallow, their growth will of course be diminished, and they will consequently require less room: but in low and sheltered situations, and deep rich soils, where the trees are little exposed to winds, and attain a large size, wider intervals must be allowed them. In the former instances, a distance of twelve yards between each row, and half as much between each tree, will be sufficient; in the latter, twenty or twenty-four yards between each row, and eight between each tree, will not be found too much, particularly if the ground is intended for tillage after the trees have grown to a considerable size. *

Where the ground is not afterwards intended to be ploughed, standard trees may be planted at 30 or 36 feet distant, and Hawthorndens, Nonsuch's and Codlins alternately; which latter bear in two or three years after planting, but commonly die in ten or twelve years, and leave room for the standards to spread. †

With regard to the manner of planting fruit-trees, different methods are adopted in different districts. According to Mr Knight, the Here-

* See Knight's Treatise on the Culture of the Apple and Pear.

† MS. communication from the late William Harvie, Esq. of Brownlee, in the county of Lanark, 26th November 1810.

fordshire planters generally perform the business in the 'quincunx form,' (as recommended in this Abstract for forest-trees), or in straight lines crossing each other at right angles. The former method is preferred in the hop yard, and pasture; and the latter in tillage, being less inconvenient to the ploughman. But it is evident, that any given number of trees planted near each other in rows, with wide intervals, would be less injurious, either to pasture or tillage, than in either of the preceding methods. 'The trees in each row,' Mr Knight remarks, 'should be of the same variety 'of fruit, that no one, by possessing greater vi- 'gour and luxuriance, may overgrow and shade 'another; and that the whole row may appear 'to be but a continuation of the same tree. The 'intervals between, would afford considerable 'space for the plough or pasture; and every 'tree having room to extend its branches on 'each side, would be more protected than in- 'jured by its neighbours, and would attain near- 'ly, or quite as large a stature, as if entirely in- 'sulated. Unless an orchard be very large, not 'more than five or six kinds should be planted 'in it; and if some of these be such as blossom 'early, and others late, the planter will have as 'good a chance of an annual supply of fruit, as 'a larger number of kinds would afford him.' *

Where the mode of cultivation will admit, the rows should always extend from north to south,

* See Knight on the Apple and Pear.

as in this direction each part of every tree will receive the most equal portion of light and heat.

§ 7. *Mode of Planting.*—On this particular, few remarks are necessary. 'In choosing your trees 'from the nurseries,' says Mr Harvie, 'observe 'that the roots of the plants are regularly and 'equally spread out, and not twisted together 'by careless nurserymen; as plants with twisted 'roots seldom become healthy or luxuriant trees. 'The soil round where each tree is to be plant-'ed, should be dug or trenched eighteen inches 'deep, and four feet wide, placing the sod, if 'the ground be pasture, in the bottom of the 'pits, and pointing in rotten dung or compost; 'and if the trees be so planted as to be capable 'of resisting the wind, they cannot be planted 'too near the surface. This operation should be 'performed twelve months before the trees are 'planted, and repeated annually. The autumn 'is the most eligible season for planting all kinds 'of fruit-trees.' *

§ 8. *Weeding and Cropping.*—It is essentially necessary to a thriving orchard, that the ground be regularly wrought, manured, and kept clean of weeds; root weeds by the spade, and seed weeds by the hoe; and while the trees are young, the intervals, after dunging, may be sown with turnips, or planted with potatoes. Where the best orchard cultivation is practised, the soil a-round the trees is regularly dug twice a year, in

* MS. communication.

spring and in autumn, and only green crops admitted.

In young orchards, if the ground be arable, and the trees planted at a considerable distance from each other, particularly in England, the usual rotation of corn and green crops have been practised; such as potatoes, oats, cabbages, turnips and clover. The following rotation has been approved of: 1. oats; 2. potatoes with dung; 3. oats sown down with clover and ryegrass; 4. hay; 5. hay, &c.* And as the trees advance in growth, the undercropping is gradually discontinued, and the whole sown down with grass.†

Stock are seldom admitted into an orchard in Scotland. Upon the whole, cropping orchards, except for a few years, is not to be recommended; for, without good healthy wood, and in full leaf, nothing can be produced but crabbed, stinted fruit.

§ 9. *Pruning.*—Too little attention, in general, is paid to the pruning of fruit-trees in Scotland. The pruning knife ought not to be spared, whereever the branches are in danger of interfering with one another; for, where even one is allowed to rub on another, the bark is injured, and gangrene is occasioned, which may eventually destroy the whole tree. Excessive pruning, however, is equally to be guarded against. Many

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* See Gen. Rep.

† *Poa nemoralis* is a grass much recommended for sowing in orchards. See Neill's Chap. on Orchards, Gen. Rep.

hundred trees annually perish from this cause. It is believed the present system of pruning ought to be precisely reversed; and that, instead of getting into the middle of the tree, like the ignorant pruner, and laying about him to right and left, the pruner should confine himself almost entirely to the extremities of the bearing branches, which are always too full of wood, and leave the internal parts of the tree nearly as he finds it, except where branches cross or rub against each other. Large branches should rarely or never be amputated.*

The proper time to commence this process, is when the trees are four years old; after which, all standard trees in an orchard should be trained, pruned, and cleaned, with as much care as wall trees, in order to ensure their productiveness. The principal rules to be observed in pruning fruit-trees, are, to keep the heart of the tree somewhat thin of wood, which promotes the formation of fruit buds; to remove all branches that interfere with each other; to take off the shoots clean, and close to the stem, or large branch; never to let the branches spread lower than three or four feet from the ground; and to cover the wounds with paint or plaster. And, for this purpose, nothing is more efficacious than a mixture of horse-dung and clay, well mixed. The season

* See Knight's Treatise on the Culture of the Apple and Pear.

for pruning fruit trees, as well as forest trees, in general, is from November to March inclusive. Dead branches, however, are more easily perceived in autumn, immediately after the fruit is gathered.

§ 10. *Gathering the Fruit.*—' The principal ' rules observed in gathering the fruit, are, to ' gather it only when dry, and to avoid bruising ' it. The early dews of the morning are equally ' pernicious as wetness arising from rain.' * The slovenly practice of shaking apples and pears, is still too common in Scotland, and should be abolished. They ought uniformly to be plucked by the hand into baskets suspended from a bough or ladder, without injuring the fruit.

§ 11. *Value.*—It is scarcely possible to make even an approximation to the annual value of Scotch orchards, the crops being so variable, and so much dependent on the season, and other circumstances. Where they are let by the acre, or on lease, the rent varies from 7*l.* to 40*l.* an acre: the average may be from 10*l.* to 15*l.* In the Clydesdale district, the crop of old orchards, for the season, is often let at the rate of from 30*l.* to 50*l.* an acre. †

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* See Neill's Chap. on Orchards, Gen. Rep. Vol. II. p. 192.

† ' In the year 1801,' observes Mr Harvie, in his Communication formerly referred to, ' one rood and thirty falls of ' one of my orchards, produced fruit which sold at 150*l.* in ' the Glasgow market; the most extraordinary crop ever

The average profits derived from thriving orchards in the Carse of Gowrie, is reckoned at from 16*l.* to 20*l.* Sterling per acre; the under-crop is generally worth about 6*l.* Sterling per acre, and is sometimes let along with the fruit; but many of the old neglected orchards will not bring 10*l.* per acre, at an average. *

The orchards of Clydesdale, consisting chiefly of apples, pears, and plums, amount to about 350 acres, † which, one season with another, will average 15*l.* Sterling per acre, exclusive of the under-crops; thus exceeding five thousand pounds per annum. The orchards in the Carse of Gowrie, about fifty in number, consisting of 150 acres, yield about fifteen hundred pounds per annum; and if from three to four thousand pounds Sterling only, is allowed for the produce of all the other orchards in Scotland, the gross produce will amount to ten thousand pounds Sterling per annum.

There is still ample room, and many excellent situations, in Scotland, peculiarly adapted for extending the profitable cultivation of fruit-trees, applicable to few other useful purposes. Were the mode which Sir James Stuart of Coltness has

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'known in this country: but of all crops, perhaps, fruit is the 'most precarious; in the succeeding year, 1802, the whole 'acre, of which the above constituted a part, produced only '13 apples, having been exhausted by the crop of the former 'year.'

* See Caled. Hort. Mem. Vol. I. p. 331.

† Nasmyth, Harvie, &c.

adopted,* practised more generally, many hundreds of acres might be planted with fruit-trees, with great advantage to the proprietors, and highly ornamental to the country.

§ 12. *Grafting*,—is the taking of a shoot from one tree, and inserting it into another, in such a manner as that both may unite closely, and become one tree: this is called, by the ancient writers on husbandry and gardening, incision; to distinguish it from inoculating, or budding, which they term *inserere oculos*. The shoots used in grafting are called scions, or grafts, and the trees intended for grafting are termed stocks.†

When the stocks have been three or four years in the orchard, they are ready for cleft-grafting, which, in England, is performed in the following manner:—The heads of the stocks are taken off with a saw, and then smoothed with a keen knife: the height depends on the fancy of the planter, though generally seven feet; a cleft is then made across the centre of the stump, and kept open

* Sir James Stuart of Coltness, has encouraged the planting of fruit-trees on his estate, to the extent of not fewer than sixty acres, within the last twelve years; and these are chiefly steep banks fit for nothing else. The terms of agreement are, that the tenant shall pay one half of the expense of planting, and one guinea per acre; and that the proprietor shall receive one half of the annual produce in name of rent. The lease for twenty-five years. Gen. Rep. Vol. II. p. 169.

† See Forsyth on Fruit-trees, p. 283.

with a wedge of wood, while two scions are inserted, one on each side: the wood being withdrawn, the parts close, and keep the grafts firm in their places. One graft would be sufficient to form a head large enough; and it is the practice of some planters to remove the least promising of the two, where both strike the following spring, and with a sharp knife or chisel pare off the top of the stock in a sloping direction to the remaining graft; by which means the water is prevented from lodging, and the sap is then directed to and concentred in a smaller compass. It is proper, after this operation, to renew the compost of clay and chopped hay, which was wrought round the grafts after their insertion, in order to bring on a more speedy healing of the wound, by preventing the bark from being dried by the sun and air, or annoyed by insects. *

In Scotland, trees are generally grafted in the nursery lines, on young stocks, and in the mode called tongue-grafting. † These grafts are perhaps taken occasionally from fruit-bearing trees; but it is frequently impossible for nurserymen to procure grafts of the desired kinds, from bearing branches of fruitful trees. Hence the necessity

* See Glocester Reprinted Report, p. 217.

† For a more particular description of the different species of the operation of grafting, such as tongue-grafting, crown-grafting, saddle, side, root, and shoulder-grafting, inarching, &c. see Forsyth; Nicol; Edin. Encyc. Art. Horticulture, &c.

of planters, who wish to avoid disappointment, grafting their own fruit-trees. *

Apple-trees intended for full standards, are grafted either on free stocks, or crab stocks. The stocks whether apple or crab, are raised, by sowing the seed in drills in a piece of good ground, and keeping the plants clean. Some prefer the apple, others the crab stock; the former comes into bearing sooner, but is more liable to the diseases of the moss and canker, and much less durable. The grafts ought always to be taken from the extremities of the best bearing branches, of

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* Mr Billingsley gives the following directions for planting and grafting apple trees. 'As soon as the ground for 'the orchard is ready, plant your trees, (stocks), and be particularly careful not to plant them deep in the ground. After the expiry of about four years, lop their heads, and graft 'them with the fruit you most esteem; taking care to adapt 'your grafts to the stock. In other words, let your grafts, 'and the trees on whose heads you graft, be as similar in respect to luxuriancy as you can: as on this much depends. 'It is found, that a luxuriant gross-growing graft will never 'succeed on a slow-growing stock, and *vice versa*. It may 'also be observed, that some excellent sorts of fruit are naturally so slow of growth, that a man, instead of planting 'for himself, plants for his grandchildren; and if you endeavour to force them (which is often injudiciously done) with 'luxuriant stocks, you occasion disease. The tree never becomes large, vigorous, or lasting, and the fruit will be tasteless and insipid.'

trees neither too old nor too young, but such as are healthy. *

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* For a list of the principal apples and pears cultivated in the Vale of Clyde, and in the Carse of Gowrie, See Appendix (L). The reader who is desirous of more detailed information on the cultivation of orchards, will find them fully and scientifically discussed in Mr Knight's Treatise, which has been formerly referred to; in Mr Duncumbe's Survey of Herefordshire; in Rudge's Glocestershire; and in the Edinburgh Encyclopædia, Article Horticulture.

CHAP. VIII.

OF THE DISEASES INCIDENT TO FRUIT AND FOREST TREES.

FRUIT and forest-trees of all descriptions, are subject to such a variety of mischiefs and diseases, even under the most judicious management, that it is to be ranked among the favours of Providence that the sustenance of man does not depend upon them.

Our limits can only admit a very superficial discussion of this intricate subject, our knowledge of which is still in its infancy. The best prevention of disease, in general, probably is, in the selection of such healthy seeds and plants, as are the most likely to be exempted from diseases and insects; and more attentive management.

Blight is the general term, (the theory of which is very imperfectly understood), to which a variety of the diseases incident to trees, are generally assigned; but the particular causes may perhaps be more properly classed under the heads of frost, lightning, insects, and canker.

SECT. I. *Disease of the Larch.*—The disease that has of late prevailed so generally in the larch, has been thought to be occasioned by the deposition of the eggs of insects, as the tree is often infested with a downy white insect, moving all over the plants, which proves so injurious, as not only to stagnate their growth, but frequently to kill them.*

Mr William Salisbury, in his 'Hints to the 'Proprietors of Orchards,' published in 1816, gives it as his opinion, that this is the same insect with the apple-aphis, (*A. lanigera*), sometimes called American blight, which has of late proved exceedingly destructive to young apple trees, and first appeared in the neighbourhood of London only about the year 1796. It is described by Mr Neill as a minute insect, covered with a long cotton-like wool; it breeds in chinks and rugosities of the bark, and at length almost covers the infected tree. It is said that the application of the spirit of turpentine to the bark, proves an effectual remedy. We know, says Mr Neill, † that it

* Sir Archibald Grant ascribes this disease to the general practice of raising plants from the seed of larches not arrived at full maturity, and recommends 'importing ripe, healthy 'seed, from the Alpine regions.' Gen. Rep.

† See Edin. Encyc. Art. Horticulture.

has been wholly banished from a garden where it had spread, by merely smearing the infected branches with oil, as recommended by Sir George Mackenzie. Sir Joseph Banks extirpated it from his own apple-trees, by the simple means of removing all the rugged old bark, and then scrubbing the trunk and branches with a hard brush. *

SECT. II. *Frost.*—The fatal effects of frost may be clearly traced. Dry frosts, unless very severe, are seldom injurious; but most surely so, when succeeding a storm of rain. Similar effects are probably produced on the vegetable as on the human system. Sudden transitions from heat to cold are uncongenial to either: by warmth the vessels are expanded, and the juices flow freely: a sudden application of cold, causes a sudden contraction, without a proportionate diminution of the fluids, which, being thus unnaturally checked in their current, become stagnant, morbid, and diseased. Rain is congenial to the growth of plants; and, while nature disposes them to open all their pores, by which its influence can be received, the consequence of being overtaken by frost in this situation, must be fatal. †

* See Edin. Encyc. Art. Horticulture.

† See Glocest. Reprint. Rep. p. 203. Dr Paterson, in his 'Observations on the Climate of Ireland,' gives the following explanation of the mode of action by the frost. 'The 'abstraction of heat, or what is termed cold, besides its oppo-'sition to the adequate fluidity of the vegetable juices, must

The moisture of fog is equally mischievous, as far as it extends, especially if suddenly succeeded by frost. Cold winds coming on after a day of sunshine, may also prove destructive to the blossom. Hence, in a northern aspect, the fruit is often preserved, when in others it has been destroyed; for the sun, not having much influence on the trees in this situation, they are left to the prevailing temperature of the season, and thus enabled to bear the cold north-eastern blasts of the night. The only methods yet discovered to obviate this mischief are, the selecting trees suitable to the climate, and carefully covering the tenderest kinds with bass or netting, during the night, in frosty weather, and removing them again in the day time. Paper screens have lately been used for protecting the blossom of wall-trees in the spring.

SECT. III.—*Hares* and *Rabbits* are declared enemies to young fruit and forest-trees, and are extremely mischievous, by barking young trees during the winter season.

'be unfriendly to the animation of the solids, causing either 'local canker, or death, of the whole plant. When the vege-'table fluids are chilled, and converted into ice, their bulk is 'vastly enlarged, and this enlargement sometimes takes place 'with such extreme violence, as to rend them in pieces. In 'this way, frost destroys those parts of vegetables which are 'most succulent, particularly in that form called hoar-frost, 'or rime, so common in the spring season.'

The following simple and effectual remedy is recommended by Mr Joseph Smeall, gardener to Mr Liston, at Milburn Tower, in the First Volume of the Caledonian Horticultural Memoirs, p. 361. 'Take hog's-lard, and as much whale 'oil as will work it up to a thin paste or paint. 'With this, rub the stems of the trees upwards 'at the fall of the leaf. This may be performed 'once in two years, and will be found effectually 'to prevent either hares or rabbits from touching 'them.'

Another preparation, used with equal success by Mr Elliot, gardener at Castlecraig, in Peebles-shire, for the last six or seven years; is, a mixture of three parts of tallow, and one of tar, melted over a gentle fire; and go over the bark with a small brush, with the mixture, in a milk-warm state, laying on a very thin coat. *

SECT. IV. *Hide-bound, or Bark-bound.*—Transplanted trees are more subject to this disease, than those that are raised from the seed. When a tree becomes hide-bound, or when the stem swells too fast for the bark, the usual remedy is, to make longitudinal incisions in the bark, from the top to the root of the trunk, in various places: but the most effectual remedy for oak, ash, elm, and all the kinds of trees that stole, is, to cut the plants over near to the ground, upon

* See Caled. Hort. Mem. Vol. II. p. 119.

the first appearance of the disease, or wherever any want of vigour is perceptible. The leading shoot only being afterwards preserved, will readily make its way, and generally surpass its youthful competitors. *

Sect. V.—*Insects* frequently constitute a very serious disease in trees, and are generally considered as one of the principal causes of blight. Blighted trees are indisputably covered with insects; but it is by no means equally clear, whether they are the primary efficients, or consequences of the mischief. It is the nature of various insects, to find a nidus in particular diseased plants and trees, without being the cause of disease. Accurate experiments are still wanting, perhaps, fully to determine the question.

The common idea, that insects or their eggs are brought on the tree by the winds, is absurd. Mr Knight, whose abilities, as a naturalist, are well known, is of opinion, that they are deposited by the different species of the parent insects in the winged state, partly in the spring, and partly in the preceding summer, on those trees where they afterwards commit their depredations. Others suppose, with greater probability, that the appearance of insects on plants and trees, is the effect, and not the cause of blight, and that this malady is occasioned by sudden changes of the

* See Devonshire Report, p. 265.

atmosphere from heat to cold, or from cold to heat; by which the tender organs of vegetation are injured, the rising sap checked and inspissated, and both a nidus and food created for various kinds of insects. *

One antidote to this disease, recommended by Mr Rudge, in his Survey of Glocestershire, is smoking, or the burning of weeds and other vegetable substances, mixed with a little sulphur, on the side of the orchard from which the wind blows. Salutary effects are said to have been experienced from this process.

Some of the most experienced practical gardeners in Scotland follow a more tedious and laborious plan, in order to clear trees of insects, and their eggs and larvæ, and prevent their breeding: they regularly wash with some penetrating liquid, every winter, the trunk, branches, and even twigs, of their fruit-bearing trees. Nicol's liquid, is the mixture generally adopted for this purpose. The recipe is as follows.

'Take of soft soap, 2 lb.; flowers of sulphur, '2 lb.; leaf or roll tobacco, 2 lb.; nux vomi'ca, 4 oz.; turpentine a gill, English measure. 'These ingredients are boiled in eight gallons 'English of soft or river water, down to six gal'lons. This mixture is applied, by means of a 'house-painter's brush, and a sponge, generally

* Monthly Review, 1802, and Herefordshire Reprint. Rep. &c.

'when in a milk-warm state. This operation may 'be performed any time from the beginning of 'November, till the middle of February.' *

Sir George Mackenzie has attained the same object by a simple anointing of the stems and branches with oil, taking care not to touch with the oil, the buds that are to produce blossoms. Coal-tar would probably produce the same effect. An easy remedy for the white blight, or American bug, is, to clean the diseased parts, and to apply to them linseed-oil, with a brush; and the nuisance is got rid of, without injury to the plants. † The leaves and blossoms of the apple-tree, are also sometimes entirely destroyed by a numerous tribe of caterpillars, some kinds of which, become moths and butterflies in the summer and autumn, and others, in the succeeding spring, as well as by a minute insect of the cochineal tribe. ‡ A species of the phalæna, is also frequently very destructive to fruit. It is supposed, that wherever flax is reared, or where the elder-berry grows, few worms or caterpillars will be found. ‖

SECT. VI. *Lightning*, is another supposed cause of blight, which, like frost, affects trees and ve-

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* See Edin. Encyc. Art. Horticulture, § 548.

† Code of Agriculture, p. 437.

‡ See Knight, on the Apple and Pear.

‖ See Caled. Hort. Mem.

getables by its expansive power, bursting their vessels as it passes through them. Sometimes a single limb loses all its foliage, and ceases to vegetate, in one night; at other times, one tree of many, in an orchard; a row of trees in one direction; and sometimes whole orchards, are affected in the same way; and decay, or recover with difficulty. *

SECT. VII. *Mildew*, consists in a thin whitish coating, investing the leaves of the finer kinds of fruit-trees. It commonly appears in the warm months, when the ground is dry, the weather calm, and when hazy vapours, or slight fogs, occur in the evenings. Mildew, in trees, and in grain, probably originate in the same cause; being the effect of hoar-frost, when expelled by a hot sun, or a sudden change of atmospherical temperature, frequently producing the almost immediate death of the plant.

It is remarked by experienced gardeners, that trees washed during winter with such a liquid as that above described, are seldom affected with mildew; and washing the foliage with the garden engine has been found very useful in removing, or in stopping the progress of mildew. †

SECT. VIII. *Misletoe*, in the west of England,

* See Gloc. Rep. p. 204.

† Edin. Encyc. Art. Horticulture.

is a great enemy to the health of apple trees, by exhausting their vital juices, and ought carefully to be removed. In Scotland, this parasitical plant never troubles the orchard.

Sect. IX. *Moss*, is highly injurious to trees: it is the effect of damp, arising either from inadequate draining, thickness of the wood, or allowing the grass to accumulate underneath. It is generated over the tree, in most cases, from a collection of it first formed at the root; originating from a strong, wet, matted grass, permitted to grow rank in the plantations, and having its noxious qualities increased by continual loppings, generally left to rot in the wood. Moss is frequently eradicated from trees, by a hard wooden-scraper, shaped like an ivory folder; the trunk and branches are afterwards hard swept with a birchen besom, in wet weather. If these operations are performed in September, and repeated in February, they generally prove effectual. Liming, dunging, and draining, are the other most potent auxiliaries in destroying moss or lichens. This disease has been termed *suffocation*.* Ivy and honeysuckle ought also to be carefully eradicated both from fruit and forest-trees.

Sect. X. *Resinous Distemper of the Scots Fir.*—There is a disease exclusively incident to the

* See Edin. Encyc. Art. Horticulture, § 543.

Scottish pine, particularly on moory and barren soils. The turpentine frequently begins to exude from near the top of the tree, which soon extends, and causes its death. This distemper has been thought something akin to plethora, and to have its origin in long and severe drought, in violent gales of wind, or in sudden transitions from heat to cold, or from cold to heat. No remedy, it is presumed, has been hitherto applied for this distemper.

SECT. XI. *Vermin.*—The field mouse (*mus sylvaticus*), is a determined enemy to the seeds of trees sown in autumn; particularly, if not sufficiently covered with soil. To avoid their depredations, the seeds should be principally sown in spring, whether in the nursery, or in the field. They may also be subdued, by placing a number of *fourth-figure* traps (as they are called, from resembling in shape the Arabic 4) in the plantations. *

Snails may be destroyed in the morning, and moles ensnared in the usual manner. †

* A figure and description, of this simple but effectual trap, may be found both in Nicol's Gardener's Calendar, and in Abercrombie's Pract. Gardener.

† No species of cattle can be admitted into young orchards or plantations for a moment without injury; and hares, rabbits, and black game, ought to be extirpated from young plantations without mercy.

SECT. XII. *Wounds, Bruises, and Canker.*—Wounds and bruises in trees may, in general, be easily cured, by carefully removing the injured parts, smoothing the edges of the wounds, and covering them with a mixture of dung and clay, or a coat of coal-tar.

Canker is a disease incident to trees, which occasions the bark to grow rough and unhealthy, and turns the wood affected to a rusty-brown colour; probably arising from various causes; but principally from pernicious subsoil, obstructed circulation, and external injury done to the branches by friction, injudicious pruning, large wounds, biting of cattle, stones, frost, &c. This species of gangrene generally commences at the extremities of the branches, and proceeds towards the trunk, killing the tree in a few years.

No effectual remedy has hitherto been pointed out for this distemper, nor is there a greater desideratum in horticulture. * To prevent canker, and other diseases incident to trees, it is of the utmost importance, to procure ripe and healthy seeds, from the native climes of the plants intended to be raised; and, wherever they appear infected to any extent, to cut out the whole of the cankered part, both bark and wood, by instruments such as are figured and described at the end of Mr Forsyth's volume, and to make the surface smooth and even. The well known com-

* See Gen. Rep. vol. ii. p. 231.

position, * prepared by Mr Forsyth, may then be applied; and in the course of a year, the wound will be found healed over, to be filled with new wood, and covered with healthy bark.

This composition, invented by Mr Forsyth, is said to be of a soft and healing nature, to possess an absorbent and adhesive quality, and, by resisting the effects of washing rains, the contraction of nipping frosts, and the operation of a warm sun and drying wind, excludes the pernicious influence of a mutable atmosphere. But any simple application of clay and cow dung, has been found equally effectual.

Farther, to guard against canker, where the soil is indifferent, the trees should be lifted and planted as much on the surface as possible. Great care should be taken to cut clean in pruning, and to cover the wound with paint or plaster; and, where the extremities of unripe shoots are nipped by the frost, they should be carefully removed

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* The late Lord Meadowbank, in the conclusion of his 'Instructions for Foresters,' published in 1815, recommends an addition of well-prepared mortar to the plaster of Mr Forsyth, to prevent the winter's waste. The following is the composition recommended by Mr Forsyth.

'Fresh cow dung, one bushel; half a bushel of lime rubbish; half a bushel of wood-ashes; and one sixth of a bushel of pure sand.' The mixture is applied with a painter's brush, and the surface finally smoothed by the hand.

with a sharp knife. For further information regarding canker, the reader may be referred to three papers on that subject, published in the first volume of the Caledonian Horticultural Society's Memoirs.

APPENDIX A. (Chap. I.)

Table of the Cultivated and Uncultivated Lands of Scotland.

The following Table of the cultivated, and of the uncultivated lands of Scotland, deduced from the 'General Report,' is perhaps as near an approximation to the truth, as can be expected, considering the present imperfect sources of information, regarding that important subject of inquiry.

Names of the Counties.	Eng. Acres cultivated.	Eng. Acres not cultivated.	Total Eng. Acres.	Proportion in 100 cultivated.
Aberdeen -	451,584	802,816	1,254,400	36
Argyle, besides Islands	163,970	1,244,030	1,408,000	11
Ayr - -	325,830	339,130	664,960	49
Banff - -	123,840	288,960	412,800	30
Berwick -	137,196	145,684	282,880	48.5
Caithness -	92,333	347,347	439,680	21
Clackmannan -	23,040	7,680	30,720	75
Cromarty -	20,480	143,360	163,840	12.5
Dumbarton -	53,990	91,930	145,920	37
Dumfries -	232,557	569,363	801,920	29
Edinburgh -	145,000	81,560	226,560	64
Carry forward,	1,769,820	4,061,860	5,831,680	

Names of the Counties.	Eng. Acres cultivated.	Eng. Acres not cultivated.	Total Eng. Acres.	Proportion in 100 cultivated.
Brought forward	1,769,820	4,061,860	5,831,680	
Elgin - -	121,088	181,632	302,720	40
Fife - -	209,216	89,664	298,880	70
Forfar -	369,408	198,912	568,320	65
Haddington -	139,264	34,816	174,080	80
Inverness, besides Isles	148,685	1,709,875	1,858,560	8
Kincardine -	92,416	150,784	243,200	38
Kinross -	27,648	18,432	46,080	60
Kirkcudbright -	168,243	357,517	525,760	32
Lanark -	271,296	331,584	602,880	45
Linlithgow -	57,600	19,200	76,800	75
Nairn - -	37,440	87,360	124,800	30
Peebles -	24,500	179,660	204,160	12
Perth - -	501,118	1,126,298	1,627,416	32
Renfrew -	72,000	72,000	144,000	50
Ross, besides Islands	120,378	1,187,678	1,307,856	9
Roxburgh -	205,920	251,680	457,600	45
Selkirk -	10,100	158,220	168,320	6
Stirling -	195,600	117,360	312,960	62.5
Sutherland -	63,045	1,059,515	1,122,560	5.6
Wigton -	101,136	187,824	288,960	35
Buteshire -	29,440	73,600	103,040	26.6
Argyle Islands	107,020	487,540	594,560	18
Inverness Islands	95,680	640,320	736,000	13
Ross-shire Islands	30,117	328,283	358,400	8.4
Orkney -	24,480	247,520	272,000	9
Zetland -	21,888	525,312	547,200	4
Total, Scotland and its Islands	5,043,450	13,900,550	18,944,000	26.6*

* See Gen. Rep. of Scotland, (Appendix) Vol. IV. No. I. p. 2.

APPENDIX B. (Chap. I.)

Hints regarding the Royal Forests.

Though there is scarcely a vestige of any royal forest, belonging in property to the Crown, at present existing in Scotland, (as the extensive tracts in the counties of Perth, Aberdeen, Moray, Inverness and Ross, which naturally produce the Scots fir, do not come under this denomination), a few hints regarding these forests may not be deemed inapposite.

When it is considered that many of the royal forests are situated upon soils which might produce, with advantage, all the usual crops raised by the common agriculture of the kingdom, they will, without question, appear to be a national object which merits no slight degree of attention.

From the returns of the King's forests, it appears, that through mismanagement, and inadequate regulations, they do not, on an average, furnish above one-fortieth part of the oak timber required annually for the naval and commercial purposes of Great Britain. In the year 1791, a Paper of Observations on the Propagation and Management of Oak Trees in general, but more particularly applying to his Majesty's New Forest in Hampshire, was published by T. Nichols, Purveyor of the Navy for Portsmouth dock-yard. In this paper, it is remarked, that 'there are to be seen, in many parts of the forest, from 40 to 50 fine oaks standing on an acre, that will 'measure one with another two loads a tree.

'Several woods in the forest, however, are almost ruined 'for want of thinning, and its being done at proper times; 'particularly the enclosures that were made in the year 1700: 'these were originally well planted, and great numbers of 'trees reared up in them, which now remain so close together, 'that they are nearly stagnated, particularly in Salisbury 'Trench, Brimley-Coppice, and Woodfidley; and although it 'is 90 years since they were planted,' (now 120), 'the trees 'will not measure, one with another, above six or seven feet a 'tree; whereas, if the business of thinning had been executed 'as it ought, the remaining trees (after drawing much useful 'timber) would by this time have been of a size fit for naval 'uses, as in some of the woods that were planted at the same 'time, the trees which have had room to expand, and free air 'admitted to them, will measure from 70 to 80 feet.'

It is also judiciously observed, by the very able Commissioners of the Land Revenue, that 'the public interest certainly re-'quires that so extensive and so valuable a part of the landed 'property of the country, should not be suffered longer to 'continue in its present unproductive state; and that either 'the plan of management which has been pursued, ever since 'the beginning of the last century, and which has had such 'destructive effects, should be completely altered, and new re-'gulations established, which may render those forests useful 'nurseries of timber for the Navy; or that they should be 'sold, and converted to tillage or pasture, so as to add to the 'produce and population of the kingdom.' *

The miserable state of the Royal forests, does not perhaps originate from any want of public spirit in those who may have the charge of them, but necessarily arises from the errors of an ancient and absurd system, which had in view more the preservation of deer than of timber; and consequently sacrificed the preservation of the latter, for the purpose of securing food for the former.

'It is a truth well worthy of the serious consideration of 'his Majesty's Government,' observes Mr Donaldson, in his Agricultural View of Northamptonshire, 'that the depredations 'committed in the extensive forests and chases in this county, 'by the deer and cattle, in destroying the young trees at a 'very early period, prevent the possibility of obtaining any

* Eleventh Report of Commissioners on Land Revenue, Vol. II. p. 3.

'considerable succession of oak-timber, as scarce any saplings 'or young oaks are to be seen, although there are undoubtedly a great number of seedlings produced by the falling of the 'acorns; yet, when the great number of destructive enemies, 'to which they are exposed in their infancy, is considered, it 'is a wonder how any of them escape their devouring jaws.'

'If no speedy and effectual means are taken,' adds Mr Donaldson, 'for the better management and preservation of 'the forest-woods, in order to procure a regular succession of 'oak-timber, the Navy will, in a short time, be entirely de'prived of this valuable resource.' *

It appears from the fifteenth Report of the Commissioners of the Land Revenue, that they received representations from twelve parishes, within and adjoining to Epping Forest, of the injury sustained from the deer; these representations, signed by more than 200 persons of great property and respectability, were accompanied with a requisition that the Commissioners would recommend to the Legislature, the disafforestation and enclosure of the forest, or that the deer might be removed or confined within parks.

The royal Forests are viewed as a great nuisance by the farmers, under their present system of management, who declare, that their right of commonage does not indemnify them for one-tenth part of the losses they sustain from the deer, which break their fences, trespass on their fields, and destroy their crops.

'These forests,' says Mr Arthur Young, speaking of Epping and Hainault, 'so near the metropolis, are well known to 'be the nursery and resort of the most idle and profligate of 'men: here the under-graduates of iniquity commence their 'career with deer stealing, and here, the more finished and 'hardened robber secretes himself from justice,' &c. †

On a survey of the timber in the King's woods in Essex,

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* Northamptonshire 4to Report, p. 37.

† See Young's Agriculture of Essex.

taken in the year 1783, it was found, that the whole number of oak-trees from ten feet upwards, was 11,055. Of these 2760 were reported to be trees of 30 feet and upwards, and to be fit for the use of the navy: 7825 were young trees from 30 feet down to ten feet each, and the rest scrubbed and unthrifty. On the whole, the number of oaks was less than four trees to the acre, and of those, thirty feet and upwards, less than *one* to the acre! *

The following statement will show the extent of land in which the timber belongs to the Crown, in each of the forests which were submitted to the inquiry of the Commissioners of the Land Revenue.

	Acres.	R.	P.
In New Forest,	66,942	3	26
Dean Forest,	23,015	3	29
Aliceholt and Woolmer Forest,	8,694	1	31
Whittlewood Forest,	4,850	3	32
Whichwood Forest,	3,709	3	5
Waltham Forest,	3,278	3	2
Salcey Forest,	1,847	0	23
Sherwood Forest,	1,466	3	10
Bere Forest,	926	2	13
Sulehay Walk, in Rockingham Forest,	860	3	23
	115,594	0	34

'Although any computation which might be made, before 'an actual settlement has taken place with those who have 'claims on the forests, must be liable to error, yet we are per-'suaded no extravagant expectation is held out, when we sup-'pose, that in the whole of those forests the allotments to the 'Crown may, altogether, amount to 60 or 70,000 acres, fit for

* See Young's Agriculture of Essex; and Annual Review, Vol. VI. p. 778.

'the growth of oak.' * It remains for the wisdom of the Legislature, by the adoption of more efficient regulations, to convert these extensive forests into productive seminaries for naval timber; or, by immediate disafforestation, appropriate them to the plough, by which means the Royal Forests, instead of being an unseemly blemish, might be rendered one of 'the brightest gems in the British diadem.'

* See Eleventh Report of Commissioners on Land Revenue, Vol. II. p. 24.

APPENDIX C. (CHAP. I.)

IN England, landlords who grant leases, frequently insert a clause to oblige the tenant to plant a certain number of forest-trees yearly, during the currency of his lease, in such places as the proprietor or his steward shall point out; and protect the same, and replace them when destroyed. Such was the practice uniformly adopted by the late Earl of Chesterfield.* This compulsive clause, however, is seldom well performed; nor is it in the nature of things that a man will do that willingly, by which he is put to some trouble and expense, without a chance of reaping any benefit from it. Some stimulus or encouragement is necessary to engage the tenant's attention to the propagation of timber; and this is well provided for in Ireland, by a mode which might be adopted in Scotland, with equal chance of success. A law exists in Ireland, by which any tenant holding by lease for any term, may take a beneficial interest in planting timber trees upon the land he occupies.

There is an office in Dublin, at which the number and quality of the trees are registered by the planter, with the name of the land, and of the land-owner. At the expiration of the lease, the trees are to be valued by two persons, to be chosen by landlord and tenant; and the landlord has his option, either

* The proportion of trees to be planted, is, in general, five trees annually to every ten pounds of yearly rent. For example, in a lease reserving a rent of 125*l.* a year, 25 trees are to be annually planted the first five years; making in all on such a farm, 125 trees to be preserved or replaced, so as to leave at the end of such a lease, 125 growing trees.

Every farm should have growing on it as much timber as is necessary for making and repairing instruments of husbandry, buildings, utensils, &c.

to pay his tenant such value as these valuators set upon the trees, or, in case of refusal, the tenant may sell and carry them away.

By this method of securing to the tenant a return of his capital, with the profits of it, many valuable groves of timber are produced, which never would have existed otherwise. The landlord has the advantage of obtaining a stock of timber at a fair value, which he could not have procured, but by means of such a reasonable provision on behalf of the tenants.*

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* See Monmouthshire Report.

APPENDIX D. (Chap. I.)

Average Prices of Timber, and of Oak Bark, at the Port of Leith, at different periods.

Some idea of the value and scarcity of wood in Scotland, may be formed from the following statement of the progressive increase of the average prices of timber, within the last thirty years, furnished by respectable merchants at Leith, (in 1810 and 1819), the principal port for the importation of timber in the east of Scotland.

Price of Timber, per Foot.

	1789.	1799.	1809.	1819.	
	sh. d.	sh. d.	sh. d.	sh. d.	sh. d.
Oak, English,	1 9	2 10	4 9	3 6 to	3 9
— American,	–	–	6 0	–	–
Ash, - -	1 2	2 2	3 3	2 8	3 0
Elm, - -	1 2	2 0	3 3	2 6	2 9
Beech, -	1 2	2 0	3 3	2 2	2 6
Scots fir, planted,	–	–	2 0	–	–
—— natural,	–	–	2 8	–	–
Memel fir, -	1 0	2 4	4 6	2 7	2 10
Common do. -	0 8	1 8	2 8	2 4	2 6
American log	–	–	4 0	2 0	2 4

Price of Oak Bark, per Ton.

	1810.	1820.	
	L. s. d.	L. s. d.	L. s. d.
Best English Oak bark,	18 10 0	10 0 0 to	12 0 0
— Scotch ditto, -	12 0 0	—	—
— Danish, or foreign do.	8 0 0	5 10 0 to	7 0 0

APPENDIX E. (Chap. I.)

Wood proper for Instruments of Husbandry.

[From Lord Kaimes's Gentleman Farmer, 6th edit. p. 265.]

'Among the most expensive articles of a farm, are carts, 'ploughs, brakes, harrows, rollers, &c.; and it is of import'ance, with respect to economy, that these should be con'structed of proper wood. To that end the following hints 'may be of use.

'I begin with examining at what age a tree is in perfection 'for the purposes of a farm. At the age of sixty, it is suffi'ciently large for every farm purpose; being, when cut to the 'square, from twelve to fifteen inches each side. I must ex'cept the oak, which, even for the purposes of farming, im'proves till it be a hundred years old. Every oak consists 'of red and white wood; the former the firmest of all wood, 'the latter good for nothing. Ash, after the growth of sixty 'years, turns short and brittle.

'The proper season for cutting a tree is, when it has least 'sap; which is precisely in the middle between the time of 'shedding the leaf, and that of budding: in that interval it is 'tough, and fittest for every farm purpose. When cut in the 'sap, the wood is short, and apt to split with drought.

'For preserving wood after being cut, there are three me'thods. One is, to dry it in the air; another, to immerse it 'in water; and a third, to cover it with horse-dung. Ash 'when sawed green, never fails to split. Before applying an 'instrument, it ought to be exposed eighteen months in a dry 'situation, that all the sap may evaporate. During that time, 'both ends ought to be covered from the air: the bark pre'vents the body from splitting; but when the ends are expos'ed, they will split into the body five or six inches. When 'ash is designed for uses that require splitting, let it be split 'immediately after cutting, and the parts laid up where the air 'has not free access, in order that they may dry by slow de- 'grees; for sudden drought makes them warp. Oak and elm 'require the same treatment. The Huntingdon willow, and 'other willows that rise to a large size, turn extremely tough 'when dry; and therefore, if intended for planks or boards, 'they ought to be sawed directly after being cut. But as in 'this case, they are apt to split, great care ought to be taken 'to dry them slowly. Alder and birch ought to be managed 'in the same manner.

'The immersing in water, and covering with horse-dung, 'are far from being the best methods of drying wood. It is 'always harder and tougher when dried slowly in the air. 'Therefore these methods are only for expedition, in order to 'extract the sap the more quickly, when the wood is wanted 'for immediate use.

'There is not an instrument of husbandry that consists of 'different parts, but requires wood of different kinds. Of all 'wood, oak is that which resists moisture the best, and can the 'best endure the being totally deprived of air. For these reasons, 'oak is the only wood fit for being mortised into other wood. 'From the part that is mortised, air is totally excluded; and 'yet some moisture finds access, being more penetrating than 'air. Therefore the spokes of a wheel, which are mortised 'both into the nave and fellies, ought indispensably to be of 'oak; the sheaths of harrows, which bind the parts together, 'ought to be of the same wood; as also the head of the chain- 'plough, because it is mortised into the beam. As ash is less 'apt to split than oak, it is more proper for naves and fellies. 'Being the toughest of all wood, and the most elastic, it is the 'fittest for the shafts of a cart. The best wood for the body 'of a cart or waggon, is the Huntingdon willow. It is both 'lighter and tougher than even the best red fir. The head of 'the Scotch plough may be of alder, because it is not mortised 'into any other part. Whatever the plough be, the mould- 'board may be of willow, or alder, or plane; because they are 'light, and not apt to split.* The bulls of brakes and har-'rows should be of birch or alder. A roller should be made 'of beech-wood, being heavy; the sheaths and pins of oak, 'and the shafts of ash. Foreign fir is the best and cheapest 'for couples. Beech-wood would be still better, were it not 'apt to take the worm: but in a farm house that is not lofted, 'will not the japanning with smoke prevent that evil? The 'handles of spades, shovels, picks, &c. ought undoubtedly to 'be of ash: besides its toughness, it is less apt to turn warm 'in handling than any other wood. For gates, fir is undoubt-'edly the best: it is light; it resists moisture; and is not apt 'to warp.†

'One general rule I give, of more importance than at first 'view may be thought, which is, that the angle made by mor-'tising, or otherwise, being always the weakest part of the in-'strument, ought to be fortified with a plate of iron, fitting 'accurately the angle of the wood.'

* Iron is now employed for many purposes, in place of wood. The head and mould-board (and frequently the whole) of the plough, are now generally made of cast-iron.

† Willow is preferable where it can be procured.

APPENDIX F. (Chap. III.)

The total extent of wood-lands in Scotland, natural and planted, on the basis of the County Reports, and other data, may be generally estimated at about eight hundred thousand acres, English measure, one half planted, and the other natural woods.

The following general estimate of the woods and plantations of Scotland, is extracted from the 'General Report,' which may be considered as a near approximation to the truth; though, from the unavoidable circumstance of the computations, in many cases, being founded partly on conjecture, the stated amount of natural wood has been generally supposed to be considerably beyond what actual observation fairly warrants. *

* See Farmer's Magazine, Vol. XVI. p. 350.

TABULAR

TABULAR STATE OF THE NATURAL WOODS AND PLANTATIONS OF SCOTLAND.

Counties, or Shires.	Acres planted.	Acres Natural.	Total.
1. Aberdeenshire -	50,000	74,000	124,000
2. Angus, or Forfarshire -	33,624	5,604	39,228
3. Argyleshire - -	4,000	30,000	34,000
4. Ayrshire - -	26,000	6,000	32,000
5. Banffshire - -	12,000	6,000	18,000
6. Berwickshire -	5,500	500	6,000
7. Caithness-shire -	250	600	850
8. Clackmannanshire -	2,000	900	2,900
9. Cromarty, and Ross-shires	5,000	72,000	77,000
10. Dumbartonshire -	4,000	7,000	11,000
11. Dumfries-shire -	28,000	3,000	31,000
12. Edinburghshire -	14,000	3,000	17,000
13. Elginshire - -	10,000	21,000	31,000
14. Fifeshire - -	18,000	—	18,000
15. Galloway - -	4,400	3,800	8,200
16. Haddingtonshire -	4,500	400	4,900
17. Inverness-shire -	10,000	45,590	55,590
18. Kincardineshire, or Mearns	17,000	609	17,609
19. Kinross-shire -	1,993	—	1,993
20. Lanarkshire - -	4,430	2,150	6,580
21. Linlithgowshire, or West Lothian - -	5,000	200	5,200
22. Nairnshire - -	4,000	8,000	12,000
23. Orkneys, and Zetland -	—	—	—
24. Peebles-shire - -	2,000	500	2,500
25. Perthshire - -	50,970	118,930	169,900
26. Renfrewshire - -	4,000	500	4,500
27. Roxburghshire -	4,682	608	5,290
28. Selkirkshire - -	2,000	—	2,000
29. Stirlingshire - -	10,000	4,000	14,000
30. Sutherlandshire -	1,173	3,000	4,173
31. Western Isles, or Hebrides	5,000	—	5,000
In Scottish acres	343,522	417,891	761,413
English ditto	412,226	501,469	913,695

APPENDIX G. (CHAP. IV.)

METHOD OF EXTRACTING SUGAR FROM THE MAPLE TREE.

THERE is found in North America, says the late Dr Anderson, in his Miscellaneous Remarks on Planting, * certain species of Maple, upon which the natives have bestowed the name of Sugar Maple, because from it they extract a juice which yields a perfect sugar when evaporated, which the inhabitants of Canada employ for every purpose which would require sugar; and, for many uses, prefer it even to that extracted from the sugar-cane.

The following interesting remarks on the *Acer saccharinum*, are transcribed from 'Stewart's Account of Prince Edward's Island.'

'This is frequently a large tree; the butts of many of them, 'for six or eight feet from the ground, being finely curled, 'render this timber extremely beautiful in cabinet work, as it 'is very close grained, and susceptible of a high polish: what 'is called the Bird's-eye Maple, is a variety of this tree. The 'chief value of the Maple at present, arises from the quantity 'of sugar annually manufactured of its sap; the making of 'which generally commences about the 25th of March, and 'continues through the first ten days of April; the quantity 'made varies much in different years, and depends greatly on 'the weather at this period; the more snow there is on the 'ground, the trees run the greater quantity of sap; dark or 'rainy weather is unfavourable. The sap is produced in the 'greatest quantities in bright sun-shiny days, after a frosty 'night. To procure the sap, a gap is cut in the tree with a 'common felling axe, from an inch and a half to three inches 'deep, and from six to eight inches long, slanting in the form

* Scots Magazine, Vol. XXXIII. p. 515.

'of the letter V, and should face the south-west; the sap will 'run freely from this gap, from the lower end of which it is 'guided into a trough placed below, by a chip driven into a 'slight cut just under the gap. A full grown tree will some- 'times run upwards of two gallons a day. The persons em- 'ployed in the business visit the trees frequently, to see that 'the sap runs fairly into the troughs, and to collect it into 'barrels, which are conveniently placed for that purpose, and 'in which it is drawn on hand-sledges to the boiling place, or, 'as it is styled, the sugar camp. The apparatus for boiling 'generally consists of three kettles, the largest double the size 'of the second, and that rather more than in the same pro- 'portion to the third: these are suspended over a large fire 'made in a temporary hut in the forest. The sap is first boil- 'ed in the large kettle, and removed into the others in succes- 'sion, as it is reduced by boiling to the quantity each can con- 'tain: when removed into the second kettle, the first is again 'filled with fresh sap; and boiling is continued in all the ket- 'tles, which are filled up from each other. The liquor requires 'to be frequently skimmed, to prevent its rising suddenly over 'the kettle; a small portion of tallow or butter is occasionally 'thrown in. When the syrup in the smaller kettle appears of 'a proper consistency, it is poured into wooden moulds; the 'kettle is again filled up from the second, which is replenished 'from the larger; and that is filled with fresh sap. A small 'quantity of lime water is sometimes put into the smaller ket- 'tle, to promote its granulation. In every stage of the pro- 'cess, much attention is required to make good sugar. Before 'boiling, the sap should be strained, to clear it of chips and 'adventitious substances. When well made, this sugar is an 'agreeable sweet, and answers all the purposes of common su- 'gar. Very good vinegar is also made by boiling three gallons 'of sap into one, and then fermenting it with yeast.

'A tree will continue to yield juice for a very long time, 'without being in any measure hurt by it, if only one hole is 'made at a time; but if too great a number are opened at once, 'it hurts the tree, and sometimes causes it to perish. It is 'always necessary to make a fresh incision annually, as there 'is never any juice flows from it, but that year when it is made. 'Young trees afford a greater quantity of juice; but that ob-'tained from old trees is of a richer quality, and yields a great-'er proportion of sugar.

'The sugar thus obtained from the Maple is all clear gain, 'being made at a time when very little other out-of-door work 'can be performed. Three smart lads working together, will 'often make one hundred weight each in the course of a fort-'night, and sometimes in a favourable year more.' *

Dr James Anderson calculates the annual value of an acre of ground, containing 540 trees, planted at ten feet distance from each other, at 243*l.* Sterling. †

* Stewart's Account of Prince Edward's Island.

† See Scots Magazine, Vol. XXXIII. p. 516.

APPENDIX H. (Chap. IV.)

Lambert's Description of the Genus *Pinus*.

Of the genus *Pinus*, (class and order *Monœcia monadelphia* of Lin.) there are twelve species mentioned by Marshall, and thirty-three distinct species enumerated by Aylmer Bourke Lambert, Esq. F. R. S. Vice-President of the Linnean Society.

The following are their designations:—

1. *Pinus sylvestris*; Scots fir, or wild pine.
2. — *pumilio*; the mugho, or mountain pine, *sylvestris* γ of Aiton.
3. — *Banksiana*; Labradore pine, *sylvestris* δ of Aiton.
4. — *pinaster*; cluster pine.
5. — *pinea*; stone pine.
6. — *maritima*; maritime pine.
7. — *halepensis*; Aleppo pine.
8. — *Massoniana*; Indian pine.
9. — *inops*; Jersey pine, *Virginiana* of Gmelin.
10. — *resinosa*; pitch pine.
11. — *variabilis*; variable-leaved bastard pine, *taeda* γ of Aiton.
12. — *taeda*; frankincense pine.
13. — *rigida*; three-leaved Virginian pine, *taeda* β of Aiton.
14. — *palustris*; swamp pine.
15. — *longifolia*; long-leaved Indian pine.
16. — *strobus*; Weymouth pine.
17. — *cembra*; Siberian stone pine.
18. — *occidentalis*; West Indian pine.
19. — *abies*; Norway spruce fir.
20. — *alba*; white spruce fir.
21. — *nigra*; black spruce fir.
22. — *rubra*; Newfoundland red pine, or spruce fir.

23. *Pinus orientalis;* Oriental pine.
24. — *picea;* silver fir.
25. — *balsamea;* balsam of Gilead fir.
26. — *canadensis;* Canadian fir.
27. — *taxifolia;* Nootka fir.
28. — *lanceolata;* broad-leaved fir.
29. — *larix;* larch.
30. — *pendula;* black larch.
31. — *microcarpa;* red larch.
32. — *cedrus;* cedar of Lebanon.
33. — *dammara;* Amboyna pitch pine.*

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* See Lambert's Description of the genus *Pinus.* Folio.

APPENLIX I. (Chap. IV.)

The first barren trees planted in Scotland, not long before the middle of the seventeenth century, were those of exotic growth; such as the plane, alder, beech, chestnut, lime, pitch and silver firs. These, at the time, were planted in gardens, rather from curiosity or ornament, than for use. There is no planted oak, ash, elm, or fir, of such an old date, as the country was then full of natural woods composed of those trees, and little demand for them. *

From the best information that can be obtained, the other exotic forest-trees were first planted in Scotland, at or about the following periods, and at the following places. †

Lime, *Tilia europea*, - -	Taymouth, -	1664.
White Willow, *Pop. alba*, - -	Prestonfield,	1678.
Silver and pitch firs, *A. picea*, and *P. resinosa*, Lamb. - - -	Inverary, -	1682.
Maple, *Acer*, - - -	Inverary, -	1682.
Walnut, *Juglans*, - -	Kinross, -	1690.
Hornbeam, *C. betulus*, - -	Drumlanerig,	1692.
Black poplar, *Pop. nigra*, -	Hamilton, -	1696.
Laburnum, *Cytisus laburnum*, -	Panmure, -	1705.
Horse-chestnut, *Esculus hippocastanum*,	New Posso,	1709.
Sycamore, *Acer pseudo-platanus*,	Holyroodhouse,	1710.
Flowering-ash, *Frax. orn.* Lin. -	Bargaly, -	1712.
Weymouth pine, *Pin. strobus*, Lamb.	Dunkeld, -	1725.
Larch, *larix*, Lin. - - -	Dunkeld, -	1727.
Evergreen oak, *Quercus ilex*, -	Newhails, -	1730.
Balm of Gilead fir, *Pin. balsam*, Lin.	Arbigland, -	1732.
Deciduous cypress, *Cupress. dist.* Lin.	Loudon, -	1733.

* See Walker's Essays, p. 26.

† See Walker's Econ. Hist. of the Hebrides.

Spanish oak, *Quercus ægilops*, Lin.	Newhails, -	1734.
English elm, *Ulmus campestris*, Lin.	Dalmahoy, -	1736.
Norway maple, *Acer platanoides*,	Mountstewart,	1738.
Tinebank willow, - -	Newhails, -	1739.
Cedar of Lebanon, *Pin. cedrus*,	Hopeton, -	1740.
Carolina bird cherry - -	Hopeton, -	1743.
Hungarian nut, *Corylus colurna*?	Carmichael,	1744.
Amerina willow, *Salix amerina*,	Mellerstain,	1746.
White Newfoundland spruce, *A. alba*,	New Posso,	1759.
Sugar maple, *Acer saccharinus*, Mich.	New Posso,	1759.
American larch, and paper birch,		1763.
Black American birch, *B. nigra*, H. K. Mich. - - -	Elliock, -	1765.
Lombardy poplar, - -	New Posso,	1766.
Balsam poplar, *P. balsamifera*, -	Leith, -	1770.

APPENDIX K. (CHAP. VI.)

BARKING OAK, &c.

THE high value of oak bark, renders it an object of peculiar importance that the operation of Barking be performed in an efficient and economical manner. This process, as it is generally performed in Scotland, is thus described by the late Mr Nicol. *

'Three classes of people are employed: the *hagmen*, or 'cutters, the carriers, and the *barkers*. The latter in general 'consist of women and children. The cutters are, or should 'be, provided with ripping-saws widely set, with sharp, light 'hatchets, and with short-handled pruning hooks. The car-'riers should be provided with short ropes, stout limbs, and 'broad shoulders. The *barkers* are provided with light, short-'handled, ashen mallets, the head being about eight inches 'long, three inches diameter in the face, and the other end 'blunt, somewhat wedge-shaped; with sharp ashen wedges, 'somewhat spatula-shaped, and which may either be drove by 'the mallet, or, being formed with a kind of handle, may be 'pushed with the hand; and with a smooth-skinned *whin*, or 'other landstone, the size of one's head.

'The cutters are divided into two parties; hatchet-men, 'who sever the stem; and hookmen, who prune it of small 'twigs, and cut it into convenient lengths. The carriers bun-'dle the small branches (*all* an inch in diameter are barked) 'into their ropes, and bear them, the large ones, and the trunk, 'if liftable by one person, to the barkers, who are seated on 'the grass at a convenient distance.

'Small branches and twigs are held by one hand on the 'stone, and beat with the mallet until the bark be split, †

* Practical Planter, 2d Edit. p. 231, &c.

† It must be acknowledged, that this practice, of beating the small branches and twigs of the oak with mallets, to de-

'which is then stripped off, and laid regularly aside, as in reap-'ing of corn, till a bundle of convenient size be formed. The 'trunk and branches as large as the leg, &c. are laid along on 'the ground; the upper side is beat, with force, from one end to 'the other; the bark is *started*, at the thick end, by thrusting 'or driving in the wedge, which, being run along the whole 'length, rips it open in an instant; the wedge is applied on 'both sides of the incision, in manner of the knife in skinning 'a sheep, observing to beat *before its point* with the mallet, 'until the bark is completely loosened. The point most par-'ticularly to be attended to is, to take off the bark in as long 'shreds or strands as possible, for the conveniency of carriage 'to, and drying it on the *horses*.

'These are formed of long branches; and pieces of a yard 'in length, sharpened at one end, and having a knag at the 'other to receive and support the end of the former. Two

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tach the bark, observed in Scotland, is most improper, and occasions a very serious loss to the purchaser of the wood; as every bruised piece of oak bark perishes as effectually as bruised places in apples, and become totally useless to the tanner. It has been remarked, accordingly, that Scots bark brings only about two-thirds of the price at Leith, which bark from Sussex, and other parts of England, fetches at that port. The tools, also, generally used in Scotland, are greatly inferior to the tools and processes of the bark-peelers in England, which are described by Mr Farey in the Agricultural Magazine for August 1807.

As this subject is of the greatest importance to the proprietors and purchasers of oak-coppice in the Highlands of Scotland, and as the loss of one-third of the value of the bark is a serious matter, it has been recommended to the extensive proprietors of natural woods in Scotland, to bring down some intelligent persons from the midland counties of England, with their improved instruments, to instruct the natives of the Highlands in the best mode of manufacturing so valuable an article as bark.

'*knags* are driven into the ground at the distance of a foot 'from each other, until their upper ends are within thirty 'inches of it, and on a level; other two are placed in like man-'ner, at a distance suitable to the length of two straight 'branches, which are laid on, parallel to each other; thus 'forming the *horse*.* The *horses* may stand within four or 'five feet of each other, and are always to be placed on a dry, 'elevated spot, that the bark may have free air in drying.

'At the end of each day's work, the bark is carried to, and 'laid on the *horses;* across, and to the thickness of about six 'or eight inches. The large, boardy pieces are set up on end, 'leaning against the *horses*, or being formed into small pyra-'midal stacks. Due attention must be paid to turning the 'bark once, or perhaps twice a day, according to the state of 'the weather.

'The method of barking and treating the Birch, is much 'the same as the Oak; with this difference, that the season is 'winter, or early in spring; and that it is *more tedious*, by 'reason that the outward shreddy bark of the Birch is peeled 'off, and rejected. Wherefore, it follows, that if the wood in 'question is composed of Birch and Oak, and if the Birch is 'to be barked, the best method is to *time the work* so as that 'the Birches may be cut, barked, and finished by the first of 'May; and then proceeding with the Oak.' †

Method of Charring Wood.

The following is the usual method of charring wood in Scotland. The wood being collected near the place intended for

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* Sometimes an improvement in the construction of the *horses* has been adopted; the poles are not placed on a level, but the one a few inches lower than the other; so that the bark, when laid on, has a considerable slope to run off the wet in heavy rains.

† See Nicol's Practical Planter, p. 231, 235.

the operation, and cut into billets, generally about three feet in length, the pits or stacks are formed as follows: A spot adapted to the purpose, from about fifteen to twenty feet in diameter, of a conical form, is selected; and after being properly levelled, a large billet of wood, split across at one end, and pointed at the other, is fixed in the centre of the area, with its pointed extremity in the earth, and two pieces of wood, inserted through the clefts of the other end, forming four right angles; against these cross pieces, four other billets of wood are placed, one end on the ground, and the other leaning against the angles.

A number of large and straight billets are afterwards laid on the ground, to form a floor, each being, as it were, the radius of the circular area; on this floor, a proper quantity of brush or small wood is strewed, to fill up the interstices, when the floor will be complete: and in order to keep the billets in the same position in which they were first arranged, pegs or stumps are driven into the ground, in the circumference of the circle, about a foot distant from one another; upon this floor a stage is built with billets set upon one end, somewhat inclining towards the centre billet; and on the tops of these, another floor is laid, in a horizontal direction, but of shorter billets, as the whole is, when finished, to form a cone. The whole is then coated over with turf, and the surface generally plastered with a mixture of earth and charcoal dust.

Previous to the operation of setting fire to the pile, the central billet in the upper stage is drawn out, and pieces of dry combustible wood substituted in its place, to which the fire is applied. Great attention is necessary, during the process, in the proper management of the fire, and in immediately covering up the apertures through which the flame obtrudes itself, until the operation be concluded, which is generally effected in the space of two or three days, according to circumstances.

When the charcoal is thought to be sufficiently burnt, which is easily known from the appearance of the smoke, and the flames no longer issuing with impetuosity through the vents; all the apertures are to be closed up very carefully with a mixture of earth and charcoal dust, which, by excluding all access of the external air, prevents the coals from being any further consumed, and the fire goes out of itself. In this condition it is suffered to remain, till the whole is sufficiently cooled; when the cover is removed, and the charcoal is taken away. If the whole process is carefully managed, the coal will exactly retain the figure of the pieces of wood: some are said to have been so dexterous, as to char an arrow, without altering even the figure of the feather. *

The improved method of charring wood for the making of gunpowder, is, however, a much more costly operation, though the expense attending it is amply compensated by the superior excellence of the article when manufactured. It is performed in iron cylinders, and in so complete a manner, that every particle of the wood is charred. The oily or tarry matter is also preserved, and may, so far as the quantity goes, be made use of instead of foreign tar or pitch. This manufacture is carried to the greatest perfection, near Petworth in Sussex.

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* See Encyclopædia Brit. Vol. V. Art. Charcoal, 4th edit.

APPENDIX L. (Chap. VII.)

The following LIST contains the names of the principal kinds of APPLES and PEARS cultivated in the Vale of Clyde, though there are other varieties not distinguished by any particular appellations.

Summer Apples.

Amber,
American pippin,
Chucket egg,
Lady's lemon,
5. Dryly pippin,
Garrion,
Hawthornden,
Milford,
Jenniting,
10. Kailbed,
Lady Apple,
Summer Strawberry, &c.

Autumn do.

Bloodheart,
Common codlin,
15. Dumbarton pippin,
Hamilton pippin,
Lady's finger,
Lemon pippin,
Marrow,
20. Moncrieff,
Queen of England,
Salmon,
Whistleberry,
White-cluster, &c.

Winter do.

25. Carse of Gowrie,
Coal-house,
Corstorphine,
Ely,
Fulwood,
30. Grass apple,
Golden Monday,
Golden pippin,
Green Calendar,
Green cluster,
35. Green Leadington,
Grey Leadington,
Naked apple,
Nonpareil,
Nonsuch,
40. Purse-mouth,
Royal codlin,
Sheep head,
Winter Strawberry,
Yorkshire greening, &c.

Summer Pears.

Crawford,
Early lemon,
Fair maid,
Forrow cow,
5. Gold-knap,
Green pear of Pinkey,
James,
Jargonelle,
Lady's lemon,
10. Minister,
Rob-hind, early,
Saffron, &c.

Autumn do.

Auchan,
Bergamot,
15. Bishop,
Bush,
Carnack,
Grey gudewife,
Grey honey,
20. Keather,
Laugh,
Longueville,
Muirfowl egg,
Pear-urie,
25. Rob-hind,
Swan egg,
Vicar, &c.

Winter do.

Brier-bush,
Pear iron,
30. Pear Wilson,
Winter bergamot,
Winter warden,
Winter citron, &c.*

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* For a Table illustrative of the Clydesdale Orchards, containing a statement of their extent, annual value, &c. see General Report of Scotland, Vol. IV.

LIST of the principal APPLES, PEARS, and PLUMS, cultivated in the Carse of Gowrie Orchards.

The following are all great bearing, standard Apples.

Black stock, or Fox whelps,
Bulastrae hill,
Carlisle codlin,
Cat's head,
5. Dupplin codlin,
Glammis pippin,
Green fulwood,
Grey Leadington,
Hawthornden,
10. Kinnoul codlin,
Lady's finger,
Lamont,
Lemon pippin,
Loman's pearmain,
15. Moncrieff pippin,
Moncur Apple,
Monstrous rennet,
Naked apple,
Norfolk beaufin,
20. Oslin,
Queen of England,
Ribston pippin,
Royal codlin,
Royal russet,
25. Scarlet Leadington,
Stoup Leadington,
Striped Leadington,
Summer Queening,
Summer Strawberry,
30. Tower of Glammis,
White Captain,
White codlin,
33. Winter Queening, &c.

STANDARD PEARS.

Autumn bergamot,
Benvie, Summer & Autumn,
Black Auchan,
Briar-bush,
Cadillac,
Carnock or Drummond,
Christie,
Crawford,
Elshenhaft,
Galston's muirfowl egg,
Green chisel,
Green yair,
Gold-knap,
Grey Auchan,
Green honey,
Jargonelle,
Longueville,
Muirfowl egg,
Pear James,
Pear nut,
Pow Meg,
Scots bergamot,
Soutar's thumb,
Summer bergamot,
Swan egg, &c.

PLUMS CULTIVATED IN THE ORCHARDS.

Blue perdrigon,	Green Julian,
Common Orleans,	Red Magnum,
Damson,	White Magnum bonum, &c.
Fotheringham,	

The preceding list contains the names of the best-bearing fruit-trees that are most commonly to be met with in the Carse of Gowrie Orchards, although there are a great number of valuable kinds of both apples and pears, not included in the foregoing list, cultivated on walls; besides others of inferior note, and several new kinds lately imported from England. *

* See Memoirs of the Caledonian Horticultural Society, vol. i. p. 325, &c. For a Table farther illustrative of the Carse of Gowrie Orchards, in which will be found, in one view, the names of the orchards and proprietors; the parishes in which they are situated; their extent; the nature of their respective soils; the annual value of their fruit from 1809 to 1813, as far as could be ascertained, &c. See Mem. Caled. Hort. Soc. vol. i. p. 330.

AUTHORITIES REFERRED TO IN FOREGOING ABSTRACT.

The Figures indicate the pages of the Abstract in which such Authorities are mentioned.

END OF ABSTRACT.

AN ACCOUNT

OF THE

MANUFACTURE OF TURPENTINE FROM THE PINUS SYLVESTRIS,

AS PRACTISED BY THE NATIVE PEASANTRY OF THE INTERIOR OF THE RUSSIAN EMPIRE.

By WILLIAM HOWISON, M. D.
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THE Russian empire, a very large and extensive tract of country, embracing almost the whole of the northern, eastern, and southern parts of Europe, and subjected to a proportional variety of soil and climate, is covered with innumerable forests of natural wood, constituting, in a very considerable degree, the wealth of its inhabitants, and the resources of the empire. The trees which compose these forests consist of a great many different species, each of which differ materially in their appearance, nature, &c. according to the climate, soil, and situation, under which they are placed. Of these, however, it is my intention, at present, to confine my remarks to the Pine tribe, and particularly the common pine, with the manufacture of turpentine from it, as practised by the Boors of the interior.

Of the several kinds of trees, those that have narrow-pointed leaves, called by the Germans Nadelhælser, or needle timber, from their leaves growing in that shape; including the Fir (*Pinus picea*), the Pine (*Pinus abies*), the Black Pine (*Pinus sylvestris*), the Larch tree (*Pinus larix*), and the Siberian cedar (*Pinus cembra*), are chiefly indigenous towards the northern part of the Russian empire; and, there, form woods of prodigious extent. These species of trees, dispersed over the country, are entirely natural wood, springing up from the accidental blowing about of the seeds, or from the parent trunk; and, during their growth, no care nor attention is bestowed upon them by human industry. In many parts of the country, particularly far into the interior, at a distance from the great roads, navigable rivers, lakes and canals, where the rapacious hand of man has not as yet had time to penetrate, they acquire an immense height and thickness, and present by far the finest trunks I have seen in any part of the world. By retaining their foliage also during the long and severe winter peculiar to these parts, these trees tend greatly to alleviate the dreariness of the scene; pointing out the road to the traveller amidst trackless snow;

and afford shelter and protection, from the intensity of the storm, to the animals of the forest.

Whilst travelling through extensive forests of these species of trees, with a friend going to purchase timber for the consumption of Great Britain, in that tract of country surrounding the Biel Oser or White Lake, in the extensive government of Novogorod, we observed, as we passed along, numbers, from a deficiency of nourishment, completely dead; whilst others of them were blown over with the force of the wind, their spreading roots tearing up the soft surrounding soil for a considerable distance. In this way, the feebler and more delicate plants, unable to withstand those destructive causes, are injured, and perish; whilst their more hardy neighbours remain masters of the soil, and reach to great perfection, numbers here and there presenting fine stately trunks, destitute of branches, and capable of forming mainmasts for frigates, or even line of battle ships. Among those forests, that species of tree denominated the Scotch fir, we observed to be very abundant, and to attain to great luxuriance. What surprised us much in passing along, was, that numbers of the fir trees, and, amongst these, many of the finest ones, presented a burnt appearance. In these, the outer bark was perfectly fresh and uninjured; but, wherever there happened to be a perforation through it, or a part accidentally removed, there the timber of the trunk was visible, in a completely burned state, resembling charcoal. I had some difficulty, at first, in understanding how this could have happened; but upon inquiring at the Russian nobleman, to whom the surrounding country belonged, and with whom we had taken up our residence, he informed us, that during the excessive heat of the summer months, the travelling boors, for the sake of the shade afforded them by the trees, were in the custom of stopping during the day, and kindling fires to cook their provisions; that at times they fell asleep, leaving them burning; and that, during that period, the fire communicated to the smaller roots of the trees, with which the soil is there completely interwoven. From these, it gradually passed to the main root, then up along the trunk, destroying entirely the inside timber, and leaving the surrounding bark uninjured; and, in that way, the finest trees slowly and insensibly fell victims to its destructive ravages. In the above described manner, it propagated itself, by means of the roots, from one tree to another; until, at times, to put a stop to its destructive progress, the proprietors are obliged, with great labour, to dig a deep trench, so as to insulate the whole extent of forest attacked by the fire.

In the immediate neighbourhood of the great towns of the Russian empire, I may now remark, the Pine tribe of trees do not present themselves, with the exception of a few straggling ones here and there; these situations, in general, being occupied by the different varieties of Birch. They are found in greatest perfection in the interior of the country, and at a distance from the residence of man; the density, durability, and consequently the value of their timber, increasing as they approach within a certain distance of the North Pole, owing to the severity of the climate. From this cause also, the great superiority of the timber of more northern countries, over that of Great Britain, which in the market does not bring one half of the price, depends. Beyond a certain distance, however, they gradually diminish in size, and at length cease to exist. In these northern parts of the world, a sheltered situation, and good soil, appear to be of great utility to the growth of the trees: as those situated under such circumstances, are always far superior to those growing upon an exposed and poor soil.

The *Pinus sylvestris*, besides a great variety of other important purposes to which it is applied, from the quantity of turpentine, or inflammable matter which it contains, is used over the extensive empire of Russia by the natives, to supply fuel, and as a substitute for candle. For the latter purpose, the trunk of the tree is split into laths, or thin pieces, above a yard in length, which are kept drying in the interior of the house, during the winter. When a stationary light is required, they fix one of these in a sort of wooden stand, with which every isba or cottage is supplied, furnished with an iron spring which holds it in a horizontal direction; they kindle it at the lower extremity, when it burns slowly up, with a clear and brilliant flame; the cinder, or charred wood, either being removed at intervals, or gradually falling away of itself. When a moveable light is wanted, they carry one from place to place in their hands, supplying a fresh one, as the other is consumed.

For my present purpose, it is necessary that I should state, that the *Pinus sylvestris* also exists in the Highlands of Scotland in great abundance in its natural state, but principally in its cultivated, or artificial one; and that to this day it is used by the poor peasantry as a substitute for candle or oil. The reverse of the natives of Russia, however; they make use of the roots, which they dry, and which furnish a pure, clear, and abundant light, burning completely away, in the erect position, like a candle; an evident proof that the root contains more inflammable matter, or turpentine, than any other part of the tree; and this the experience of ages has tended to confirm. In the Highlands, also, immense numbers of the stumps of fir trees are to be found in the mosses, where they have remained for ages, covered by a thin film of vegetation, all of which would furnish turpentine by distillation. I shall now proceed to describe the manufacture of turpentine from the stumps and roots of the *Pinus sylvestris*, or Wild Pine, as carried on by the boors of the interior of Russia, which, with the addition of a few improvements, I am of opinion may be introduced with great advantage into Britain, particularly the Highlands of Scotland; and the introduction of which, to the notice of this Society, is the sole object of these pages. Before doing so, however, it may be necessary that I should recal to the recollection of my readers, the method of procuring it, at present in use in France and this country; which I shall extract from Dr Rees's Encyclopædia.

'Common turpentine is about the consistence 'of honey, and is obtained from the wild pine '(*Pinus sylvestris*), which is extremely resinous, 'insomuch, that, if not evacuated of its juice, it 'often swells, and bursts. The tree is at perfec'tion when about seventy or eighty years old, 'but is fit to yield turpentine at the age of forty. 'Those trees which are most exposed to the 'sun, and have the thickest bark, afford it in the 'greatest abundance. The operation for pro'curing it commences in the month of May; 'the outer bark is stripped off for six inches, so 'as to expose the inner smooth bark, near the 'foot of the tree, and a wound is made with a 'sharp tool three inches square, and an inch 'deep. The resinous juice soon begins to exude 'in transparent drops, which fall into a hole pre'viously dug at the root of the tree; fresh inci'sions are repeatedly made till September, when 'the cold begins to check the further exudation.

'The warmer the weather is, the greater quantity of turpentine is obtained; and a healthy tree may thus yield from six to twelve pounds of turpentine annually for a century of years. Part of the juice concretes in the wounds, and is called Galipot in Provence, and Barras in Guienne: but although it contains oil, yet it is not used for the purpose of procuring it. The proper turpentine is purified by being exposed to the sun's rays in barrels perforated in the bottom, through which it filters when liquified by the heat.

'The juice, as it issues from the tree, is sometimes received in trenches made in the earth, and afterwards freed from its grosser impurities by colature through wicker baskets. The cones of the tree appear to contain a resinous matter, of a more grateful kind than that of the trunk; distilled while fresh, they are said to yield a fine essential oil, called by the Germans Carpathicum Oleum, much superior to that of turpentine.

'The oil of turpentine is obtained by distilling the resin with water in a common still, when the oil is found in the receiver, swimming on the water, from which it is easily separated. The average proportion is 60 lib. of oil from 250 lib. of good turpentine. This process is carried on both abroad and at home; but the oil drawn in this country is always preferred.'

My readers will particularly observe, that the process now described is entirely different from that made use of by the natives of Russia, which I shall presently give an account of, and which I wish to introduce into this country. In the usual process, the oil of turpentine is supplied by means of a *complicated*, *tedious*, and *expensive* operation, from the *trunk*, or valuable part of the tree, whilst in its growing state; to which, from the destruction of the bark, and other causes, it cannot fail to prove injurious, and which contains a proportionally less quantity of the turpentine. Whereas, in the Russian one, it is furnished by the simple process of *distillation alone*, without any expense of fuel (which is supplied by the refuse chips of the boiler left from the former distillation), and is obtained from *the roots and stumps* of the tree, which remain in the ground after the trunk is cut down, for other more valuable purposes; which roots, &c. otherwise become an incumbrance to the land, abstracting the nourishment of the soil from the surrounding trees, preventing agriculture, &c. and which contain a much greater quantity of the turpentine, or inflammable principle. It can be no disgrace, I may also add, for an enlightened people to be indebted for a simple process to the rude and uncultivated boor living amidst the forests of Russia.

To furnish turpentine, what may be called the useless parts of the fir tree, (viz. the roots, and the lower part or base of the trunk, which remains in the ground after the tree which affords it is cut down), are alone made use of, by the peasantry of the interior of the Russian empire. These being dug from the earth, during the summer months, when the surrounding soil is soft and covered with snow, are conveyed to the distilling houses, in which they are collected, to furnish in-door work during the dreary winter. I cannot give a better account of the preparation of the turpentine from these, than by describing it, as witnessed by myself repeatedly, at the residence of the nobleman already alluded to, upon the borders of the White Lake.

The second day after my arrival, I made an excursion in the neighbourhood of the mansion-house, during the course of which I arrived at a wretched building, situated upon the margin of the forest, at the door of which two Russian boors were busily employed, with their hatchets, in cutting into small chips the stumps, and dried roots of fir trees, which had been previously dug from the earth, and were lying collected together upon the surface of the snow. Upon going into the interior of tho wooden shed, or building, there was a fine clear fire burning, and two old boors distilling turpentine from the chips of fir wood broke down, as already noticed, by their companions. In the centre of the apartment there was a brick furnace, with a clear fire burning in it, and a large iron boiler built in above it. The boiler was completely filled with the cut chips of wood, and a quantity of water; the flame of the fire reverberating upon its under surface. From the top of the boiler, which was accurately and neatly covered up with a close lid, a spiral iron tube passed out, and entered a large wooden vessel placed within a short distance from it, which originally had been completely filled with snow and ice, but which, by this time, were almost entirely converted into warm water, by condensing the heated tar and vapour which passed from the boiler. Within the vat, this spiral tube formed a tortuous worm; and again passing out at the opposite bottom of the vessel to the end of it, a long glass bottle was luted, which received the turpentine as it dropped from the tube. One side of the house was filled with the recent cut chips of the fir wood, which had not as yet been put into the boiler; whilst the other side contained those which had come out from it, from which the turpentine had been extracted, and which were now used as fuel to supply the fire.

A little after my arrival, the distillation was completed, and the boors removed the bottle, which was rudely luted, by means of clay, from the tube. Upon examining its contents, I found that the under half of it contained water, whilst the upper one contained the empyreumatic oil of turpentine, which, from its less specific gravity, naturally rises towards the surface. In order to separate it from the water, these Russian boors took a very simple method, and, at the same time, one very characteristic of a barbarous people. The bottle, which was of coarse green glass, had a very minute hole bored in the bottom of it, which was stopt up with a small wooden plug. They removed this plug, and allowed the water gradually to escape, until the turpentine made its appearance at the hole, when they replaced the pin, and poured the turpentine into another bottle, for preservation; which constituted the whole process.

Upon requesting to see the quantity of turpentine which they had made in the course of the day, the old Russian brought from the corner of the house a bottle, which might contain from four to five pounds, if my memory does not mislead me; and this, as already mentioned, was entirely procured from the stump, and roots, which remained after the trunk was cut down, and which could be applied to no other use.

Distilling houses, similar to that now described, are to be met with upon the estates of the different noblemen, or landed proprietors, in the northern parts of the Russian empire. Consequently, an immense quantity of turpentine must be procured in this way, during the course of the year, both for public and private consumption. It produces a great advantage also, in affording in-door work for the boor during the severity of a long and dismal winter. Turpentine, I must also add, is an article every year increasing in consumption, and consequently in value, throughout Great Britain. It is supplied to us principally by foreign countries: the manufacturing it therefore in our own, must save money, both to the public and to individuals.

I shall now conclude with the following queries.

1*st*, Might not this rude process of procuring turpentine, from the *useless part of the trunk*, and the *roots*, of the *Pinus sylvestris*, practised by the boors of the interior of Russia, be followed with advantage and emolument, upon an improved scale, in Great Britain, and particularly in the Highlands of Scotland?

2*d*, Would not the digging up, and removal of the stump and roots of the trees, for this purpose, (being attended with emolument in place of expense), from the ground at one period occupied by fir plantations, much of which exists in Great Britain, facilitate greatly the bringing of it into cultivation, and a state fit for producing grain?

3*d*, Would not the distillation of turpentine, from the stumps and roots of the *Pinus sylvestris*, if carried on by enterprising individuals upon a large and improved scale, in the Highlands of Scotland, where this tree exists in abundance, add considerably to the emoluments of the landed proprietor, and also benefit, to a considerable extent, the revenue of the country?

Lastly, All these circumstances taken into consideration, Would not subjecting the above proposal to a fair trial, merit well the attention of the Highland Society of Scotland?

P. S.—I would also strongly recommend the *Pinus larix*, the larch tree, to be submitted to experiment, to furnish turpentine. Upon the Ural and Oloncate mountains, upon the authority of Pallas, the peasantry obtain a considerable quantity of turpentine annually from this tree.

N. B. To prevent ambiguity, it may be necessary to state, that, in making use of the word *Turpentine* throughout these pages (with the exception of the quotation from Dr Rees), I mean the oil (*Oleum terebinthinæ*), never the resinous matter (*Resina*), from which it is distilled.

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ESSAY

ON

THE APPLICATION OF TIMBER TO THE CONSTRUCTION OF A BRIDGE.

By Mr GEORGE ROBERTSON, of Bower Lodge, Ayrshire.

THAT a wooden bridge, on a small span, may be constructed of an elegant form, and at a small expense, is a fact on which no doubt can be entertained. But, that timber is applicable to the construction of a bridge on a great scale, and at a comparatively small expense, and still capable, without being under propped, of sustaining a great weight, is a fact to which not much attention has been paid, or, at least, has been very little acted upon.

To demonstrate this, it is first necessary to inquire, what sustaining power timber possesses, and which, on mechanical principles, confirmed by experience, is found to be in proportion to the *square of its depth.*

Plate I. fig. 1. Thus, suppose *a a* to be a rod of fir an inch square, suspended over two props, P P, at the distance of 36 inches, and is found capable of sustaining 120 lib. in a weight w, suspended over it from the centre, C, (which, although it bends it downwards considerably, is still unable to break it). Now, if to the rod *a a*, there be an additional rod, of the same dimensions, laid over it, as represented by the dotted line *b b*, and a weight suspended from the centre over both, it will be found capable of sustaining *four* times the quantity, or 480 lib., although it contains only twice the quantity of wood. In like manner, if another rod of an inch square be laid over both, as represented by the dotted line *c c*, this combined quantity, though only three times the original quantity in the rod *a a*, will sustain *nine* times the weight, or 1080 lib. in all.

From this it may be shown, that a sustaining power may be given to timber in a manner *unlimited*, as it may be augmented geometrically, or in proportion to the *square* of the depth, *ad infinitum*. Thus, if we lay 12 rods, of an inch square each, over one another, or a 12-inch deal (inch thick) set on edge, under propped as above, this deal, or the 12 combined rods, will sustain a weight, compared to one inch, as the square of 12 (144) is to the square of one, or 144 times, equal to 17280 lib.; and in the same ratio, any given quantity in depth, to any extent. But if, instead of piling one rod *above* another, we lay

Fig. 1.

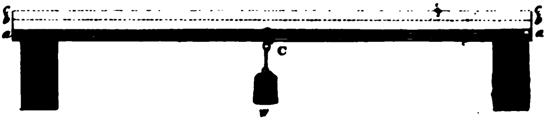


Fig. 2.

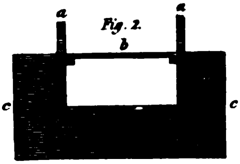


Fig. 3.

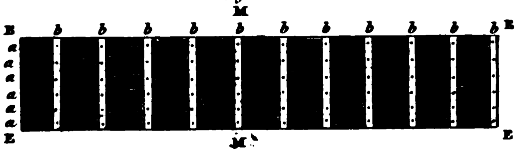


Fig. 4.

Fig. 5.

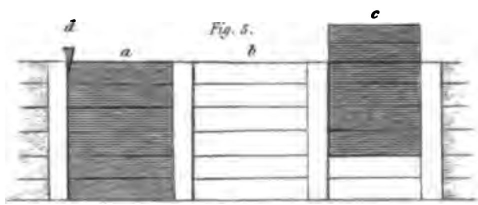
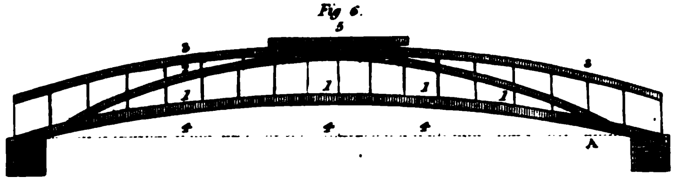


Fig 6.



FOOT-PATH BRIDGE.

Fig. 7.

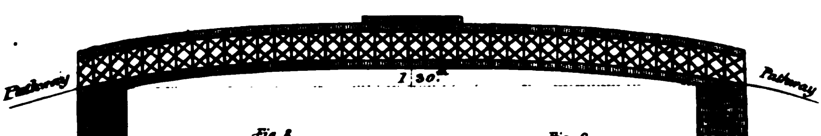


Fig. 8.

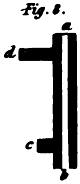
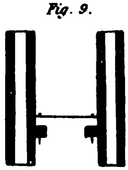


Fig. 9.



the two rods *side by side*, making a piece of wood two inches boad and one inch deep, the sustaining power acquired by this mode of combination, would be merely in proportion to the actual quantity of wood, or, as two to one, = 240. Or, if a deal 12 inches broad were laid *flat* in the above circumstances, it would sustain only 12 times what an inch square would do, or 1440 lib., or one-twelfth of what it would do if set on edge.

Again, in the converse proportion to the distance of the props, so is the sustaining power of the timber—the *greater* the distance, the *less* is the strength, in *arithmetical* proportion. Thus, as above, at the distance of 36 inches betwixt the props, an inch rod can sustain 120 lib.; were the props to be set at 72 inches, or double the distance, it would be able to sustain 60 lib., or one half only; or, were the distance to be diminished one half, or to 18 inches, it would, with equal ease, sustain double the weight, or 240 lib.; and so of any other dimensions or distances. Now, let us apply these principles to practice.

	lib. weight.
If a rod an inch square, at three feet distance of under props, can sustain 120 lib., at 60 feet of distance, or 20 times farther, it could sustain only one-twentieth part, or	6
But 2 inches deep would sustain four times this, or - - -	24
3 inches deep would sustain nine times this, or - - -	54

	lib. weight
6 inches would sustain four times this last, or	216
12 inches would quadruple this, or	864
Were the distance to be prolonged from 60 feet to 100, the sustaining power of the last number would be reduced in proportion (the converse), as 60 is to 100, or	518
2 feet, or double this depth, would sustain four times this, or	2,072
3 feet would sustain nine times what one can do, or	4,662
Let the distance be again prolonged, and extended to 150 feet—This would reduce the sustaining power as 100 is to 150, or to two-thirds of the above—hence	3,008
Let the depth be augmented to 4½ feet, the sustaining power would be augmented as the square of 3 = 9 is to the square of 2 = 4, or to	6,728
Such would be the power of a combination of deals above deals to the depth of 4½ feet, and at one inch thick. But were it to be planks of three inches thick, the sustaining power would be thrice the above, or	20,184
Were this depth to be augmented to 6 feet, the sustaining power would be augmented as the square of 4 = 16 is to the square of 3 = 9, or to	35,882

It must, however, be adverted to, that in calculating the sustaining power of timber, suspended as in this instance, its own weight makes part of the quantum. Hence this will require to be deducted, before the *free sustaining power* is ascertained. This may be found by calculating the quantity of square feet in the timber employed; and, multiplying the result by 35 lib., will give the quantum of weight. Hence, in this instance, 150 feet long by 6 feet deep, = 900 feet, and this by 3 inches thick, or ¼th of a foot, gives 225 cubic feet, which, at 35 lib. each, amounts to 7875 lib., which, deducted from 35882, leaves 28007 lib. of free sustaining power of a piece of timber so combined, extending across an expanse of 150 feet in length;—which, so far as known to me, is more than any architect has ventured to throw a stone arch, in Great Britain; the longest being that at *Pontitipred* in Wales, which is 140 feet span. Now as, in forming a wooden bridge, two sides (betwixt which the road-way will be suspended) are required, hence each of them being of the dimensions as above, will, in conjunction, possess a free sustaining power of more than 56,000 lib., or 25 tons weight; and this, not in equal portions over the whole extent, but altogether on its weakest point, the centre,—over which, however, it may be remarked, that there can hardly ever be one-tenth part of that weight at a time.

The *section* represented in Plate I. fig. 2., will serve to show how the road-way may be connected betwixt the two sides.

a a, the two sides; *b*, the floor or road-way; *c c*, the landstool, or buttress, on which the bridge rests on each side of the water.

It is necessary also to show how the sides may be built or connected together, each in all its parts. The *elevation* of a part (Plate I. fig. 3.) may give an idea of this.

a a a a a a, represents the horizontal planks, stretching across from side to side of the river, lying, each, one above another; *b b b b b*, upright spars on each side (one side only seen), opposite to each other, and connected firmly together by small screw bolts represented by the dots, and which, in conjunction, connects the whole side into one solid piece. This adds in a considerable degree to the *expense* of the construction, and also to its *weight*; but, on the other hand, it adds *vastly* to the *strength* of the fabric, making *every part* combine equally to resist the pressure, and to sustain it. For before the weaker part, at the middle M M, can bend downwards, or have a tendency to yield, the *under* tire of planks must separate *outwards* from M to E on each hand; while the upper tire will be impelled to the opposite course of condensing more closely on each hand from E to M, so that all will combine, though in opposite directions, to preserve the horizontal position, or, in other terms, to prevent breaking.

But a still more efficient mode of construction, consists in dividing the whole thickness of plank required into three equal parts—two sides and a middle, in which *a a* of the same figure represents the outsides, having the upright pieces *b b* inserted in the middle; the whole connected (as before) through and through by small screw bolts. The intermediate spaces betwixt the upright bars is filled up by pieces of wood, correspondent in size, firmly driven home like to a wedge, giving an additional tenacity to the whole, as in Plate I. fig. 4.

a a, and *a a*, the outside deals, supposed in this instance to be an inch thick each; the intermediate space an inch wide, which is filled up by upright pieces going, from top to bottom, through the whole, and connected to the two sides by screw bolts. The spaces represented as vacant betwixt these are afterwards filled up by pieces of deal, inch thick, laid lengthways, that they may be more incompressible; as in Plate I. fig. 5., where one space *a*, is represented filled up; another *b*, as open; and a third *c*, as in the act of filling; also, *d* represents a wedge driven hard into the filled up space *a*, to make it still more close. This compact filling has the effect to give the whole an archiform tendency, although originally constructed on a plane, insomuch that, in forming a foot bridge of 60 feet span, the work, in the carpenter's hands, rose two inches in the centre while in the act of making, in consequence of these wedges. Indeed, a bridge or beam constructed in this mode becomes almost incompressible. It may be *crushed* by preponderating pressure, but *bend* it hardly will. But a more assured mode of giving strength to a bridge on this principle, is to form it *archwise*, which is done with very little additional trouble, and is made at greatly less expense of timber, and is of course lighter,—both points of considerable importance; whilst it must add greatly to the strength, though in what proportion I have no *data* on which to calculate, beyond what may be anticipated from such an overloading as may induce a *crush of materials*; a catastrophe that perhaps neither iron nor stone is altogether exempted from, no more than timber—only not to the same degree.

Plate I. fig. 6. is the sketch of a wooden foot bridge at Eglinton Castle, in Ayrshire, erected in April 1814. The span is 60 feet. The arch No. 1. is 15 inches deep, and elevated in the centre about two feet above the chord or dotted line, 4 4 4. The arch No. 2. is $7\frac{1}{2}$ inches; and the upper arch, No. 3, is $4\frac{1}{2}$ inches; forming in all a combined depth of 27 inches, exclusive of the straight bar 5, over the centre, which is six inches deep. The whole is composed of inch thick plank; one on each side of the upright spars, which are also inch thick, and all of fir wood. It is all connected together in one piece with driven large nails, instead of what would be a more correct mode, small screw bolts. The pathway is 3½ feet wide, and is carried along the line 1 1 1 1, immediately above the under arch, and in contact with it. The whole was made in two weeks by two country wrights, who put it together on the adjacent dry land, from whence it was *launched* or drawn to its site by means of a windlass with ropes, winded by two men. The *strength* has hitherto (February 24. 1819) met with nothing that can indicate a failure, as it is wholly incompressible from any weight that has yet come upon it. Nor do I suppose it could be *crushed* with any pressure under ten, or, it may be, fifteen tons. It underwent a remarkable trial in the following winter after it was built, when, from an unprecedented rise of *floating* ice, pieces perhaps a ton weight came bounce upon it at the mark A, and fairly cut out there a piece from *the whole of the under arch* on one side, about four or five feet in length;—an occurrence that would have been fatal to any bridge of ordinary construction; but this passed quite harmless—the bridge did not decline a hairbreadth, being held in its original situation chiefly by the hand-rail or upper arch, No. 3, as the second arch, No. 2, besides being itself shattered by the shock, does not reach quite to the landstool or buttress. The bridge, of course, was repaired afterwards at leisure. It remains merely now to state, that the intermediate spaces in the sketch betwixt the upright spars, are filled up with fancy-work, but which neither adds to nor diminishes from the strength of the fabric. The quantity of timber, in all, including the pathway of 1½ inch plank, extends to about 130 cubical feet, and cost (wood, iron, and work) about 48*l.* From the difference in the price of timber now (1s. 6d. per foot, instead of 4s.), such could be erected, at present, for less than 32*l.*

This mode of constructure would, if adopted, be a vast improvement on *the ordinary footpath bridges* in the country, which are almost uniformly composed of heavy logs of wood stretched over, under supporters, at even the moderate distance or width of 20 or 30 feet from bank to bank; whilst their hand-rails, instead of adding to the support, as they would if built into the underworks, always operate as an encumbrance only, from their weight. At every flood, too, more especially in winter, when the waters are loaded with floating ice, the under props are broken away, and utter demolition of the bridge takes place; notwithstanding that its aggregate quantity of timber is much more than is required in this new mode of construction. To a stretch of more than 30 feet without under props, in the usual footpath bridges, there is perhaps not an instance. But, were the new mode, as above, adopted, with the greatest facility, and at a much less expense, bridges for footpaths could be made to stretch over waters not only 45 feet broad, or less, but over those that are 60, 90, 100, or more, even to 500, without any under propping at all, and with every required security.

Foot-path Bridge, (*Plate I. fig.* 7.)

The scale on which this view is drawn is *general*, being determined by the elevation of the arch above the chord, which is here supposed to be at one-thirtieth part, and of course the rise of the pathway, were it on a straight line, would be one foot in fifteen. It is not proposed as a pattern of elegance, but merely as an example of economy in the construction, from which the following are the deductions.

1. Suppose the width betwixt the landstools to be 45 feet, the rise of the arch above the chord will be 1½ foot. The depth of the two arches in conjunction will be 11 inches, and capable of sustaining 4840 lib. on its weakest part, the centre—will require about 45 cubical feet of fir to construct it in all its parts, and will cost about 8*l.* The pathway, for the sake of strength, only 2 feet broad—the side open rails 3 feet deep—the strengthening beam over the centre, one-fifth part of the whole length, and 3 inches deep.
2. A similar bridge of 60 feet span, would rise 2 feet above its chord—would support 5070 lib.—would require about 64 cubic feet—and would cost about 11*l.*:—the pathway in it 27 inches.
3. A bridge 75 feet, would rise 2½ feet—would support 5400 lib.—would require about 86 cubic feet, and cost about 15*l.* In this the depth

of the two arches conjoined is 15 inches; in the preceding one it is 13:—the pathway here 30 inches.

4. If 90 feet span, the depth of the arches will be 16½ inches, the rise will be 3 feet—it will support 5440 lib.—will require about 113 cubic feet—and will cost about 22*l.*:—the width of the pathway in this, 3 feet. The thickness of the sides, on which the upholding of the whole fabric depends, is in all these cases 2½ inches; namely, each of the sides ¾ inch deal, and the upright connecting spars one inch thick, four inches broad, and set in at 12 inches of distance from each other—all of fir. The calculated power of support is on the supposition of being the whole constructed on a *plane*, not an arch, and no allowance is taken for the strength obtained from the connecting upright bars:—of course a vast deal more power may be reckoned on, than what is stated. On the other hand, no deduction is made for the weight of the bridge itself; it being concluded that this is much more than provided for by the *curvature* of the construction, and the strengthening obtained from the whole being combined into one solid mass by the connecting upright bars.

In the process of making such a bridge, (which should all be made on dry land adjacent to the place where it is to be cast over), the wrights will be at first much alarmed, when a *side*, by itself, is reared upwards to a *plumb* position. For, on account of its being so very *thin* in proportion to its *length*, it becomes so *limber*, or supple, as to wave backwards and forwards like an eel, thus

This may be prevented in a great measure, by having the support for the *floorway* attached firmly to it, before an attempt is made to raise it on edge. Thus, in the section view, (Plate I. fig. 8.) *a b* represents the side deals, with the upright post betwixt them, and *c* the floor supporter, which contributes greatly to correct the limberness. Should it not be found quite sufficient, a temporary addition may be made to it as at *d*, which will keep it quite steady. This may be *tied* on with ropes, till such time as both *sides* are got to their proper position, when the inputting of the floor, as in fig. 9, keeps all fixed.

In calculating the cost of each bridge, regard is had to the present price of best fir, being about 1s. 6d. per cubic foot: 2s. more is allowed for workmanship and nails. No estimate is made of the mason work, there being no data on which to go; and this must vary according to circumstances. It can hardly however exceed, for such light fabrics as these, above one-fourth part of the whole expense: probably much less may do.

Such may be the constructure as to form and strength for wooden bridges, intended merely for foot passengers; but for a bridge intended for horses and carriages, it must be made vastly stronger, perhaps in no instance of less strength than to sustain 30 tons on any part of it. In this view of it, the sketch represented in Plate II. fig. 1. is submitted to consideration.

The scale is *general*, being adapted to a bridge of any span, from 60 feet to 600, more or less. The rise of the arch being, in all cases, 1-30th part of the chord, whilst the represented depth of the arch A A, and of the straight beam B B, as well as of the intermediate flanks betwixt them, is in the same ratio; but the depth of the hand-rail R R is, in all cases, supposed to be 3 feet, which in the above sketch corresponds only to an arch of 60 feet span. In this instance the depth of the arch is 20 inches, the beam laid over it 6, and the upper beam 4;—in all 30. The centre beams, 1 and 2, are inserted partly for ornament, but more directly to add to the strength of that part, if required, which, instead of allowing it to be the weakest, as its central position naturally makes it, ought to be made considerably strong, so as to serve as a point of *appui* to the weaker parts at C C, which, without such aid, are, from relative situation, liable to be depressed, having no adequate support beyond them nearer than as far as A respectively, being four times the distance that each is from the centre. It is there-

Fig. 1.

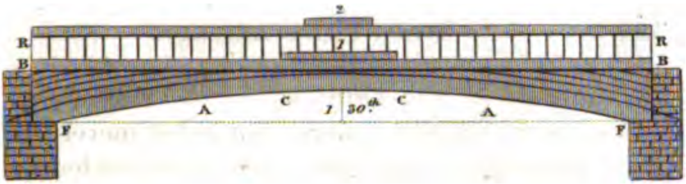


Fig. 2.

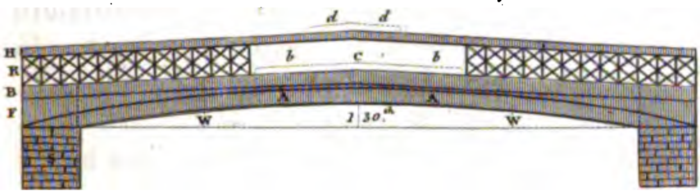


Fig. 3.

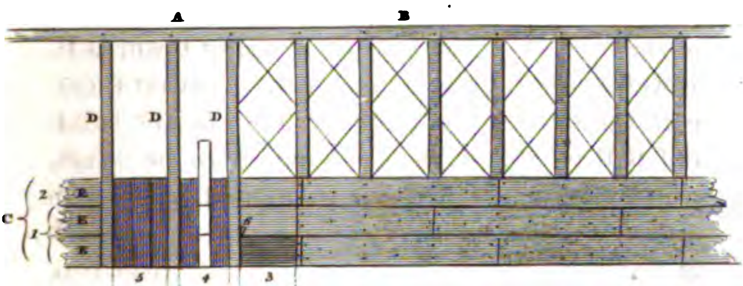


Fig. 4.

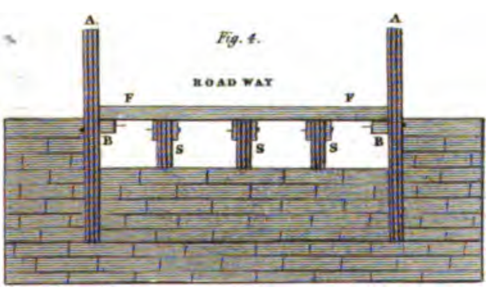
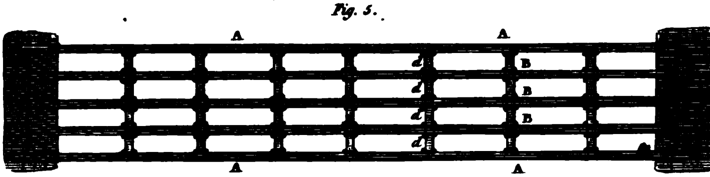


Fig. 5.



fore of essential importance, in a bridge of this description, that the centre be strongly strengthened, in order to check the impulse of weighty bodies, which otherwise would be felt along the whole line, from the one landstool to the other.

In the preceding plan, there are two circumstances that are perhaps objectionable. The *first* is, that the depth of the flanks at F F is too great in proportion to the depth of the arch A A, and the horizontal beam B B, at the centre, being of necessity equal to the rise of the arch from the chord (= $\frac{1}{30}$ of the width of the span), in addition to the deepness of the arch and deepness of the beam in conjunction;—whilst, *2dly*, the pathway is thus thrown altogether on a level along the under edge of the beam B B. It would be better that this had a declivity from centre to flank, that the rain water might the more easily be carried off. To obviate this, the form might be as represented in Plate II. fig. 2. where the arch A A is supposed to be 60 feet span; to rise $\frac{1}{30}$ or 2 feet at the centre, and to be itself 12 inches deep: the floor-plank B to be 9 inches, and the upper, or hand-rail H, to be 6 inches, forming in conjunction a depth, at the centre, of 27 inches; the flank F, the same depth with the arch, or 12 inches; forming, in conjunction with the three other parts mentioned, a depth of 39 inches over the landstool S. The average depth of the whole conjoined, is at the medium, or weakest parts W W, 33 inches; and it is from these points, (half way betwixt the centre and land-stools), that the power of sustaining is in all cases calculated, as it is supposed always that the centre at C is rendered *insuppressible*, (by any weight that there is any chance of ever being brought upon it), either by means of the additional bars *b b*, or *d d*, that may be augmented at pleasure, or by a mode of forming the floor-way that shall afterwards be explained. The tessellated rail R, is supposed in all cases to be 30 inches deep; forming, in conjunction with B and H, a depth of 45 inches. Though it might be shown that this gives a considerable addition to the sustaining power, it is not, however, taken into account. The other various circumstances, such as the quantity of timber required, the quantum of sustaining power, the expense of the whole, &c. &c., will appear in one general Table in a subsequent page; but, before giving this, it is necessary to state on what principle the floor or road-way is formed, and how constructed.

Though the *form* of construction has already been explained, yet it will appear more precisely in the *side* view of a part, on an enlarged scale of half an inch to a foot, (Plate II. fig. 3.); and supposing the whole to be *straight*, without regard to curvature in the internal arrangement. In the division A, the under part C is shown unfinished, having only the offside planks E E E, laid against the inside upright posts D D D.

No. 1. shows two planks, each 6 inches deep, forming together the whole of the arched work in a bridge of 60 feet span. No. 2. shows the straight plank, 9 inches deep, that is laid in immediate contact, and above that arched work. The interstice above No. 3. is filled up, as far as the under plank No. 1., with a piece of deal correspondent in size, put in crossways, and rendered still more firm by a wedge, No. 6., driven in at top. When an interstice is filled up in this manner, it is always finished off plank by plank, as they are laid on. No. 4. shows how an interstice may be filled up by pieces of wood laid lengthways; two first, (one on each side); and a third, somewhat larger at top than the vacuity, but which is driven home like to a wedge, rendering the whole as firm as possible. No. 5. shows an interstice finished in that manner. One can hardly conceive which of these modes is most effective, nor what degree of pressure from above should be able, either to break them or to tear them asunder. Of course, they must add greatly to the general strength of the fabric, as the planks on each side are closely connected to them, and to each other, by screw bolts, whose heads are represented by the dots in the division B, which is shown as in a finished state, and nothing appearing outwardly but the planks themselves.

In this division, B too is represented as divided each into pieces of 4½ feet in length, attached to four upright posts, stretching over two entirely, and fastened at both ends to other two, where a separate correspondent piece meets on the middle of these, each having there its own attaching small screw bolts. The breadth of the road-way 9 feet, composed of planks 2 inches thick and 9 inches broad, supported, as shall now be explained, in the section view given in Plate II. fig. 4.

A A, upright sides of the bridge, resting on a land-stool of masonry. F F, the floor of 2 inch plank, resting on the supports B B of the sides, and on the three under beams S S S, 15 inches deep, which rest on the mason work, at equal distances, directly under the carriage-way in the middle of the road, whereby each of the floor-planks, 9 inches broad and 2 inches thick, which at the centre could have supported only about 1600 lib. will, with these under beams, support 6480 lib.

The floor *lengthways* is supported on the principle of the roofing of a house, (Plate III. fig. 1.), only on a lower elevation; namely, on a rise of one foot in 30 from end to middle, resting at the centre on a strong plank *a a*, set edgeways, where the two sides meet, and firmly connected to it by screw bolts, but which (whilst the ends resting on the landstools cannot move back) have no tendency to separate; more especially as these ribs S S S, (Plate II. fig. 4.), are bound together at different parts (as in Plate II. fig. 5.) by the bracers *d d d*.

Fig. 1.

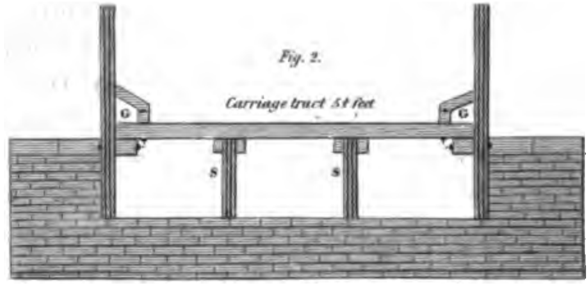


Fig. 3.

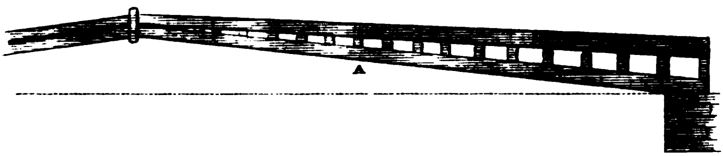


Fig. 4.

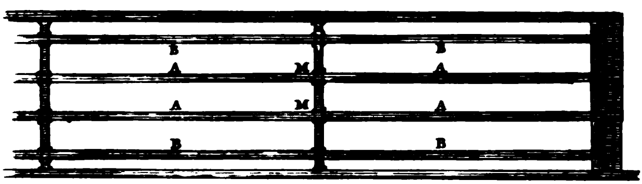
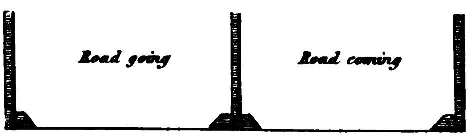
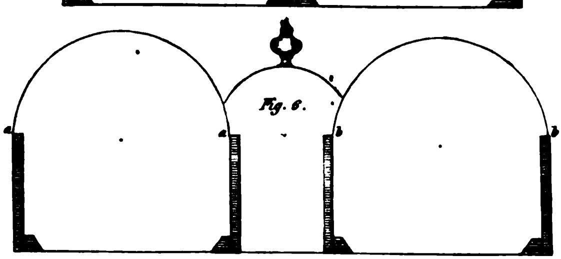


Fig. 5.

15 feet from outside to outside





In constructing the *sides*, however, as in the figure described of a timber bridge, it is evident, from what was previously shown, that its power is augmented rapidly by adding to the depth, being in proportion as a *square is to its root*, or as 4 is to 2, 9 to 3, 16 to 4, and so on *ad infinitum*; also, it is augmented by adding to its thickness, in *plain proportion*, as 2 is to 1, or as 4 is to 1, &c. &c.: it therefore possesses great powers of effect from augmentation. But in constructing a *floor*, no such advantages arise; for, on the contrary, the extension of it *in breadth* diminishes its power; and adding to its thickness, although it adds to its tensity, yet diminishes to a certain extent its power of sustension, by the addition thus made to it by its own weight. It becomes therefore particularly requisite, that the floor be no *wider* than the carriages that travel along it require, nor no thicker than necessary (without any risk of breaking) to support the weight that comes upon it. These circumstances being held in view, the mode of construction of an *end* view, as represented in Plate III. fig. 2. is submitted to consideration, on a scale of half an inch to a foot, adapted to a span, as before, of 60 feet.

The width betwixt the two sides is here 7 feet, and being contracted at the floor, by the *safe-guards* G G, each 9 inches broad by 4½ inches deep, leaves a space of 5 feet 6 inches for a cart or other carriage to travel on. Carts are commonly set at 4 feet 2 inches (the wheels) of separation, at their *tread* upon the ground; and being also in general 3½ inches in breadth at the ring or shod, they hence occupy a space of 4 feet 9 inches on a road altogether. They will have thus 4½ inches extra room on each side, to traverse on this proposed bridge road-way;—quite sufficient, with *ordinary care*, whilst even double the breadth of the whole road would insure no defence against inattention in the drivers. Four-wheeled carriages and gigs occupy each about the same space.

From the sketch itself the construction may be understood. It is only necessary here to state, further, that betwixt the different supporters there are only 18 inches in length of vacancies; and that a plank of 2 inches thickness and 9 inches broad, will, in these circumstances, sustain a weight of 8640 lib. on the weakest of each space, which may be stated as fully more than three times of whatever weight can at any time come upon them.

The formation of the *sides* has already been explained. Plate III. figure 3. will show how the under supporters S S are constructed; premising merely, that it is still for a bridge of 60 feet span, in which the depth of the arched work at the centre is 12 inches, and of the flanks over the landstools is 24 inches. Hence these supporters will be formed to suit these proportions, and be 24 inches deep at the landstool end, and 12 inches at the centre, where they rest upon a common beam which at that point connects both ends of the floor into one firm mass:—Scale, two tenths of an inch to a foot.

The *Plan* view (Plate III. fig. 4.) will show how the under supporters are connected to each other and to both sides, at their weakest point A, half way betwixt the landstools and centre, same scale. The under supports A A, A A, are connected at their middle M M by pieces of plank 9 inches deep inserted betwixt them, and firmly tightened by *wedges*, and further secured by diagonal pieces of wood fixed in each corner by nails. The planks are laid *over* them. The rods BB, BB, 3 inches square, are *laid over the planks*, and attached to each by a screw bolt. These rods form part of the safeguards G G, plate III. fig. 2.

In forming the floor, besides the necessary strength required, there is another object to be had in view, namely, *durability;* and which again divides into two heads, as it respects *wearing*, from the treading of horses and carriages, and *wasting*, from the effect of rain or moisture. To guard sufficiently against both, is perhaps not practicable; but to a great extent, precautions may be effectual. One device is, to cover the whole road-way that is exposed with *sheet iron.* This is not so expensive an operation as might be supposed. Iron plate at an eighth of an inch thick, would be sufficient; for, while it would add greatly to the strength of the fabric, and

and would endure for a considerable period, it can be afforded for about a shilling the square foot, which, on a floor of 60 feet in length and 5½ feet broad, as in the present views, would extend to 330 feet, or 16*l*. 10s.; to which, if we add 1*l*. 10s. for nails and workmanship, would be accomplished for 18*l*., or at the rate of 6s. for each foot in length of the whole. It is to be observed, that this sheet iron can be obtained in various shapes and sizes—from 3 inches broad to 18 inches or more. The narrowest would perhaps be the most advisable to employ; from this consideration, that when any part is worn too thin (as in time they all must), it could be taken up and another put in its place, without removing those pieces that do not require it. I am here supposing the whole to be laid *lengthways* along the whole carriage way. A disadvantage may perhaps arise from this,—that from the uniform smoothness of the road thus clad, the horses might be apt *to slip*: But, on the other hand, it may be remarked that, from this very smoothness, the wheels will glide as easily along as on a railway; so that the draught being thus made vastly more easy, the horse in it, having less occasion for exertion, may keep himself more steadily on his feet, with less risk of sliding. Or, to obviate this objection—That part of the road on which the horses walk, which, when two are abreast of each other, may be stated at 4 feet—may be covered with a layer of inch-thick plank, laid in the same direction with the under planks, and always putting the middle of the uppermost over the joinings of the lower—and again connecting these upper deals by fillets of wood over their own joinings. This would afford a safe footing for the horses; to which, on each side, where the wheels run, let there be a covering of plate iron of 9 inches broad, occupying the whole space of 5½ feet. The expense of all this covering would be included within 10*l.* for a 60 feet bridge, or at the rate of 3*s.* 4*d.* the running foot. More devices may occur for the purpose proposed; but as either of these may be adopted with propriety, no other at present shall be brought into view. In the calculations in the following Table, of the expenses, &c. &c. of bridges of various extent of span, the rate of expense of this part of the work is taken at the highest rate, or 6*s.* the running foot.

TABLE

TABLE of DIMENSIONS and EXPENSE, &c. of WOODEN BRIDGES, being *single* Road-way 7 Feet wide, inside, each.

I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.		XIII.	
											L.	*s.*	*L.*	*s.*
60	2	12.	12 + 15 = 27	24 + 15 = 39	33.	3.	78,408	134	140	274	68	5	86	5
90	3	8.	14.5 + 15 = 29.5	29 + 15 = 44	36.75	3.5	75,600	256	210	466	116	5	143	5
120	4	6.	17 + 15 = 32	34 + 15 = 49	40.5	3.75	72,900	384	280	664	164	0	200	0
150	5	4.8	19 + 15 = 34	38 + 15 = 53	43.5	4.	72,808	556	350	906	226	5	271	5
180	6	4.	21 + 15 = 36	42 + 15 = 57	46.5	4.25	73,505	760	420	1180	295	0	349	0
210	7	3.4	23 + 15 = 38	46 + 15 = 61	49.5	4.5	74,890	972	490	1462	365	5	428	5
240	8	3.	25 + 15 = 40	50 + 15 = 65	52 5	4.5	74,412	1184	560	1744	436	0	508	0
270	9	2.333	27 + 15 = 42	54 + 15 = 69	55.5	4.5	73,908	1372	630	2002	500	5	581	5
300	10	2.1	29 + 15 = 44	58 + 15 = 73	58.5	4.5	73,908	1590	700	2290	572	5	662	5
600	20	1.2	38 + 15 = 53	76 + 15 = 91	72.	6.	74,640	5056	1400	6456	1614	0	1794	0

Explanation of the Table.

Col. I. Width of span in feet.

II. Rise of arch in feet.

III. Comparative power of bearing at these different spans.

IV. Depth of the *sides* at the centre in inches; being, first, of the arch work; and, second, of the floor-plank and hand-rail in conjunction, in all cases 15; viz. $9 + 6 = 15$ inches.

V. Depth of the sides above the landstools, in which the flank F (see the figure) forms an additional depth, equal to the archwork.

IV. Medium depth, in inches, from which the sustaining power is calculated.

VII. Thickness, in inches, of the sides.

VIII. Sustaining power in lbs. avoirdupois—supposing the whole, plank by plank, to be laid loosely each above another, without calculating what power is gained by the archiform mode of structure, and the complete connexion of the whole into one solid mass—the horizontal side planks, with the interior upright spars connected by screw bolts—which must give a vast additional tensity.

IX. Cubic feet of timber in the sides.

Col. X. Cubic feet of timber in the floor or road-way.

XI. Total cubic feet of timber in the whole.

XII. Expense of sides and floor-way.

XIII. Total expense of the whole, supposing the floor to be clad with a covering of sheet iron, one-eighth of an inch thick. Timber is here supposed to be at 3s. the foot. As it can now be had for 1s. 6d., a great deduction from the expense will arise.

The preceding views and calculations are all formed on the supposition of a single road-way, barely sufficient to admit of one carriage passing at a time. In situations of a greater thoroughfare, where it may be required to have a breadth sufficient to admit of one carriage to pass another,—it will be requisite to give a double breadth, or rather a double road-way, separated from each other by a hand-rail in the centre—and the carriages to be strictly regulated to *go* in one track, and to *come* in another, so as never to interfere with, or to interrupt one another. The construction would therefore be of the form represented in Plate III. fig. 5.—Scale ¼ of an inch to a foot.

In this case the expense would be doubled; for although there be a saving of one upright rail in the middle, instead of two, (for one will serve for both roads), yet that one will require to be of double strength, which, if acquired by double thickness, as represented in this figure, will just cost double the expense. But it would be more scientifically constructed, were it to be made of the same thickness with the side rails; only to have less *open* work, and more *solid* work, in the proportion of 3 to 2, which would be a considerable saving in the expense. But that latter consideration is not to be talked of in works of this construction, where even a double bridge, of wood, is so remarkably cheap when compared with one of stone, more especially in the greater extensions of span.

Should it be required to have a separate *foot-path* in these bridges, the construction might be as in Plate III. fig. 6., where, in a breadth of 18 feet, there might be a completely sheltered foot-path of 3 feet in the middle, at an expense additional, not exceeding 1s. 6d. per foot in breadth of span. From the top of the side rails *a a*, an iron bar formed archwise might be erected; another from *b* to *b*, at such a height as to allow carriages to pass under. Also one from *a* to *b*, with a lamp at top.

The advantages to be derived from adopting this mode of constructing a wooden bridge, may be stated in few terms.

I. With respect to *Footpath* Bridges, which are already constructed in general of wood.

1. In this mode they are very superior in point of *strength*.

2. They require *less timber* to erect them.

3. As they are constructed *without* any *under-props*, they are free of all risk of being carried away by the waters in a flood, or by any thing that floats upon them; provided always that the land-stools on which they rest are raised high enough not to be overflowed.

Lastly, As they can be repaired piecemeal with the greatest facility, they can be kept up for ages.

II. With respect to *Carriage-way* Bridges—of which few examples are yet known, in this country, of their being built of timber.

1. I should not propose that a wooden bridge should be substituted for stone in general over any water that is less than 50 or 60 feet in breadth; for the assured durability of a stone arch at that moderate expanse should give it the preference: But wherever an arch of much more than 60 feet span is wanted, the expense becomes so great, that even the *coom* of wood required for it will be equal in cost to this kind of wooden bridge altother: And in cases where the water is so broad, that more arches than one of moderate stretch is required, the piers set in the bed of the stream to support them, are so liable to be beat down and swept away by a flood, that hardly a single season passes without some being destroyed by this

occurrence, notwithstanding of all the precautions yet devised, by professional men of acknowledged skill, to guard against it.

2. In all navigable waters over which a bridge is required, the interrupting piers of the stone arches occasions such a current in time of a flood below the bridge, as renders the navigation extremely difficult. The wooden bridge obviates this completely; for, having no piers, it presents no obstacle; and the water flows with no greater rapidity below it, than in any other part of the stream.

3. But admitting that a bridge of arches, with its several piers, may in every case be so strongly constructed as to withstand every land flood, with all its accumulation of floatage; yet there are many situations where it is desirable, for general accommodation, that a bridge should be set down, but which cannot be undertaken, either from the excessive depth of water, the impetuosity of the flow, or from unsteady foundation, that it becomes so extremely expensive, as to be almost impossible to found a pier within the stream; so that it cannot be attempted. The wooden bridge, in such a case, presents a ready resource; as it is calculated for almost any span, and requires no piers whatever.

4. There are cases, too, in which steep hollows or ravines occur in the track of a highway, so very deep, and at a breadth beyond the reach of any stone arch yet known, as to be, if not altogether

impossible, yet so very impracticable to throw a stone bridge across them, that the road must be led a great way about to avoid them. A wooden bridge could, with great facility, conduct the road across these, at a moderate expense; and, as before observed, with respect to footpath bridges, as it admits of being renewed piecemeal from time to time as required, it may be kept up for ever.

Lastly, The wooden bridge might even serve as a *conductor* to a coom of a stone arch, over a stretch that has never yet been conceived practicable by any architect in this part of the world. Suppose one of 600 feet span (as in China.) It could be over only some deep chasm that this would be required, or over a large navigable river, or narrow branch of the sea. Throw over, first, the wooden bridge, on which the workmen, as on a platform, would stand, and over their heads could erect a coom of any arch, of any required altitude. It would remain for the architect only to calculate the power of his own arch of stone to sustain its own pressure. Any additional weight, by passengers and carriages, that might at any time travel along it, would be but as a drop in the bucket. Should a bridge of this extent require 300,000*l.* to accomplish it, who would grudge a tenth part of that sum for the wooden conductor and its superincumbent coom? It could at same time be made for only one third of this tenth part, or for 10,000*l.*

Extract of Letter, MR ROBERTSON *of Bower-Lodge to* MR GORDON, *dated 12th February,* 1820.

After expressing thanks for Premium voted for his paper on Rail-Roads, the letter proceeds—

"In the mean time, I transmit to you *another Essay,* on another *subject,* which I should be glad you would lay before the Society, or Committee of the Society, at your earliest conveniency. For this I am looking for no reward, farther than the Society's approbation, if it should be found to merit it,—my object being to give the subject a *publicity* that it could not have so readily through any other channel, or at least through any individual exertion of my own. The subject is one that I have long had in view, and, from what you will observe on perusing it, has been brought to the test of *experience,* and been *successful* beyond even my own sanguine expectations. A wooden bridge, on the principles laid down, I could have no hesitation in constructing to the extent at least of 300 feet span, without an under-prop; and so formed or put together, that any piece of it, as it might be required, could be taken out, renewed and replaced, at any time; so that it might be kept in repair for ever.

" I am aware, however, that my definition of its mode of construction, and demonstration of its powers, is not so clearly laid down as to be obvious at the *first vidimus*, but will require some time and patience to investigate.

" I am," &c.

APPEN-

APPENDIX.

No. I.

List *of* Existing Members *of the* Highland Society *of* Scotland, *in November* 1820,

Distinguishing the Dates of their Admission; with a List of the Office-Bearers and Directors for that Year, annexed.

The late Duke of Argyll was the Original President of the Society:—since his death, the Dukes of Atholl and Montrose, and the late Duke of Buccleugh, have successively held that Office, which is now filled by the present Duke of Argyll.—By the Regulations, no Member can continue in the office of President more than four successive years.—Those marked thus ** have been Presidents; and those with * prefixed to their names have been Vice-Presidents; two of whom are elected annually, and two go out by rotation.

The following were declared Original Constituent Members of the Society in 1784.

Most Noble the Marchioness of Stafford.
* The Right Hon. John, Earl of Breadalbane.
The Right Hon. George, Earl of Glasgow.
* The Right Hon. Sir John Sinclair of Ulbster, Bart.
* Sir Ilay Campbell of Succoth, Bart.
Sir William Honyman of Armadale, Bart.
The Hon. Lord Bannatyne.
Sir Alexander Muir Mackenzie of Delvin, Bart.
Sir Benjamin Dunbar of Hemprigs, Bart.
Sir John Macgregor Murray of Lanrick, Bart.
Sir Ewen Cameron of Fassfern, Bart.
Donald Macleod, Esq. of Geanies, Sheriff of Ross-shire.
James Grant, Esq. of Corymony, Advocate.
General Alexander Campbell of Monzie.
Lieut.-General Duncan Campbell of Lochnell.

Archibald Fletcher, Esq. Advocate.
James Ferrier, Esq. one of the principal Clerks of Session.
John Campbell, Esq. Clerk to the Signet.
Charles Gordon, Esq. of Pulrossie.
Patrick Macdougall, Esq. of Macdougall.
Henry Mackenzie, Esq. Comptroller of Taxes.
James Horne, Esq. of Langwell.
General Alexander Ross, Colonel of the 59th regiment.
John Clerk, Esq. of Elden, Advocate.
William Farquharson, Esq. of Monaltry.
William Macfarlane, Esq. W. S.

1785.

** His Grace Jas. Duke of Montrose.
The Hon. Lord Hermand.
Alex. Maclean esq. of Coll.

10th *January*, 1786.

George Skene esq. of Skene.

24*th July*, 1786.

*His Grace Alex. Duke of Gordon.
Eneas Robert Bruce Macleod esq. of Cadboll.
Robert Stewart esq. of Garth.

9*th January*, 1787.

Sir John Leslie of Findrassie and Wardes, Bart.
John Francis Erskine esq. of Marr.
John Campbell esq. W. S., now of London.

27*th July*, 1787.

Most Noble the Marquis of Stafford.
* Right Hon. the Earl of Rosslyn.
Sir John Campbell of Ardnamurchan, Bart.
Col. Alex. Robertson of Strowan.
Al. Hamilton esq. of Grange, Adv.
Kenneth Mackenzie esq. of Inverennet, W. S.

8*th January*, 1788.

Sir Geo. Stewart of Grandtully, Bart.

Gen. Wm. Wemyss of Wemyss.
Col. Alexander Macregor Murray of Napier Ruskie.
The Hon. Lord Robertson.

25*th July*, 1788.

Lt.-Col. Thomas Kinloch of Kilrie.

13*th January*, 1789.

Archibald Campbell esq. of Jura.
Major-General Robert Campbell of Kintarbert.
Dr William Farquharson, physician, Edinburgh.
Norman Macdonald esq. of Barnisdale.
Alex. M'Alister esq. of Strathaird.
Lieut.-Col. Alexander Macdonald of Lyndale.

1*st August*, 1789.

** His Grace John Duke of Atholl.
The Right Hon. James, Earl of Lauderdale.
Duncan Campbell esq. of Ross.
Major Colin Campbell of Balliveolan.
Matthew Ross esq. Dean of the Faculty of Advocates.
William Kerr esq. Secretary, General Post Office of Scotland.

12*th January*, 1790.

** His Grace George William, Duke of Argyll.

Coll Macdonald esq. of Dalness, W. S.
Lieut.-Col. James Spens, late of the 73d regiment.
Hector Macdonald Buchanan esq. of Drumakill, one of the principal Clerks of Session.

11th January, 1791.
The Hon. Lord Craigie.
John Campbell esq. of Southhall.
James Lamont esq. of Knockdow.
John Macleod esq. of Colbecks.

8th July, 1791.
The Most Noble George, Marquis of Huntly.
* Hon. Baron Sir John Stuart of Fettercairn, Bart.
Major-Gen. Sir Allan Cameron, 79th regiment.

10th January, 1792.
Right Hon. Sir William Drummond of Logie-Almond.
John Peter Grant esq. of Rothiemurchus, M. P.
Right Hon. Arch. Colquhoun of Killermont, Lord Register for Scotland, M. P.
John Campbell esq. Receiver Gen. of the Customs in Scotland.
The Hon. Lord Succoth.

29th June, 1792.
David Macdowall Grant esq. of Arndilly.
Colin Mackenzie esq. of Portmore, principal Clerk of Session.

8th January, 1793.
* The Right Hon. Francis, Earl of Moray.
Right Hon. Charles Hope, Lord President of the Court of Session.
* Right Hon. Francis, Lord Gray.
Hon. Baron Sir P. Murray of Ochtertyre, Bart.
Col. Donald Cameron of Lochiel.
Alex. Macdonell esq. of Glengary.
James Grant esq. W. S.
Alex. Maclean esq. of Ardgour.
Alexander Houston esq. of Clerkington
George Watson esq. Edinburgh.
Donald Maclean esq. W. S.
Capt. Alexander Macdonald, late 74th regiment.
The very Rev. Dr George Baird, Principal of the Univer. of Edin. Chaplain to the Society.
Robert Dundas esq. of Beechwood, one of the principal Clerks of Session.

1st June, 1793.
* The Right Hon. Archibald Earl of Cassilis.
* Right Hon. Francis, Earl of Wemyss and March.
Sir John Hay of Haystown, Bart. banker, Edinburgh.
Tho. Farquharson esq. of Howden.
Dr Andrew Coventry, Professor of Agriculture in the University of Edinburgh.
Dougald Campbell esq. of Balinaby.
John Campbell esq. of Carsbrook, W. S.

14th January, 1794.
Sir Arch. Dunbar of Northfield, Bart.
John Leslie esq. of Balquhaine.
Patrick Murray esq. of Simprim.
William Inglis esq. of Middleton, W. S.
James Laidlaw esq. W. S.

29th June, 1794.
Charles Stewart esq. of Ardsheal.

13th January, 1795.
James Dewar esq. of Vogrie.
Walter Watson esq. late of Bombay.
John M'Ritchie esq. of Craigton.

22d June, 1795.
* Right Hon. James Earl of Caithness.
James Mansfield esq. of Midmar.
John Mill of Noranside esq.
Alexander Watson esq. of Turin.
Captain Neil Campbell of Dunstaffnage.
Thomas Crichton esq. Advocate.

13th January, 1796.
* The Right Hon. Alexander, Lord Macdonald.
Major General the Hon. Godfrey Bosville.
Hon. Archibald Macdonald.
Sir George Abercromby of Birkenbog and Forglen, Bart.
James Stirling esq. of Keir.
Hope Stewart esq. of Ballechin.
John M'Neil esq. of Oakfield.
Capt. Alexr Macleod of Dalvey.
Archibald Lundie esq. W. S.
John Ferrier esq. W. S.
James Donaldson esq. Edinburgh.

4th July, 1796.
Right Hon. Earl of Kellie.
Sir James Hall of Dunglass, Bart.
R. Macdonald esq. of Staffa, Advocate, Principal Secretary of the Society.
James Raymond Johnston esq. of Alva.
Major Charles Macvicar, late of the 42d Regt.
John Forbes esq. of New, formerly of Bombay.
William C. Cunningham Graham esq. of Gartmore.
Lieut-Gen. Alexander Dirom of Mountannan.
Lieut-Gen. Simpson of Pitcorthie.
George Greenlaw esq. of Hilton.
John Young esq. of Cliesh.
Lt-Col. Charles M'Quarrie, late of the 42d Regt.

10th January, 1797.
James Traill esq. of Hobbister, Sheriff of Caithness.
Col. Matt. M'Alister of Rosehill.
Archibald Alves esq. of Springfield.
Lt-Col. James Campbell 94th Regt.
Capt. John Robertson of Tullybelton.
William Elder esq. of Forneth.

3d July, 1797.
Sir Hew Dalrymple Hamilton of Bargeny and North Berwick, Bart. M. P.
Thomas Kennedy esq. of Dunure.
Captain John M'Donald of Springfield.
Peter Gordon esq. of Abergeldie.
John Ochterlony esq. of Guynd.
John Campbell esq. of Glenfeochan, W. S.
Lt-Col. John M'Donald of Kinsburgh.

9th January, 1798.
The Right Hon. Lord John Campbell, M. P.
Sir Archibald Grant of Monymusk, Bart.
Captain Angus M'Donald of Milltown.
Major Alexr Grant of the Madras Cavalry.
Jas Gordon esq. of Culvenan, one of the Commissaries of Edinburgh
James Edmonston esq. of Newton.
Lt-Col. James Sinclair of Forse.
Robert Menzies esq. W. S. one of the Depute Clerks of Session.

2d July, 1798.
* Right Hon Lord Visc. Melville, First Lord of the Admiralty.
Sir James Dalyell of Binns, Bart.
James Macleod esq. of Rasay.
Robert Nutter Campbell esq. of Kailzie.

Robert Drummond esq. of Megginch.
Roderick Macneil esq. of Barra.
Gen. Ilay Ferrier, Lt-Governor of Dunbarton Castle.
Theodore Morison esq. of Bognie.
Henry Johnston esq. Surgeon, Edinburgh.
Alexr Forsyth, esq. writer, Edin.
Andrew Watson esq. W. S.
Captain Iver M'Millan of the Valentine Indiaman.
Chas Fraser esq. of Williamston.
Thos Smith esq. banker, London.

8th January, 1799.

* Most Noble the Marquis of Queensberry.
* The Right Hon. the Earl of Morton.
The Hon. George Abercromby of Tullybody.
Sir Michael Shaw Stewart of Greenock and Blackhall, Bart.
Colonel Robert Anstruther, Edinburgh.
Gilbert Innes esq. of Stow, Treasurer of the Society.
Hugh Monro esq. of Teaninich.
Murd. Mackenzie esq. of Ardross.
John Mackenzie esq. of Kineraig.
Wm Stewart esq. of Ardvorlich.
Cap. Dug. Stewart of Balachulish.
Dr Jas Home, Professor of Materia Medica in the Univer. of Edinr.
David Munro Binning esq. of Softlaw, Advocate.
Cap. Patrick Campbell of Inveraw.
Captain Adam Ferguson, late of 58th regt of foot.
Captain Neil Macleod of Gesto.

1st July, 1799.

The Hon. Ro. Lindsay of Leuchars.
Geo. Oswald esq. of Scotstown.
Lt-Col. Ro. Macgregor Murray.
John Smith esq. of Swinridgemuir.
James Pillans esq. merchant, Leith.
Henry Jardine esq. of Harewood, W. S.
Alexr Campbell esq. late of Tobago.
John Osborne Brown esq. W.S. one of the Clerks of the Jury Court.
Lewis Gordon esq. Depute Secretary of the Society.
Thomas Martin esq. Edinburgh.
John Tawse esq. Edinburgh.
Archibald Menzies esq.

14th January, 1800.

* The Right Hon. the Earl of Haddington.
General Sir Robert Abercromby, of Airthry, G. C. B.
General Sir Jas Stewart Denholm of Coltness and Westshields, B.
Hon. Lord Meadowbank.
John Campbell esq. of Lincoln's-Inn.
Alexander Marjoribanks esq. of Marjoribanks.
Al. Macleod esq. of Muiravonside.
Simon Fraser esq. of Foyers.
William Pagan esq. of Spittaltown.
Crawford Tait esq. of Harviestoun.
George Tod esq. writer, Edinr.
John Fletcher esq. of Dunans.
Major Pat. Macdougall of Scroba.
Major Alex. M'Ivor of Stornaway.
James Chapman esq.
James Shearer esq. Surveyor-General Post-Office, Edinburgh.
Pat. Stewart esq. of Achluncart.
Geo. Douglas esq. Advocate, Sheriff of Kincardineshire.
Donald Macleod esq. of Talisker.
Thomas Grierson esq. W. S.

30th June, 1800.

The Rt Hon. Errick, Lord Reay.
Right Hon. Lord Dundas.
Hon. Lord Balgray.
Sir James Gordon of Letterfourie, Bart.
George Baillie esq. of Jarviswood.

William Nisbet esq. of Dirleton.
Arch. Campbell esq. of Blythswood
Hercules Ross esq. of Rossie, M. P.
Lewis Dunbar Brodie esq. of Burgie.
Thos. Adair esq. of Genoch, W. S.
Archibald Swinton esq. W. S.
John Dillon esq. Edinburgh.
Duncan Cameron esq. younger of Fassfern, W. S.
And. Farquharson esq. of Breda.
Thomas Williamson esq. Leith.
John Gillanders esq. of Hayfield.
Jas. Herriot esq. of Ramornie, W S.
Jas. Walker, esq. wine merch. Leith.
Robert Hill esq. of Firth, W.S.
James Ferguson esq. of Crosshill, one of the Commissaries of Edinburgh.
William Berry esq. younger of Tayfield, W. S.
John Jeffrey esq. of Balsaroch.
Charles Bremner esq. W. S.
Revd. Dr John Stewart, minister of Luss, honorary member.
Rev. Dr Alex. Stewart, one of the ministers of Canongate, honorary member.

13th *January*, 1801.

Right Hon. Lord Montague.
Sir G. S. Mackenzie of Coul, Bart.
Sir David Hunter Blair of Dunskey, Bart.
Sir James Colquhoun of Luss, Bt.
Sir W. Fettes of Whamphrey, Bt.
Lieut-General A. Graham Stirling of Duchray and Auchyle.
William Grant esq. of Congalton.
Col. Jas Campbell, late of Madras
Col. Lud. Grant, late of Bengal.
Major-General John Lamont of Lamont.
Col. Alex. Macgregor Murray of the late Ceylon regt.
William Fullerton esq. of Skeldon, Advocate.
Geo. Bruce esq. Depute Clerk of Session.
William Mackenzie esq. younger of Pitlundie.
Lieut-Colonel Alexander Gordon, Sutherland Highlanders.
Alexr. Paterson, esq. of Thurso.

29th *June*, 1801.

Right Hon. Will. Dundas, M. P.
Sir William Bruce of Stenhouse, Bart.
Sir James Montgomerie of Stanhope, Bart. M. P.
Col. John Boyle of Stewalton.
Lieut-General Andrew Dunlop of Dunlop.
Major-General Sir Thomas Brisbane of Brisbane.
Col. Andrew Macdowal of Logan.
Lieut-Colonel John Bannerman, late of Madras.
Alexander Stewart, esq. younger of Balnakeilly.
John Stewart esq. of Crossmount.
Hugh Mair esq. of Wiseby.
Wm. Graham esq. of Mossknows.
John Murray esq. Tundergarth.
William Stewart esq. of Hillside.
Colin Mackenzie esq. Kilcoy.
Henry Clephane esq. W. S.
Robert Patrick esq. of Treehorn.
James Smith esq. merchant, Leith.
Wm. Ker esq. merchant, Leith.
Adam White esq. merchant, Leith.
Kirkpatrick Williamson Burnet esq. of Monboddo.
Mr John Moir, printer, Edinburgh.
Alex. Lang esq. younger of Overtown.
Right Hon. Nicolas Vansittart, Chancellor of the Exchequer, *Honorary Member.*

12th *January*, 1802.

Rt. Hon. Sir Wm. Rae of St Catherines, Lord Advocate for Scotland.

Sir Henry Stewart of Allanton, Bart.
William Fullerton esq. of Rosemount.
James Graham esq. of Kinross.
Hugh Innes esq. of Lochalsh, M.P.
Duncan Monro esq. of Culcairn.
Geo. Jos. Bell, esq. Advocate.
Wm. Fraser Tytler, esq. of Balnain, Sheriff of Inverness-shire.
John Fraser, esq. Faraline, Advocate.
Dr Andrew Mackenzie Grieve, Edinburgh.
Va. Hawthorn esq. Garthland, W.S.
Thomas Scott esq. W.S.
Rear-Admiral Alex. Fraser, R. N.
Lieut.-Col. Don. Macniel, 91st regiment.
Capt. Will. Gordon, Minmore.
Rob. Gordon esq. late of Jamaica.
Colin Campbell esq. of Achnacroish.
Cap. Fr. Simpson, late of Bombay.
Robt. Baillie esq. of Carphine.
Major Dugald Campbell of Kilmartin.
Arch. M'Lean esq. of Pennycross.
Robert Brown esq. Factor on the estate of Hamilton.
Sir James Dunbar of Boath, Bart. R. N.
Jas. Macpherson esq. of Ardersier.
Hen. Raeburn esq. portrait painter.
Alex. Mackenzie esq. of Woodside.
Arch. M'Ra esq. of Ardintoul.
John Maclean esq. of Boreray.
Duncan Campbell esq.
Arch. Campbell esq. of Melford.

28th June, 1802.

Sir Rt. Turing of Foveran, Bart.
Sir William Forbes of Pitsligo, Bart. banker in Edinburgh.
J. H. Forbes esq. Advocate, Sheriff of Perthshire.
Henry Veitch esq. of Elliock, one of the Commissioners of Customs.
Charles Grant esq. of Waternish.
Jn. Dickson esq. of Coulter, Advocate.
Robert Hamilton esq. Advocate, sheriff of Lanarkshire.
Sir Neil Menzies of Menzies, Bart.
Ts. Millet esq. younger of Glenlee.
Wm. Macdonald esq. of St Martins, Advocate.
Ad. Maitland esq. of Dundrennan.
John Callow esq. of Stapleton.
Wm. Molle esq. of Mains, W.S.
Duncan Hunter esq. of London.
Major-General Archd. Stewart, of the Royals.
John Gordon esq. W. S.
Robert Fraser esq. younger of Torbreck.
Walter Ross esq. of Nigg.
Capt. Jn. Rutherford of the 85th regiment.
Hugh Hamilton esq. of Pinmore.
Robt. Campbell esq. of Sonobhan.

12th January, 1803.

* Rt. Hon. the Earl of Mansfield.
Honourable Dudley Macdonald.
General Richard Vyse.
Colonel William Francis Grant of Grant, M. P.
Major-General George Ainslie.
Jas. Douglas esq. of Orchardton.
Wm. Gordon esq. of Campbeltown.
Peter Johnston esq. of Cairnsalloch.
John Clerk esq. of Nunland.
David Macculloch esq. of Leaths.
Charles Granville Stewart Monteith esq. of Closeburn.
General Sir Paulus Emilius Irvine of Woodhouse, Bart.
Lieut.-Col. William Douglas, late of the 85th regiment.
Capt. Vans Agnew of Sheuchan.
Richard Alexander Oswald esq. of Auchincruive.
Jas Hunter Blair esq. of Dunskey, M. P.
Charles Stirling of Kenmure...

Lieut.-Col. Benjamin Williamson of Marlefield.
The Rev. Dr George Forbes, minister of Strathdon.
George Kinnear esq. banker in Edinburgh.
Robert Jameson, esq. W. S.
Alex. Miller esq. Monkcastle, Advocate.
J. H. Mackenzie esq. Sheriff of Linlithgowshire.
William Boswell esq. Sheriff of Berwickshire.
John Campbell esq. of Lochend.
Allan Cameron esq. Factor for Lord Macdonald, North Uist.
John Campbell esq. of Craignure.
Lachlan M'Kinnon esq. of Corrie.
Peter Hill esq. bookseller, Edinr.
Patrick Warner esq. of Ardier.
Lieut-Col. James Macdonell of the 2d or Coldstream Regiment of Guards, C. B.
Duncan Stewart esq. Chamberlain of Kintyre.
James Maxwell esq. Chamberlain of Mull.
Malcolm M'Laurin esq. of Oban.
Robert Campbell esq. Chamberlain of Roseneath.
Walter Moir esq. accountant, Edinburgh.

27th June, 1803.

Right Hon. Thomas, Viscount of Arbuthnot.
Lieut-General Right Hon. Lord Lynedock, G. C. B.
Hon. Douglas Gordon Halyburton of Pitcur.
Sir John Shaw Maxwell of Kerochtrie and Netherlaw, Bart.
Major-General Sir William Maxwell of Monreith, Bart.
James Alexander Stewart Mackenzie esq. of Seaforth and Glasserton.
John Cathcart esq. of Genoch.
Colonel James Stevenson Barns of Kirkhill.
Sir Patrick Walker, Advocate.
David Snodgrass Buchanan esq. of Blantyre Park, Advocate.
Jos. Stewart Menzies esq. of Foss
Donald Macintyre esq.
Archibald Crawfuird esq. W. S.
John Campbell esq. of Auch.
Captain John Campbell Kilmartin, late 46th Regiment.
Hugh M'Corquodale esq. of Liverpool.
Rev. Dr James Hall, Edinburgh.
Arch. Constable esq. bookseller, Edinburgh.
William Ross esq. of Bridgebank.
James Bell esq. Leith.
John Mackenzie esq. Richmond-Place.
William Mackenzie esq. W. S.

10th January, 1804.

* His Grace the Duke of Hamilton and Brandon.
* Most Noble the Marquis of Hastings, Governor-General of Bengal.
* Lieut-Gen. Right Hon. the Earl of Dalhousie, Governor-General of Canada.
* Right Hon. Lord James Murray.
Right Hon. Lord Binning.
Right Hon. David Boyle, Lord Justice Clerk.
Sir George Warrender of Lochend, Bart. M. P.
General Alexander Don, Lieut.-Governor of Gibraltar.
Major-Gen. Sir Wm. Keir, Adj.-General to the Forces at Ceylon.
Hugh Rose esq. of Kilravock.
George Gordon esq. of Hallhead.
Honourable Lord Pitmilly.
Hugh Mossman esq. of Achtyfardle.
John Hamilton esq. of Sundrum.
Geo. Paterson esq. of Castlehuntly.

Thomas Hamilton Miller esq. Adv.
John Macdonald esq. of Borrodale.
Rev. Dr Robert Douglas, minister of Galashiels.
Peter Campbell esq. of Kilmory.
Richard Lothian Ross esq. of Staffold.
William Hagart esq. wine merchant, Leith.
Neil Malcolm esq. Poltalloch.
Dr Jo. Rogerson, Physician to the Forces, N. B.
Jo. Boyd esq. of Broadmeadows.
Dr Thomas Charles Hope, Physician, Edinburgh.
James Hope esq. W. S.
Walter Campbell esq. of Carradale.
Major-General Jo. Macleod of Unish, 78th regiment.
Colonel Muir of Caldwell.

2d July, 1804.

William Arbuthnott esq. Charlotte Square, Edinburgh.
Gen. William Maxwell of Parkhill.
Lieut-Col. Richard William Howard Vyse.
Robt. Wm. Duff esq. of Fetteresso.
Peter Spiers esq. of Culcruich.
Lieut.-Col. Robert Cameron, late of Madras
Lieut.-Col. Robert Campbell Hamilton of Milburn and Dalserf.
Andrew Murray esq. of Murrayshall, Advocate.
James Farquhar Gordon esq. W.S.
Geo. Bell esq. surgeon, Edinburgh.
James Campbell esq. of Dunmore.
James Connell esq.
Francis Short esq. of Courance.
Michael Linning esq. of Colzium, W. S.
William Macleod esq. of Luskintyre.
William Gordon Macrae esq.
James Watson esq. factor to Lord Dundas.
John Rae esq.
John Menzies esq. cashier to the Duke of Gordon.
James Mackay esq. goldsmith and jeweller in Edinburgh, the Society's jeweller and medallist.
William Wilson esq. factor for the Earl of Glasgow.
David Mutrie esq. merchant in Glasgow.
Jos. Gordon esq. of Carroll, W. S.

8th January, 1805.

The Right. Hon. Flora, Marchioness of Hastings and Countess of Loudon.
* Rt. Hon. the Earl of Fife, M. P.
The Hon. William Ramsay Maule of Panmure, M. P.
Sir And. Cathcart of Carlton, Bart.
Sir George Montgomery of Magbiehill, Bart.
Alexander Irvine Forbes esq. of Chivas, Advocate.
Alexander Moir esq. of Scotstown, Sheriff of Aberdeenshire.
John Rogerson, M.D. physician to the Court of St Petersburgh.
Major-General Sir Thomas Dallas.
Lieut.-Col. David Robertson Macdonald of Kinlochmoydart.
Sir James Ferguson of Kilkerran, Bart.
Kenneth Mackay esq. of Torboll.
Alex. Fraser esq. of Inchcoulter.
Jas. Forrest esq. of Commieston.
Alexander Osburn esq. one of the Commissioners of Customs.
David Ewart esq. of Craiginvie.
John Niven esq. of Thornton.
Sir Henry Niven Lumsden of Auchindoir, Knight.
William Campbell esq. W. S.
James Cathcart esq. merch. Leith.
Captain Hugh Stevenson, late of Argyllshire Militia.
Alexander Mundell esq. solicitor, London.

William Patrick esq. W. S.
Robert Rattray esq. W. S.
Alex. Stewart esq. of Dareulich.
James Law esq. Edinburgh.

24th June, 1805.

Right Hon. George, Earl of Aberdeen.
Sir Alex. Gordon of Culvennan, Knight.
James Macdonald esq. of Langdale, M P.
Major-Gen. Lachlan M'Quarrie of Jarvisfield, Governor of New South Wales.
Major Thomas Hart of Ballencrieff
Patrick Small Keir esq. of Kinmonth, Advocate.
Richard Wharton Duff esq. Comptroller of Excise.
John Buchanan esq. of Ardoch.
Alex. Mackenzie esq. of Scotsburn.
Richard Graham esq. of Blatewood
Dugald Campbell esq. of Illandrie.
John Gregorson esq. of Ardtornish
John Ferguson esq.
Edward Lothian esq. Advocate.
John Kerr esq. of Stonypath, W.S.
William Keyden esq. W. S.
James Scott esq. of Brotherston.
Cosmo Falconer esq. Edinburgh.
Thomas M'Ritchie esq. merchant, Edinburgh.
Andrew Bogle esq. Secretary Royal Bank of Scotland.
Gilbert Bertram esq. merch. Leith.
Wm. Bertram esq. merch. Leith.
Alexander Goalen, esq. Leith.

14th January, 1806.

His Royal Highness the Duke of Sussex.
*Right Hon. the Earl of Roseberry
Right Hon. Lord Glenbervie.
Hon. Lord Cringletie.
Sir John Hope of Craighall, Bart.
Sir Thomas Gibson Carmichael of Skirling, Bart.
Colonel Elliot Lockhart of Borthwickbrae, M. P.
Robert Stewart esq. of Fincastle.
Lieut-Colonel George Callander of Craigforth.
Lieut-Col. Donald Campbell of Knock.
Ro. Hepburn esq. of Clerkington.
William Murray esq. of Polmaise.
James Hare esq. of Calderhall.
Patrick Miller esq. of Dalswinton.
Archibald M'Nab of M'Nab esq.
Gilbert Young esq. of Youngfield, Depute Commissary General for Scotland
Colin M'Lachlan esq. merchant, Glasgow.
Alex. Ramsay esq. of Demerary.
James Fyffe esq. of Smithfield.
John Russel esq. W.S. one of the Clerks of the Jury Court.
Wm Gilchrist esq. } merchants,
John White esq. } Edinburgh.
James P Inglis esq
Henry Raeburn jun. esq. Stockbridge.
Lt-Col. Jas. M'Vean, 78th Regt.

30th June, 1806.

Right Hon. the Earl of Kinnoul.
Hon. Charles Douglas.
Sir Gilbert Stirling of Rosehall, Bart.
Right Hon. Robert Liston of Listonshiels.
John Norman M'Leod esq. of M'Leod.
John Menzies esq. of Pitfoddels.
George Macpherson Grant esq. of Ballindalloch, M P.
James Glasford esq Advocate.
Jas. Pringle esq. of Torwoodlee.
Gilbert Bethune esq. of Balfour.
Charles S. M'Alister esq. of Loup and Kennox.
Duncan Darroch esq. of Gourock.

Gordon Cameron esq. of Letterfindlay.
James L'Amy esq. of Dunkenny, Sheriff of Forfarshire.
Js. Keay esq. of Snago, Advocate.
Dun. M'Farlane esq. Advocate.
Michie Forbes esq. of the house of Forbes & Co. Bombay.
Robert Ainslie esq. W. S.
John Patison esq W. S.
Ran. Macdonald esq. of Borinish.
Andrew Halliday esq. M. D.
James Fowler esq. of Fortrose, formerly of Jamaica.
Major Ludovick Stewart, 24th Regiment of Foot.
Captain Alex. Campbell, late of the Scots Greys.
Alexander Gillespie esq. surgeon, Edinburgh.
James Gillespie esq. architect.
John Johnston esq. landsurveyor.

13th January, 1807.

*Gen. Right Hon. Earl Cathcart, G. C. B.
Right Hon. Lord Archibald Hamilton, M P.
Sir Charles Edmonstone of Duntreath, Bart. M. P.
Ranald George M'Donald esq. of Clanranald, M. P.
Lt-Gen. Mathew Baillie of Cairnbroe.
Colonel John Gordon of Cluny.
Roderick Macleod esq. younger of Cadboll.
John Colquhoun esq. Sheriff of Dunbartonshire.
William Douglas esq. junior of Orchardton.
Adam Ferguson esq. of Woodhill, Advocate.
Dr Alex. Monro, Professor of Anatomy in the University of Edinburgh.
Archibald Graham Campbell esq. of Shirvan.
Ro. Campbell esq. of Ardchattan.
Joseph Williamson esq., Principal Clerk of Teinds.
Alex. Mackenzie esq. of Hilton.
John Gordon esq. Swinzie.
John Brown esq. of Coultermains.
William Grant esq. of Seabank.
Ewan Maclachlan esq. of Killimore, Mull.
Walter Dickson esq. merchant, Edinburgh.
Robert Stevenson esq. engineer of Northern Lights.
James Bristow Fraser esq. writer in Edinburgh
William Rae Wilson esq. of Kelvinbank.
Alex. Macdonald esq of Dellalay.
Robert Bruce esq. of Swinbister, Zetland.
William Mowat esq. younger of Arnisbrae, Zetland.

29th June, 1807.

Right Hon. the Earl of Galloway.
Right Hon. Lord Blantyre.
Sir James Montgomerie Cunninghame of Corsehill, Bart.
Robert Hay esq. of Spott
Samuel Anderson esq. of Rouchester, banker, Edinburgh.
Maj.-General John Macintyre, of the Hon. East India Company's Service.
James Forbes esq. of Kingerloch.
Alex. Campbell esq. of Ederline.
John Fullerton esq. of Kilmichael.
Thomas Thomson esq. Advocate.
John Graham Dalyell esq. Advocate.
Norman Hill esq. of Brownhills, Advocate.
Daniel Vere esq. of Stonebyres, Advocate.
David Falconer esq. of Carlowrie.
Capt. James Macalister of Springbank, 13th Dragoons.

Claud Russell esq. Accountant Edinburgh, the Society's Auditor of Accounts.
Jas. Hamilton esq. of Kames, W.S.
James Adam esq. of Burnfoot, factor on the estate of Perth.
James Hill esq. Glasgow.
Wm. Braidwood jun. esq. Manager of the Marine Insurance Co.
John Wardrop esq. banker Edin.

12th January, 1808.

Sir James Riddell of Sunart, Bart.
Sir Wm. Gordon Cumming Gordon of Altyre and Gordonstone, Bart.
James Vashon esq. Vice-Admiral of the Red.
Lieut-Col. Evan John Macgregor Murray of Glencairnaig, Adj.-Gen. to the King's troops at Madras.
Thomas Knox esq son of the Hon. Mr Knox, M. P. for the county of Tyrone.
Forbes Hunter Blair esq. banker Edinburgh.
John Campbell esq. of Stonefield.
James Erskine esq. of Cambus.
Thomas Mackenzie esq. of Applecross, M. P.
Dr Andrew Duncan jun. M. D. Edinburgh.
Benjamin Hawes esq. of Old Barge Stairs, Blackfriars, London.
William Francis Hunter esq. of Barjarg.
Charles Campbell esq. of Combie.
Alex. Brebner esq. of Learney.
Colin Macdougal esq. of Lunga.
Sutherland Mackenzie esq. merchant, Leith.
Colin M'Larty esq. of Chestervale, Jamaica.
Archibald Campbell esq. of Drumsainy.
James Bremner esq. Soliciter of Stamp Duties.
Henry Monteith esq. of Carstairs.

27th June, 1808.

* His Grace the Duke of Roxburgh.
Right Hon. the Earl of Minto.
Right Hon. Lord Robert Kerr.
Hon. P. R. Drummond Burrell, M. P.
Fred. Fotheringham esq. one of the Commissioners of Excise.
Alex. Gordon esq. late Captain 15th Light Dragoons.
Major Colin Mackay, late of the 78th Regiment.
Jn. Farquharson esq. of Haughton.
Lieut-Col. John Mackintosh of the Royal Marines.
Rear-Admiral David Milne of the Royal Navy.
James Harrower esq. of Enzievar, Advocate.
George Tait esq. Advocate.
Capt. Alex. Stewart of Strathgary.
Chalmers Izett esq. of Kinnaird.
Patrick Neill esq. Edinburgh.
Alex. Laing esq. Architect, Edin.
Rev. William Singer, D. D. Minister of Kirkpatrick-juxta.

10th January, 1809.

Most Noble George Marquis of Tweeddale.
Lieut-Gen. the Hon. John Leslie Cuming.
Lieut-Col. the Hon. Charles Cathcart.
Hon. Lord Gillies.
Robert Stewart esq. of Alderstone.
Henry Hume Drummond esq. of Blair-Drummond, Advocate.
John Stewart esq. of Binny.
Chas. Hamilton esq. of Fairholm.
Rose Campbell esq.
Hugh M'Lean esq. yo. of Coll.

Jn. Mackenzie esq. merch. Leith.
James Greig esq. of Eccles, W. S.
Ro. M'Millan esq. of Polbae, W. S.
William Davidson esq. younger of Hatton.
Sir Samuel Stirling of Glorat, Bart.
William Howieson Crawford esq. of Crawfordland.
John Burnet esq. of Kemnay.
William Ogilvy esq. younger of Chesters, Advocate.
John Campbell esq. of Achawilling
Charles Stewart esq. of Dalguise.
Brigade-Major Howard.
Sir Alexauder Keith, Knight Marshall of Scotland.
Henry Dundas Beatson esq.
Duncan M'Kellar esq. merchant, Glasgow.
John Forman esq. W. S.

26th June, 1809.

Dame Ann Preston Campbell of Fernton, Lady Baird.
Right Hon. Lord Elibank.
John Harvey esq. of Ickwell, Bury and Tiningly Park, Yorkshire.
William Stewart esq. younger of Garth.
Allen Stewart esq. Bunrannoch.
John Stewart esq. of Shierglass.
John Campbell esq. of Borland.
George Lyon esq. of Ogle.
David Blair esq. of Cookston.
Lt-Col. George Maxwell, younger of Carruchan.
George Robinson esq. of Clermiston, W. S.
Donald Fletcher esq. of Bernice.
Thomas Harkness esq. of Bailliemore.
Wm. Aitchison esq. of Drummore.
David Thomson esq. W. S.
Geo. Munro esq. of Culrain.
John Murray esq. of Conland.
John Philips esq. W. S.
Richard Mackenzie esq. W. S.
Francis Wilson esq. W. S.
John Govan esq. W. S.
John Macpherson esq. Chamberlain to Lord Macdonald in Sky.
Henry Davidson esq. Haddington.
Geo. M'Andrew esq. at Torrick.
David Mathie esq. Glasgow.
Colin Macnab esq. merchant, Grangemouth.
James M'Alpine esq. merchant, Strachur.
Captain William Fraser residing at Brackla.
Alex. Falconer esq. Nairnside.
Capt. John Stewart of the Prince of Wales' Excise Yacht.

9th January, 1810.

Right Hon. the Earl of Fingal.
Right Hon. James Lord Ruthven.
Right Hon. Lord Ashburton.
Archd. Spiers esq. of Elderslie.
Alexander Munro esq. Edinburgh.
Claud Alexander esq. of Ballamyle.
Wm. Campbell esq. of Netherplace
William Sommerville esq. of Sorncastle.
Alex. Cooper esq. of Smithstown.
Archibald Campbell esq. of Catherine Bank.
Duncan Campbell esq. of Barcaldine.
Alex. Young esq. of Harburn, WS.
Charles Selkrig esq. accountant, Edinburgh.
John Swinton esq. of Broadmeadows.
John M'Culloch esq. of Barholm.
James Murray Grant esq. of Glenmoriston.
Alex. Grant esq. of Jamaica, Representative in the Hon. House of Assembly for the town and parish of Port Royal.
Thomas Rennie Strachan esq. of Tarrie.

Duncan Cowan esq. mercht. Edin.
Alexander Cowan esq. merchant, Edinburgh.
William Dickson Watson esq.
John Hepburn esq. of Colquhalzie.
Major Alex. Macdonald, Royal Horse Artillery.
Captain Archibald Campbell of Askomel, Royal Artillery.
Anthony Murray esq. of Crieff.
Michael M'Millan esq. merchant Glasgow.
William Johnstone esq. of Holmeadow.
John Clapperton esq. merchant, Edinburgh.
Æneas Falconer esq. Blackhills, Nairnshire.
Andrew Bennet esq. of Muckraw.
William Smith esq. M. P. for Norwich, Honorary Member.

2d July, 1810.

Sir John Pringle of Stitchell, Bart.
Sir David Maxwell of Cardoness, Bart.
Alexander Boswell esq. of Auchinleck, M. P.
James Urquhart esq. of Meldrum, Sheriff of Banffshire.
George Harley Drummond esq. of Drumtochty.
Robert Barclay Allardice esq. of Urie.
William Cunningham esq. of Lainshaw.
Colonel Arch. Moore, Vice-Lieut. and Col. of the Buteshire Local Militia.
Lieut-Col. Alexander Campbell of Posshill, Lanarkshire.
Walter Williamson esq. of Cardrona.
Robert Clark esq. of Comry.
David George Sandeman esq. of Springland, Perthshire.
Colin Campbell esq. mercht. Glasgow.
The Rev. G. J. Hamilton, minister of Ashkirk.
Captain James Laskey, Galloway Militia.
Wm. M'Dowall esq. of Woolmet.

8th January, 1811.

Right. Hon. John Lord Cawdor.
Henry David Erskine esq. of Amondell
James Drummond esq. M. P. for Perthshire.
Col. Sir Alexander Leith, younger of Freefield.
John Gordon esq. of Cairnbulg.
William Calder esq. merch. Edin.
Geo. Garden Robinson esq. Banff.
Kenneth Francis Mackenzie esq.
Robert Buchanan esq. Glasgow.
Capt Charles Gregory, 6th Dragoon Guards.
Capt Archibald Campbell, Chamberlain to his Grace the Duke of Argyll.
James Stewart Robertson esq. of Edradynate.
William Henderson esq. merchant, Edinburgh.
Thomas Megget esq. W. S.
Major Alexander Macdonald of the 76th regt.
Peter Couper esq. W. S.
Mr John Thomson, bookseller, Edinburgh.

1st July, 1811.

Right Hon. Lord Linton.
The Hon. Col. Hugh Arbuthnot.
John Hay esq. younger of Smithfield and Hayston, Advocate.
Murd. M'Laine esq. of Lochbuy.
William Alexander Mackinnon of Mackinnon esq.
William Sinclair esq. of Freswick.
John Macdonald esq. of Sanda.
Alexr Macduff esq. of Bonhard.
John Harvey esq. } writers to the
John Murray esq. } signet.

14th January, 1812.

The Hon. Baron Clerk Rattray.
Sir George Clerk of Pennycuik, Bart. M. P.
Lieut-General Sir David Baird of Fernton, Bart. G. C. B.
George Sinclair esq. younger of Ulbster.
Gen. Alexander Hay of Rannes.
John Dunmore Napier esq. of Ballockinrain.
John Spottiswood esq. of Spottiswood, Solicitor, London.
Arthur Nicholson esq. of Lochend
John Borthwick, esq. younger of Crookston, Advocate.
Anthony Maxwell esq. of Cultoquhey.
Nicol Allan esq. manager of the Hercules Insnrance Company.
Æneas MacBean esq. W. S.
James Macdonell esq. younger of Milnefield, W. S.
James Wyld esq. merchant, Leith.
James Robertson esq. ironmonger, Edinburgh.
James M'Innes esq. writer, Edinr.
Tho. Johnston esq. writer, Edinr.
Right Hon. the Lord Bishop of Meath, of the Kingdom of Ireland, *Honorary Member.*

29th June, 1812.

* Most Noble the Marquis of Lothian.
Sir Alexander Campbell, Bart. of Aberuchill.
James Hunter esq. of Thurston.
John Maitland esq. of Eccles.
T. F. Kennedy esq. of Dunure, M. P.
William Niven esq. of Achalton and Kirkbride.
Hugh Hucheon esq. of Southfield.
Wm Hunter esq. of Ormistown.
James Crichton esq. of Friarscarse.
John Donaldson esq. of Kilphin, W. S.
William Harley esq. of Glasgow.
Hector Frederick M'Neil esq. of Gollychilly.
David Stewart Galbreath esq. of Lochsanish.
John Fraser esq. cashier, Castle-Grant.
Robert Morton esq. jeweller, Edinburgh.

12th January, 1813.

Sir Alexander Ramsay of Balmain, Bart. M. P.
Major-General William Burnet of Banchory Lodge.
William Nairne esq. Assistant Inspector General of Barracks.
Patrick Maxwell Stewart esq.
Sir John Buchan Hepburn of Letham, Bart.
Edward Boyd esq. of Mertonhall.
William Mackintosh esq. of Millbank.
James Carnegy esq. of Balnamoon.
Dugald Campbell esq. of Kildaloig.
Lieut-Colonel David Rattray, 63d Regiment.
Major John Grant of Achterblair.
Robert Lawson esq. of Ballimore,
Capt. Alex. Cumming of Docharn.
Dr James Bayne, Physician, Inverness.
Geo. MacDougall esq. Edinburgh.
Thomas Eddington esq. merchant, Glasgow.
John Mackenzie esq. writer, Edinburgh.
Rev. William Gillespie, minister of Kells.
Mr —— Hope, residing at Glenlee.
David Lawson esq. town clerk of Arbroath.

28th June, 1813.

* Right Hon. George Granville, Earl Gower, M. P.
* Right Hon. Archibald, Lord Douglas of Douglas.

Jo. Wauchope esq. of Edmonstone.
Alexander Leith esq. of Freefield.
Robert Dalrymple Horne Elphinstone esq. of Logie-Elphinstone.
John Ramsay esq. of Barra, Aberdeenshire.
James Hay esq. of Monkshill.
Walter Bigham Lawrie esq. of Red Castle, Kirkcudbright.
George Scott Elliot esq. of Lauriestone.
George Reid esq. of Rathobank.
Adam Duff esq. Advocate, Sheriff of Edinburgh.
William Horne esq. younger of Stircock, Advocate, Sheriff of Haddingtonshire.
William Macdonald esq. of Calley-Strathardle, Perthshire.
James Grant esq. of Bucht, some time Provost of Inverness.
Thomas Gilzean esq. of Bunachton, some time Provost of Inverness.
John Brander esq. of Pitgavenny.
William Young esq of Inverougie.
Patrick Seller esq. of Westfield.
Andrew Christie esq. of Ferrybank.
Dr Henry M'Laggan, Fellow of the Royal College of Physicians, Edinburgh.
George Ramsay esq. Edinburgh.
Geo. Irving esq. merchant, London.
Robert Johnston esq. merchant, Edinburgh.
Alexander Henderson esq. merchant, Edinburgh.
John Reid esq. merchant, Leith.
Cha. Oliphant esq., William Bell esq., James Swan esq. } writers to the signet.
John Arch. Campbell esq. W. S.
James Gordon esq. late Paymaster 92d regiment, or Gordon Highlanders.
Alexander Stevenson esq. writer, Edinburgh.
Dr Robert Burt, Edinburgh.
Major Alexander Mackay of Laggan, Argyllshire.
Jn. Fullerton esq. late of Jamaica.
Rev. James Bryce, late minister of Strachan.
Mr James Canning, residing at Shiels, Kirkcudbright.

11th January, 1814.

Right Hon. Lord Berridale.
Major-Gen. the Hon. Alex. Duff.
Sir John Marjoribanks of Lees, Bart. M. P.
Kirkman Finlay esq. M. P.
Charles Forbes esq. of Edinglassie, M. P.
Thomas Graham Stirling esq. of Airth.
Major Alexander Francis Taylor, Rothiemay House.
Major Robert Macdonald, Royal Horse Artillery.
Garden Duff esq. of Hatton.
John Gordon esq. of Aitkenhead.
Alexander Campbell esq. of Hallyards.
Wm Trotter esq., Wm Galloway esq., John Mill esq. } merchants in Edinr.
Thomas Allan esq. banker in Edin.
George Miller esq. of Frankfield.
George Meek esq. of Campfield.
John Learmonth esq. merch. Edin.
Robert William Hamilton esq.
Captain John Cheape, Edinburgh.
Major Hugh Macgregor, of the 91st Regiment.
Robert Gordon esq. Croughlie, Banffshire.
Ro. Wight esq. accountant, Edin.

2d July, 1814.

The Right Hon. Lord Colchester, Honorary Member.
Michael Stewart Nicholson esq. of Carnock.
Angus Mackintosh esq. of Holm.
Ro. Downie esq. of Appin, M. P.

Thomas Morrison esq. of Elsick, M. D.

Charles Alex. Graham esq. younger of Leckie.

James Eddington esq. of Gargunnock.

Lachlan Mackintosh esq. of Raigmore.

William Tait esq. of Pirn.

Capt. John Boswell Donaldson of Wairdie, R. N.

David Dick esq. of Glensheal.

John Carfrae esq. of Glenboig.

Dugald Macdougald esq. of Gallanich.

Wm. Don esq. banker in Forfar.

The Rev. George Craig Buchanan of Mackeanston.

James Caird esq. of Drumfad, writer in Stranraer

George Nelson esq. factor on the estate of Kames, Bute.

10th January, 1815.

Sir Walter Scott of Abbotsford, Bart.

James Rose esq. one of the Commissioners of Excise.

Archibald Farquharson esq. of Finzean, M. P.

Wm. Ramsay esq. banker, Edinburgh.

Robert Jameson esq. Advocate.

Dr George Wood, Edinburgh.

George Burnet esq. St Andrew's Square, Edinburgh.

John Pitcairn esq. younger of Pitcairn.

John Bowie esq. of Cambsiscan, W. S.

John Baird esq. of the Shotts Iron Works.

Rev. John M'Kinnon, minister of Slate.

Mr John Elder, merchant, Slate.

Mr Alexander Laing, residing at Edmonstone.

Mr Wm Sibbald, architect, Edin.

Mr James Brown, do. do.

Mr James Allen, } merchants,

Mr Arthur Pollock, } Grangemouth

3d July, 1815.

Field Marshall His Grace Arthur, Duke of Wellington, G. C. B. Honorary Member.

Most Noble the Marquis of Bute.

*Right Hon. the Earl of Hopeton.

Sir Thomas Livingstone of Westquarter, Bart.

Stewart Menzies esq. of Culdairs.

Wm Napier esq. of Blackstone.

Col. David Stewart, Garth.

Norman Lockhart esq. W. S.

James M'Nair esq. of Glasgow.

John Henry esq. of Corse.

Wm Cochran esq. of Ladyland.

Alex. Robertson esq. of Hallcraig, Col. Hon. East India Co.'s. service.

John Innes Crawford esq. of Bellfield, Cleghorn-house, Lanarkshire.

Duncan Shaw esq. factor to Clanranald.

9th January, 1816.

The Hon. Lady Hood Mackenzie of Seaforth.

Right Hon. Lord Belhaven and Stenton.

Right Hon. William Adam, Lord Chief Commissioner of the Jury Court.

Admiral, the Hon. Sir Alexander Cochran, G. C. B. of Murdiston, Lanarkshire.

Sir James Dalrymple Hay of Parkplace, Bart.

Jas. J. Hope Vere esq. of Craighall.

John Shaw Stewart esq. son of Sir M. Shaw Stewart, Bart.

John Tait esq. younger of Pirn, W. S.

George Wigham esq. of Halliday-hill, Dumfries-shire.
Dr Francis Buchanan, late of India.
Dr Henry Dewar, Fellow of the Royal College of Physicians, Edinburgh.
Patrick Robertson esq. Advocate.
James Saunders Robertson esq. W. S.
William Fraser esq. younger of Glenmead, W. S.
Charles James Fox Orr esq. of Thornly Park, W. S.
Ro. Kerr esq. surgeon, Portobello.
Captain Charles Grant, Tombreckachie, Banffshire.
Jo. Young esq. George Street, Edin.
Mr David Willison, printer, Edin.
Thomas Beveridge, esq. } Edin.
Donald MacIntosh esq. } Edin.
Captain Simon Fraser, Knocky, Inverness-shire.

1*st July*, 1816.

Right Hon. Charles Grant, Chief Secretary for Ireland, and M. P. for Inverness-shire.
Sir Robert Keith Dick of Prestonfield, Bart.
Colonel Sir Colin Campbell, K.C.B.
Robert Abercromby esq. younger of Birkenbog and Forglen.
Charles Fraser esq. of Inverallochy and Castle Fraser.
Lieut-Col. Martin Lindsay, 78th Regiment.
James Hunt esq. of Pittencrieff.
James Foulis esq. of Woodhall.
Alex. Brodie Campbell esq. of Forneighty, Hon. East India Company's service.
Watkins Wm. Massie esq. Hon. East India Company's service.
William Mackintosh esq. late of Madras.
John S. More esq. Advocate.
Thomas Mackenzie esq. younger of Inverinnet, W. S.
Robert Campbell esq. younger of Auchmanoch.
Arthur Campbell esq. W. S.
Hugh Macqueen esq. W. S.
Donald Mackintosh esq. W. S.
James Brown esq. accountant Edinburgh.
Captain Allan MacCaskill, Hon. East India Co.'s service.
Captain Gilbert Macdonald, late of the Scots Royals.
David Watson esq. writer, Edin.
James Lyon esq. writer, Edin.

14*th January*, 1817.

Maj-General Sir John H. Dalrymple of Cranstoun and Cowsland, Bart.
Sir Charles Macdonald Lockhart of Lee and Carnwath, Bart.
Richard B. Jonhstone Honyman esq. younger of Armadale.
Charles Lennox Cumming Bruce esq. of Rosile and Kinnaird.
Walter Campbell esq. of Shawfield and Ilay.
George Forbes esq. Banker in Edinburgh.
Alexr Norman Macleod esq. of Harris.
John Campbell esq. of Saddell.
Robert Græme esq. Advocate.
Roderick Macneil esq. younger of Barra.
Robert Maclachlan esq. of Maclachlan, Advocate.
James Stewart Hall esq. late of India.
Colonel William Macleod, Hon. East-India Company's Service.
Lieut-Colonel Donald Macdonald, late 92d Highlanders.
Major Archibald Menzies, 42d regiment, or Royal Highlanders.
Alexander Fraser esq. late Lord Provost of Aberdeen.
George More Nisbet esq. of Cairnhill.

Andrew Skene esq. of Lethinty.
Geo. Aug. Borthwick esq. M. D.
Donald Horne esq. } W. S.
Hugh Tod esq. }
Robert Sutherland esq. of St Vincent's.
William Macgillewray esq. of Mocho Plantation, Clarendon, Jamaica.
John Stewart esq. of Fasnacloich.
Richard Prentice esq. solicitor at law.
Wm. Murray esq. banker, Tain, factor on the estate of Balnagown.
Thos. Fraser esq. Lieutenant R. N.
Peter Macdowall esq. accountant, Edinburgh.
James Scott esq. accountant, Edinburgh.
Archd. Duncan esq. writer, Edinburgh.
Donald Stewart esq. factor on the estate of Harris.

30th June, 1817.

Sir William Purves Hume Campbell of Marchmont, Bart.
Sir James Wemyss Mackenzie of Scatwell, Bart.
Capt. Sir Thomas Cochran, R. N.
Sir Alex. Mackenzie of Avoch,
Colin Campbell esq. of Strachur.
James Wright esq. of Lawtown.
Dr James Hamilton of Corvar.
Lieut-Col. John Campbell, Hon. East-India Company's Service.
Daniel Macdowall esq. of the island of St Vincent's.
Alex. Gordon esq. Great King's Street, Edinburgh.
Samuel Parkes esq. of London.
James Dunsmure esq. Secretary to the Herring Fishery Board.
Major Dugald Campbell, Royal Artillery.
Captain Donald Macdonald, Royal Engineers.
Captain George Robertson, Hon. East-India Company's Service.
Stewart B. Inglis esq. late King's German Legion.
Dug. Gilchrist esq. of Ospisdale.
William Munro esq. of Achany.
Thomas Macmillan esq. younger of Shorthope, W. S.
George Graham esq. late of Cassafuar.
Andrew Taylor esq. of Westbarns.
James Easton esq. W. S.
Andrew Bell esq.
Robert Buchan esq. painter, Edinburgh.
Jas. Sands esq. at Blaircessnock.

13th January, 1818.

Right Hon. the Earl of Elgin and Kincardine.
The Hon. William Napier, Captain R. N.
Sir Alex. C. Maitland Gibson of Cliftonhall, Bart.
Lieut-General James Dunlop of Dunlop, M. P.
William Campbell Hamilton esq. of Winton.
John Corse Scott esq. of Sinton.
William Blair esq. of Avontoun.
John Crawford esq. of Auchinames.
Patrick Grant esq. of Redcastle.
Robt. Muirhead esq. of Croylakie.
Samuel Cooper esq. of Ballindalloch.
John Ure esq. of Croy Cunningham.
Peter Buchanan esq. of Auchmar.
Thomas Gordon esq. of Buthlaw.
Lieut-Colonel W. A. Gordon, late 50th regiment.
Major Malcolm Macleod, late of Bengal.
Alex. Chancellor esq. of Shieldhill.
John Morison esq. W. S.
Mathew N. Macdonald esq. W. S.
David Greig esq. W. S.

Walter Campbell esq. of Sunderland, Captain London East-Indiaman.
Captain Alexander Fraser, Royal Engineers.
Captain Ranald Macdonald, late 92d Highlanders.
Captain Charles Macgregor at Delavorar.
William Mackenzie esq. late of Calcutta.
Alex. Ponton esq. of Cairnley.
John Mackinlay esq. of Rothsay.
Robert Thom esq. of the Rothsay Spinning Mills.
John Barclay esq. M.D. Edinb.
Jas. Saunders esq. M.D. Edinb.
Rev. Angus Mackellar, minister of Pencaitland.
Alex. Craig esq. merchant, Edinb.
John Craig esq. merchant, Leith.
John Fred. Denovan esq. Leith.
John Mackay esq. Frederick Str. Edinburgh.
Donald Mackintyre esq. writer, Glasgow.

8th July, 1818.

General Francis Dundas.
Lieut-Col. John Baillie of Leys.
Wm. Baillie esq. of Polkemmet.
J. R Smollet esq. of Bonhill.
John Horrocks esq. of Tilleheun.
James Baikie esq. of Tankerness.
Alex. Garthshore Stirling esq. of Craigbarnet.
John Stirling esq. of Blackgrange.
John Bonar, esq. banker, Edinb.
Wm. Macdonald esq. of Balishare.
Alex. Scott esq. of Trinity Mains, W. S.
William Waddell esq. of Easter Moffat, W. S.
James Jardine esq. civil engineer.
Captain William Burn, 4th Royal Regiment Dragoon Guards.
Donald Stewart esq. residing at Auch.

12th January, 1819.

Right Hon. Lord Elcho.
Right Hon. Lord Strathaven.
Right Hon. Lord Glenorchy.
Right Hon. the Earl of Airly.
Right Hon. Lord Patrick James Herbert Stewart, M. P.
John Archd Stewart esq. younger of Grandtully.
James Moray esq. of Abercairney.
Wm. Robert Keith Douglas esq. M. P.
John Campbell esq. of Blairhall.
John Pringle esq. of Clifton.
Alex. Buchanan esq. of Arnprior.
Woodbine Parish esq. Chairman of the Board of Excise.
Major A. Leith Hay, younger of Rannes.
David Anderson Blair esq. of Inchyra, Advocate.
J. White Melville esq. of Strathkinness and Bennochy.
Elias Cathcart esq. younger of Alloway, Advocate.
John Whitshed Hawkins, esq. of Dunnichen, Advocate.
Græme Mercer esq. of Mavisbank.
Andrew Hunter esq. of Holybush, Ayrshire.
Robert Bruce esq. Sheriff-depute of Argyllshire.
Robert Davidson esq. Advocate.
George F. Mackenzie esq. of Allangrange.
Hugh Fraser esq. of Eskadale.
John Black esq. of Ardmannoch.
Anthony Macdonell esq. of Lochgary.
Lieut-Col. John Macdonald of Dalchosnie.
John Crawford esq. late resident at Java.
Robert Granberry Baillie esq. of Coulterallars.
John Anderson esq. of Gladswood.
Pat. Sanderson esq. banker Edin.
Robert Banks esq. of Craighead,

John Macalister esq. younger of Straithaird.
Jas. Gillespie Davidson esq. W. S.
Humphry Graham esq. W. S.
James Pedie esq. W. S.
Robert Mackglashan esq. younger of Eastertyre, W. S.
George Robertson esq. one of the Keepers of the General Records for Scotland.
Adam G. Geddes esq. Paymaster 10th Garr. Battalion.
Capt. William Balfour of Elwick.
Arch. Edmonstone esq. of Spittal.
Geo. Mackenzie Ross esq. of Aldie.
Dr Farquhar Mackinnon of Kyle, Skye.
Major Allan Macdonald 55th Regt.
Captain Patrick Campbell of the Royal Navy.
Capt. James Macdonald at Culnakyle.
Robert Scott esq. Writer, Duke Street, Edinburgh.
Robert Fraser esq. late of Malta House.
Quintin Leitch esq. Chief Magistrate of Greenock.
Robert Taylor esq. Blackness.
William Strang esq. of Lopness, Orkney.
James Dallas esq. merchant Edin.
Wm. Macbean esq. of Tomatin.
Alex. Cameron esq. of Surinam.

28th June, 1819.

Henry S. Wedderburn esq. of Wedderburn and Birkhill.
William Hay esq. of Drummelzier.
George Cranstoun esq. of Corhouse, Advocate.
John Grant esq. of Kilgraston.
Col. A. Farquharson, 25th Regt. or King's own Borderers.
John Stewart esq. late of Bombay.
Wm. Mitchell esq. of Parson's Green, Cashier Royal Bank.
Jn. Anderson esq. of Candacraig.
John Wedderburn esq. of Devonshire street, Portland Place, London.
Samuel M'Cormick esq. Adv. Sheriff-depute of Buteshire.
Miles A. Fletcher esq. Advocate.
Alexander Pearson esq. W. S.
Ralph J. Dundas esq. W. S.
Thomas Maconochie esq. W. S.
Robert Stewart esq. of Clochfoldich, Dep. Receiver General for Scotland.
Alex. Lamont esq. younger of Knockdow, W. S.
Robt. Speid esq. of Ardovie, W. S.
John Buchanan esq. of Carbeath.
Neil Mackinnon esq. of Demerary.
Dr Peter Macarthur of Delnies, Nairnshire.
William Craig esq. W. S.
Alexander Johnston esq. W. S.
Adam M'Chyne esq. W. S.
Capt. Gilbert Stewart, late 61st Regiment residing at Allein.
Capt. Peter Campbell, Hon. East India Company's service.
Daniel Fisher esq. Writer Edin.
John Macrae esq. Sheriff-substitute of Ross-shire.
Claud Marshall esq. Sheriff-substitute of Greenock.
James Macbraire esq. late of Newfoundland.
John Campbell esq. Lieut. Royal Navy, wine merchant, Edinr.
William Mackenzie esq. late of the 72d Regiment.
Alexander Shepherd esq. Solicitor, Inverness.
James Beaton esq. ditto ditto.
Gilbert M'Arthur esq. late of Demerary.

11th January, 1820.

Right Hon. Alexander George Lord Saltoun.
Right Hon. the Earl of Strathmore.

Sir David Moncrieff of Moncrieff, Bart.
Sir Joseph Radcliffe of Millsbridge, Yorkshire.
Robert Dundas esq. of Arniston.
Thomas Bruce esq. of Arnot, one of the Commissioners of Customs for Scotland.
Colonel Wm. Henry Knight Erskine of Pittodrie.
William Patrick Grant esq. younger of Rothiemurchus.
Archd. Nisbet esq. of Carphin.
Robert Jamieson esq. Professor of Natural History in the University of Edinburgh.
Roger Ayton esq. of Murieston, W. S.
Archd. Thomas Frederick Fraser esq. of Abertarff.
Samuel Anderson esq. W. S.
Gabriel Reid esq. of Gordonbush.
Major William Clunes of Cracaig.
William Dunlop esq. merchant, Edinburgh.
Alex. Henderson esq. one of the Surveyors Gen. Post-Office.
Thomas Peat esq. W. S.
Charles M. Adair esq. W. S.
Francis Suther esq. at Rhives, factor on the Estate of Sutherland.
Peter Lamond esq. merchant, Edinburgh.
Claud Muirhead esq. publisher of the Edinburgh Advertiser.
Captain John Grant of Firhall, Nairnshire.
James Anderson esq. Dep. Clerk of Justiciary.
Lieut-Col. A. Mackintosh, Hon. East India Company's service.

10*th July*, 1820.

Right Hon. the Earl of Leven and Melville
Sir William Milliken Napier of Milliken and Napier, Bart.
Thos. Alex. Fraser esq. of Lovat.
Major-General James Stirling.
J. H. Maclean esq. younger of Ardgour, Advocate.
Capt. James Pringle, Royal Navy, younger of Torwoodlee.
Hugh Macdonald esq. of Boisdale.
Robert Warden esq. of Parkhill.
Henry Ritchie esq. of Busbie.
William Cathcart esq. of Tower.
Wm. Urquhart esq. of Byth, Adv.
James Hay esq. of Belton.
James M'Alpine Leny esq. of Dalswinton
John Burn Murdoch esq. of Gartincaber, Advocate.
Mark Sprott esq. of Garnkirk, Advocate.
Rev. Dr John Campbell, Sec. to the Society in Scotland for Propagating Christian Knowledge.
Capt. William Ogilvie, R. N.
Capt. Alexander Gordon, R. N.
Wm. Balfour esq. merch. Glasgow.
John Smart esq. merchant, Leith.
George Hunter esq. of Callander.
James Buchanan esq. of Buenos Ayres, presently residing at Portobello.
Walter Morson esq. of the island of Mountserrat.
Simon Macqueen esq. residing at Corrybrough.
And. Clason, Esq. } writers to the
Wm. Renny, Esq. } signet.
Robert Stuart esq. Dep. Presenter of Signatures in Exchequer.
Rev. Mr Laurence Moyes, minister of Forglen.
Patrick Cheine esq. Great King's Street, Edinburgh.
Capt. Wm. Henderson of Gloup, late 27th regiment.

Number of existing Members, November 1820,
Twelve Hundred and Twelve.

No. II.

LIST *of* PRESIDENT, VICE-PRESIDENTS, *and other* OFFICE-BEARERS, *and of the* DIRECTORS, ORDINARY *and* EXTRAORDINARY, *for the Year* 1820.

His Grace the DUKE of ARGYLL.—President.

Right Hon. the EARL of MORAY. Right Hon. the EARL of WEMYSS and MARCH. Right Hon. the EARL of BREADALBANE. Right Hon. LORD GRAY.	Vice Presidents.

GILBERT INNES, Esq. of Stow—Treasurer.

R. MACDONALD, Esq. of Staffa—Secretary.

CLAUD RUSSELL, Esq. Accountant in Edinburgh—Auditor of Accounts.

The very Reverend Dr GEORGE BAIRD, Principal of the University of Edinburgh—Chaplain.

Mr LEWIS GORDON—Depute Secretary and Collector.

Mr CHARLES GORDON—Ditto ditto and Recorder.

Mr JAMES MACKAY—Jeweller and Medallist.

ORDINARY DIRECTORS, ACCORDING TO SENIORITY.

J. P. Grant, Esq. of Rothiemurchus, M. P.
John Hay, Esq. younger of Smithfield and Hayston.
Sir Robert K. Dick of Prestonfield, Bart.
William Inglis, Esq. of Middleton, W. S.
J. F. Erskine, Esq. of Marr.
John Norman Macleod of Macleod, Esq.
Alexander N. Macleod, Esq. of Harris.
Thomas F. Kennedy, Esq. of Dunure, M. P.
John S. More, Esq. Advocate.
James J. Hope Vere, Esq. of Craigiehall.

Alexander Marjoribanks, Esq. of Marjoribanks.
Robert Stevenson, Esq. Civil Engineer.
Hon. Lord Bannatyne.
Andrew Murray, Esq. of Murrayshall.
Patrick Neill, Esq. Secretary Caledonian Horticultural Society.
Robert Downie, Esq. of Appin, M. P.
James Hunter, Esq. of Thurston.
William Macdonald, Esq. of St Martins.
Sir Patrick Walker, Knight.
General Francis Dundas.
Sir Alex. Maitland Gibson of Cliftonhall, Bart.
H. Home Drummond, Esq. of Blair-Drummond.
C. G. S. Menteith, Esq. of Closeburn.
James Horne, Esq. of Langwell.
H. Macdonald Buchanan, Esq. of Drumakill.
Patrick Small Keir, Esq. of Kinmonth.
David Falconer, Esq. of Carlourie.

Extraordinary Directors.

Most Noble the Marquis of Tweedale.
Most Noble the Marquis of Bute.
Right Hon. the Earl of Airly.
Right Hon. Lord James Murray.
Right Hon. Sir John Sinclair, Bart.
Sir William Forbes of Pitsligo, Bart.
Sir Michael Shaw Stewart of Greenock and Blackhall, Bart.
Sir John Macgregor Murray of Lanrick, Bart.
Henry Mackenzie, Esq. Comptroller of Taxes.
Henry Jardine, Esq. of Harewood.

No. III.

TO THE RIGHT HONOURABLE

The LORDS COMMISSIONERS *of His* MAJESTY'S TREASURY,

The MEMORIAL of THE HIGHLAND SOCIETY OF SCOTLAND, incorporated by Royal Charter.

THE HIGHLAND SOCIETY OF SCOTLAND, faithful to the original objects of its institution, possessing, from the great number, rank, and respectability of its members, in all parts of Scotland, most extensive information, now, as always, having no other object than the general benefit of the community, begs leave humbly to submit to the consideration of the Lords of the Treasury, some circumstances relative to the Malt Duties; and more especially, the probable effects of two acts, * passed during the last Session of the last Parliament, whereby the duties payable for malt, made from Scotch grain, are not only increased, but the equitable principle upon which such duties had in general been previously imposed, is materially departed from to the prejudice of Scotland.

Your Lordships are aware, that although, a few years after the union of England and Scotland, a small malt tax then payable in England was extended to Scotland; yet Parliament, in 1725, acting upon the principle of the treaty of union, that Scotland was to be taxed 'with due regard to its circumstances 'and abilities,' reduced the malt tax for this part of the United Kingdom to one half of what was exigible in England; and the same proportions were observed with reference to the malt duties, until a comparatively recent period.

The Highland Society is, in a particular manner, desirous to bring under the view of your Lordships, the great difference in the quality, and in productive powers, of that inferior species of grain called Bear or Bigg, when malted, as compared with malt made from Barley; the more so, because bigg has long been found to be peculiarly adapted to the soil and severe climate of the western and northern counties of Scotland, the interests of which the

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* 59 Geo. III. Cap. 53. Do. Cap. 88.

Society is called upon in an especial manner to promote. Bigg besides its ripening earlier, is found to be a more hardy plant than barley, and, therefore, encouraging its cultivation in the Highland and less favoured parts of Scotland, is an object of high importance; as in late seasons, when not unfrequently there is almost a total failure in the crop of oats, the bear or bigg is a principal resource of the inhabitants for food.

Influenced by these considerations of equity and expediency, Government and the Legislature, in the imposition of the malt duties, continued to recognise not only the inferiority of Scotch Barley and bigg, when compared with English barley, but also the inferiority of Scotch bigg compared with barley raised in Scotland. This last distinction appears to have been first departed from in the repeal of the war duties in 1816, when the remaining duties in England were - 2s. 4d. per bushel.
In Scotland, whether malted from barley
or bigg, - - - 1s. $8\frac{1}{3}$d. per bushel.
As however these remaining duties were, upon the whole, moderate, and as the general principle of laying a smaller duty upon Scotch than English grain was adhered to, the circumstance as to the bigg, it is believed, did not at the time excite much notice or complaint. It was only upon finding, by the two acts already referred to, passed in July 1819, that duties to the amount of 3s. 6d. per bushel had been imposed upon malt made from every species of grain, the produce of any part of Great Britain, that the attention of the Highland Society was drawn to the subject.

In 1804, the relative malt duties in England and in Scotland, including certain additional war duties imposed in 1802 and 1803, stood thus—

	s. d.	
The duty on malt made in England, -	4 : 4	per bushel.
— — on malt of barley in Scotland,	3 : $8\frac{1}{3}$	do.
— — on malt of Scotch bigg, -	3 : $0\frac{1}{8}$	do.

making a difference of about 8d. per bushel in favour of Scotch barley, and of about 1s. 4d. per bushel in favour of Scotch bigg, as compared with barley malted in England; and of nearly 8d. per bushel in favour of bigg, with reference to barley the growth of Scotland.

Even this difference of duty, in favour of Scotch bigg, was thought too small; and the attention of the House of Commons having been called to the matter in 1804, and a Committee having been named to investigate the same, that Committee, as appears from its Report, printed by order of the House, of date 15th June, 1804, was of opinion, 'That there ought to be a

'deduction from the duties imposed in 1802 and 1803, in fa-
'vour of Scotch bigg, to the amount of one-third thereof.'

It appears further, from authentic official documents for the twelve years immediately preceding the 1st January, 1804, that the average price of English barley, per quarter,

was - - - - -	L. 1	16	11
Do. Scotch barley, per do. - -	1	9	8¾
Do. Scotch bigg, per do. - - -	1	6	5½

And it is believed it will be found, upon examination, that the same difference in average price to the disadvantage of Scotch grain has continued, with reference to the sixteen years which have elapsed since January 1804.

It may be here proper to advert to the experiments made in 1806, under the superintendence of the Commissioners of Excise for Scotland, with the view of ascertaining the relative qualities and value of malt made from English barley, Scotch barley, and Scotch bigg; while the general results of that investigation indisputably establish the inferiority of malt made from Scotch bigg, as compared with malt made from barley. There is no doubt that such inferiority would have been made apparent to a still greater extent, but for two circumstances: First, (as stated in the Report of the eminent scientific gentlemen employed), that of 'the English barley (of 1804) being much 'worse, and the Scotch bigg much better than usual;' and, secondly, that, with the exception of Aberdeen and Kincardineshires, the bigg on which the experiments were made, appears to have been exclusively the produce of the more southern and most improved counties of Scotland; while, from some omission, the bigg produced in the counties of Argyll, Bute, Inverness, Banff, Ross, Cromarty, Sutherland, Caithness, and Orkney, was not used in the experiments referred to, although bigg is exclusively cultivated in all these counties, which are besides known to be less favoured in point of climate, and less advanced in agricultural improvement, than the more southern counties of Scotland.

There is another important consideration, which induces the Highland Society to represent to the Lords of the Treasury, the great expediency of reducing the Malt Duties upon grain raised in Scotland. The Society repeatedly, and latterly in 1816, took the liberty of suggesting the advantage of licensing small stills in the Highland and more remote parts of Scotland, as a measure which, while it would tend materially to the increase of the revenue, might at same time, it was hoped, greatly diminish, if not effectually put down, the pernicious practice of illicit distillation; and the Society is gratified for the effect given by your Lordships to its suggestions. Legal small stills, suited to the capacity and situation of the country, have accordingly been established in various parts of the Highlands, and which are principally supplied from grain raised in those districts. Unless, therefore, there is an abatement of the present duties imposed upon Malt from grain raised in Scotland, but more especially from Scotch Bigg, these duties being, as already mentioned, 3s. 6d. per bushel, (*i. e.* the same as on the best English barley), the Society is convinced that the beneficial intentions of Government and Parliament, with reference to the establishment of small legal stills in the Highlands of Scotland, must be entirely frustrated; and that the pernicious practice of illicit distillation will not only continue, but increase;—a practice in the highest degree prejudicial to the public revenue, and to the physical and moral welfare of the people.

The Highland Society feels assured, that the Lords Commissioners of the Treasury, who can have no object but to do equal justice to all parts of the United Kingdom, will, upon deliberate consideration, see the equity and expediency of recommending to Parliament a deduction in the present Malt Duties, in so far as respects malt made from grain grown in Scotland, so as to preserve the proportion so long recognised between the English and Scotch Malt Duties; but, at all events, the Society begs leave humbly to express its opinion, that for the various reasons stated, it is just, as well as highly expedient, that there should be a considerable deduction in the duties on malt made from Scotch Bigg, with reference to the duties to be levied on malt made from Barley in England, or even from malt made from barley raised in Scotland.

ARGYLL, *President.*

HIGHLAND-SOCIETY CHAMBERS,
Edinburgh, 21*st April* 1820.

No. IV.

PREMIUMS

OFFERED BY

THE HIGHLAND SOCIETY OF SCOTLAND,

FOR

Information respecting Friendly Societies, or other Societies in Scotland which make Provision for their Sick Members.

Highland Society Chambers,
Edinburgh, July 10, 1820.

The Highland Society of Scotland, fully aware of the advantages that might accrue from Friendly Societies, if established upon proper principles, and being desirous of obtaining the most accurate information for enabling the Highland Society to suggest a remedy for the evils that have very generally prevailed in consequence of the erroneous constitution of these Societies,—has resolved to offer Premiums for the best and approved statements (founded on the experience of existing Friendly Societies, or other Societies in Scotland which make provision for their sick members) of the *quantum* and duration of sickness which has been found to occur among their members, with the view of ascertaining the proportion which "*the* "*average period of health bears to the average period of sick-* "*ness,*" and thus obtaining *data* from which may be computed the probable demand for aid among a given number of members, and the rate of allowance which any given contribution of the members of a Friendly Society can afford to its sick members.

The Statements are required to specify,

1*st*, The name of the Society referred to, and the place and date of its Establishment.

2d, The principal occupations of its Members, and whether their chief residence is in towns or in the country.

3d, The total number of the Members during the year, specifying how many are *free* Members; and, if the statement embraces more years than one, the total number of Members during *each* of the years to which it applies; the Sick and Superannuated, as well as the contributing Members of the Society, being included in reckoning the number. It will be proper that the number of the Free Members during each year be classed according to their age, thus:

Number under 20.

Ditto from 20 to 30,	40 to 50,	60 to 70.
30 to 40,	50 to 60,	above 70.

4th, The *quantum* and duration of sickness, or, in other words, the number of weeks sickness among the Free Members of the Society during each year to which the statements refer, specifying how many weeks sickness during the year occurred in *each* class, and distinguishing *bedfast* sickness, *walking* sickness, or any other description recognised by the Society, and disability from superannuation, or other causes, where it is the custom of the Society to give different allowances to persons in these different conditions.

5th, The average age of the Free Members yearly, and, when that cannot be given for a number of years, then the present average age of the Free Members of the Society, and the annual average age as far back as can be given.

6th, The limitation as to the commencement or duration of aid to Sick or Superannuated Members, established by the Rules of the Society, where there is a limitation.

7th, A copy of the Regulations of the Society, if printed, to be transmitted along with the statement.

PREMIUMS.

I. For the best and approved statement of the foregoing particulars, with reference to any one or more Societies in Scotland for any period of years preceding the year 1819, a Piece of Plate of 20 guineas value, or that sum in money, in the option of the competitor.

II. For the best and approved statement of the foregoing particulars, with reference to the greatest number of Societies in Scotland during the years 1819, 1820, and 1821, a Piece of Plate of 20 guineas value, or that sum in money.

N. B. The Premiums not to be awarded until November 1822, but the statements to be lodged at the Highland Society Chambers on or before the 1st of June of that year. It is to be understood by competitors, that all statements given in shall remain with and become the property of the Highland Society.

*** Printed Schedules, with appropriate columns, to be filled up with the several particulars required, will be furnished, on applying at the Highland Society's Chambers.

By order of a General Meeting of the Society,

LEWIS GORDON, *Dep. Sec.*

No. V.

DESCRIPTION OF AN IMPROVED SELF-ACTING PUMP.

Invented by JAMES HUNTER, Esq. of Thurston.

A, is a cistern filled by
B, a spring.
C, a cistern at which water is required.
D, a metal (water proof) box, 12 inches square and 4 inches deep, placed within A, and near the top of it. Whatever is the size of the pump, these boxes ought not to be deeper than 6 inches.
E, a pipe of half inch bore, leading from the top of A to the bottom of F.
F, a metal box, similar to D.
G, a pipe of half inch bore, leading from the top of F to the top of D, the upper part of it being above the level of B.
H, a pipe of half inch bore, leading from the bottom of D to the bottom of C, and which cannot be longer than the distance between R and S.
I, a valve (opening upwards) at the mouth of the pipe H.
K, a valve (opening upwards) at the bottom of D.
L, a valve (opening upwards) at the bottom of F.
M, a pipe which takes the overflowing water of E to
N, a small light pan, which, if filled with water, bears down
O, a lever, which, when pressed down by N, opens the valve L.
P, a pin, to which is fastened a piece of chain, having at its end a flat piece of leather, which, when N is pressed down, leaves it, and opens a hole at Q.
Q, a hole in the bottom of N, which must be made of a proper size, for the purpose of letting the water escape from N, in the same time that is required for D to be filled with water through K.

The following is the mode in which the Pump operates.

The vessels D and F being full of air, the water of A runs into E, expels the air from F, through G and D, to I; and fills E, F, and G to the level of B. It then runs over at R into the pipe M,

IMPROVED SELF-ACTING PUMP.

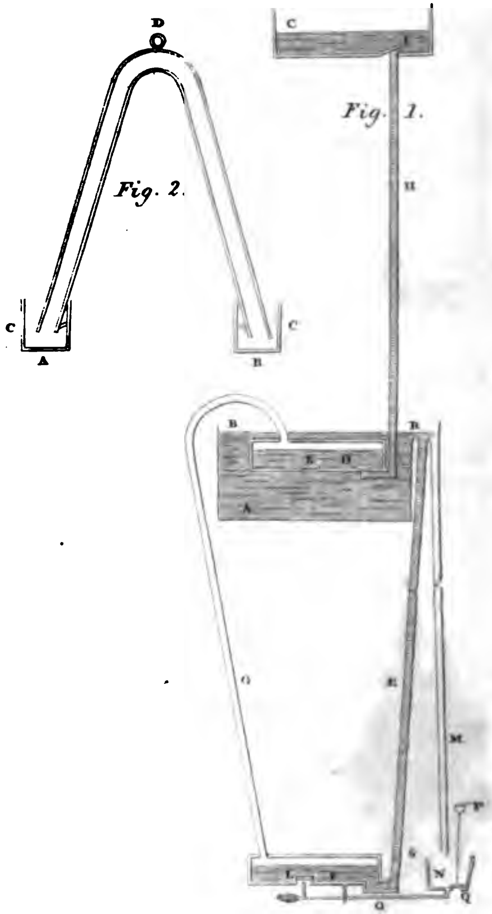


Fig. 2.

Fig. 1.

W. H. Lizars Sculpt.

Engraved for Highland Soc. Prize Essays. Vol. V. Part 2d.

fills N, which is borne down by the weight of water, and opens L and Q, as above described: the vessel F then empties itself at L, is filled with air from D through G, and D is filled with water through K. In the same time, N is emptied through Q, and returns to its place, allowing L to shut, and leaving F and G full of air. The water continues running through E, expels the air from F through G into D, which air expels the water from D through H up to C, until F and G are filled with water and D with air, when the machine is found in the same state as at first, E, F, and G being filled to the level of B.

This self-acting pump may be applied to many uses. If a person has a spring which supplies his house with water at the level of the middle storey, he may place F in the kitchen, and C in the bed-room, and every gallon of water used in the kitchen, will give a corresponding gallon (or very nearly so) in the bed-room.

In using this pump the pipe E may be supplied with impure or even very dirty water, and the whole of the spring B will be raised to C, instead of half of it being perhaps wasted at L; and in this manner any spring may be pumped up to the requisite level, without one drop being lost, merely by forming a dam or lead as in mills, and obtaining a fall for a part of the water equal to the height to which it is requisite to pump up the spring.

It is not necessary that R should be on a level with B. It may be far above or below it, and the effect will be nearly the same. The water will rise as high above D as from R to S.

The rain-water collected on the top of a house will pump up a corresponding quantity of pure water from a well as deep as the house is high; but this pump will be found most useful where a large body of water is to be raised to a small height.

The great superiority of this pump consists in its acting almost entirely without friction; and a second pump will raise half the quantity of water (not to twice, but) to three times the height of the fall.

A pump of the above dimensions (which are very diminutive) continued working without being touched for three months, and raised eight hogsheads of water every day.

Fig. 2. is a Syphon which keeps itself constantly charged, and is particularly useful where liquor to be decanted ought not to be shaken.

No. VI.

DESCRIPTION OF TWO SIMPLE INSTRUMENTS

FOR

ASCERTAINING THE RELATIVE ELEVATION OF UNEQUAL SURFACES, WITHOUT MATHEMATICAL CALCULATION.

Invented by John Graham Dalyell, Esq.

In constructing these instruments, their reduction to the smallest possible number of parts, and their application to temporary use by persons unskilled in the more complicated operations of levelling, have been principally in view.

Plate V. Fig. I. A B, a rectangular wooden bar, 6 feet 6 inches long, 5 inches broad, 1 inch thick, penetrated throughout half the length by a groove half an inch wide, and resting on the edge of a foot I K, 6 inches high, to keep it free of the ground.

C, a plummet suspended from the bar.

D E, a rectangular scale, 30 inches high and 4 inches broad, resting on a transverse edge E as a foot. It is penetrated by a groove corresponding to that of the bar, and graduated across by horizontal lines, as seen in H: the distance o H, where the graduations commence, being equal to B I.

F G, a screw and nut, whereby the bar and scale are to be connected.

If the plummet hang perpendicularly, and the angle A be a right angle, which is seen by the graduations coinciding or running in a straight line with the edge of the bar A B, the altitude of I above E is denoted by figures on the scale.

Thus, two points of different altitude being chosen, I, the support of the bar, is to be placed on the higher, and E, the foot of the scale, on the lower; while the position of both is secured by a slight turn of the thumb-screw. The bar being brought parallel to the horizon which the plummet will indicate, the upper part of the scale is to be advanced, or the re-

LEVEL.

Fig. 1.

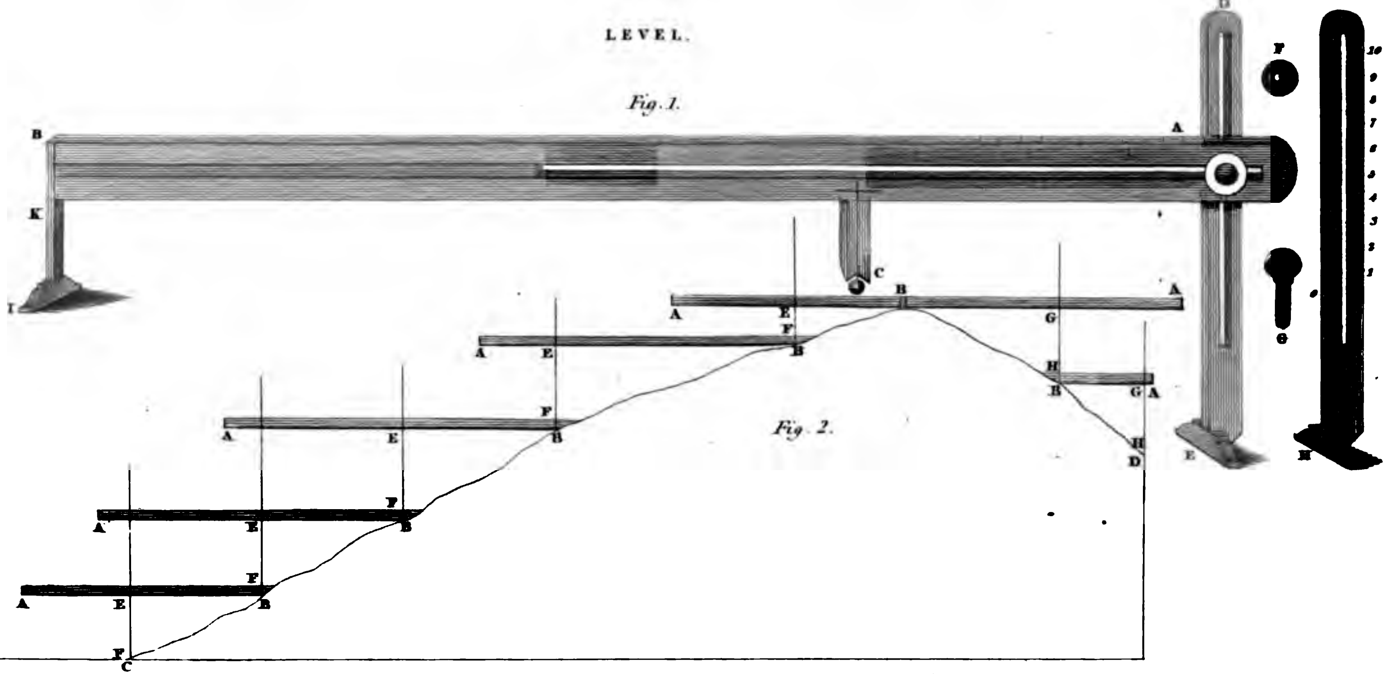
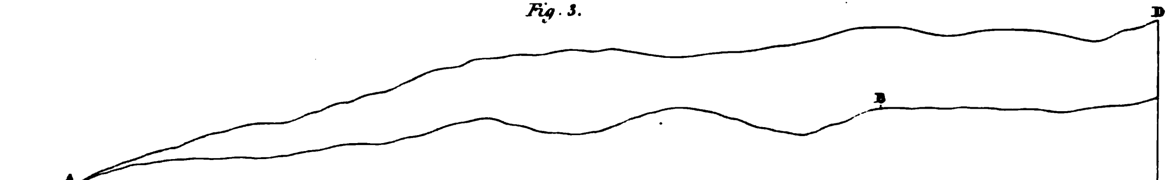


Fig. 2.

Fig. 3.



Eng^d by W.H.Lizars.

Engraved for Highland Soc. Prize Essays, Vol. V. Page 574.

verse, (keeping its foot on the point of support), until some one of the graduations coincides with, or is visibly parallel to the upper edge of the bar. The difference of altitude sought is seen in figures, without calculation.

This gives the difference of altitude between two points within the range of the instrument. In more extensive measurements, if the altitude of the point D above C be sought, (fig. 2.) let A B, the bar, become horizontal, and E F be rendered perpendicular to it, the height of B above C is found. The operation must be repeated, always resting the support of the bar on B in succession. The sum of the measurements will give the highest elevation above C. Then reversing the instrument, the declivity to D is to be found, which is the sum G H. G H. Therefore, $\overline{EF + EF + EF + EF + EF} - \overline{GH + GH}$ = the elevation sought, or the difference between C and D.

Fig. 3. If it be required to construct an inclined plane between A and B, rising an inch in a foot, the inner edge of the scale is to be brought 6 feet from B (Fig. 1.), and rendered perpendicular to it, by making the graduated line at 6 inches coincide with the horizontal edge of the bar. Being fixed immoveably by the screw in that position, the surface of the ground is then to be worked until the plummet hangs perpendicularly. The first six feet of the inclined plane having been thus constructed, other portions are to be taken successively throughout the remainder. If a plane of a different inclination is required from A to D, as of half an inch in a foot, the scale is to be shifted to 3 inches.

The dimensions of this instrument are indefinite; but, with well seasoned wood, they may be larger than above described. If designed for permanent use, three-fourths of the wood may be covered with a metallic plate; or perhaps the whole instrument may be made of metal. A common joiner can construct one such as the preceding in a few hours, and at the expense of a few shillings. The chief precaution consists in the edge of the bar being quite straight, and the lines of the scale being drawn horizontal, or at right angles to its length.

No. II. Another instrument of this kind, consists of two parallel arms, each half the breadth of the bar in the former; the upper, moveable on a brass joint, to admit of elevation. An apparatus, with a scale and expedients for rendering the upper arm horizontal, is adapted to slide along the under arm. The lower end of this apparatus with the scale resting on the ground, the scale itself is unfolded, until the coincidence of the graduations, as before, denotes the altitude sought. Either a plummet or a spirit-level may be used for ascertaining the position of the upper arm.

With instruments correctly made, and aided by the expertness gained by practice, the level of roads, drains, ditches, or subterraneous works, may be taken with great facility.—An operative model, on the principle of each, was submitted to the Society.

END OF VOLUME FIFTH.

D. Willison, printer, Edinburgh.