TRANSACTIONS

OF THE

SCOTTISH ARBORICULTURAL SOCIETY.

EDITOR AND SECRETARY.

JOHN SADLER, F.R.Ph.S.,

LECTURER ON BOTANY IN THE ROYAL HIGH SCHOOL, AND ASSISTANT TO THE PROFESSOR OF BOTANY AND MEDICINE IN THE UNIVERSITY OF EDINBURGH.

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The Society, as a body, is not to be considered responsible for any facts or opinions advanced in the several papers, which must rest entirely on the authority of the respective authors.

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ERRATUM.

Page 199 line 4 from bottom, *for* 1847 *read* 1874.

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SCOTTISH ARBORICULTURAL SOCIETY.

I. *Address delivered at the Nineteenth Annual Meeting.* By HUGH CLEGHORN, M.D., F.R.S.E., late Conservator of Forests, Madras.

GENTLEMEN,—On taking the chair to which the General Council has called me, my first duty is to thank you for the honour conferred in electing me as President of this Society, an honour which I had little reason to expect, considering that twenty-six years of my life have been spent out of Scotland, and that I am personally unknown to a large proportion of the members. I greatly regret that the notice given to me was so short, that it has not been possible for me to prepare an address suited to the occasion; but I beg to assure you that I will discharge to the best of my ability the duties of my office, and exert myself to promote the interests of the Society.

Eighteen years have elapsed since our association was formed, and though at first its growth was slow, it has been steady. It now embraces in its membership about 600 names, and advances with enlarged prospects of usefulness. The printed Transactions supplied to all our members have reached the seventh volume; these give the best clue to what is being done amongst us. In looking over them for my own information, and for suggestive material in addressing you, I observe a decided improvement in the prize reports; some are very valuable papers, while none are without interest. These records show a wish on the part of many of the members to enlarge their stock of knowledge, and here I may remark, that though we may often go over what appears to be the same ground, we must not relax our exertions as if we had attained to the full extent of knowledge; let us make sure of what we have already acquired, and then press on seeking to add our quota towards the stock of mutual help and general information, which can only be increased by individual effort.

We who are met together on this occasion are, with few exceptions, practical foresters, and it is as such that I am proud to address you. As foresters loving our calling, we are in constant converse with nature, but we are none the less a busy people, with our hands generally full. We have for the most part as much to do as we can do well, in discharging the routine duties of our position, often more than any ordinary strength or industry can dispatch in a satisfactory manner. We are, therefore, rarely inclined to travel out of the record—to undertake work which does not press. We can seldom get far enough before our duties, or high enough above them to contemplate them *ab extra*, and as a whole, to speculate, classify, consolidate, or systematise. We answer the immediate call; we meet the immediate claim; we provide for the immediate emergency; we are practical men of business, not philosophers; we apply ourselves energetically to understand and transact whatever affair is before us; but we scarcely ever find time to regard questions in their connections and with reference to long eras or to distant generations. What is forced upon us we do; what is not forced upon us we postpone.

This, I take it, is the case of most of those I am addressing. For myself, many of the best years of my life have been spent in the direct charge of very extensive forests, and I can therefore sympathise very keenly with those who feel that the engrossing nature of the duties of to-day interferes with that *foreseeing provision* for the future which distinguishes the profession of a forester more perhaps than any other. Not that I mean to convey that the life of a forester can be lived without thought, and much thought being given to the effect on the future of the labours of to-day; but all must feel that the day's need too frequently overshadows the morrow's requirement, however strongly they may realise that a forester who makes no provision for the wants of the future is unworthy of that title.

And it is in managing forests of small extent, such as many whom I address have charge of, and the property of private individuals, whose circumstances rarely admit of their sacrificing the present to the future, that the truth of my remarks becomes more apparent. Few private individuals can afford to take that higher view of forest conservancy which wishes to make provision for generations yet unborn, and fewer still, perhaps, realise the extent of their, so to speak, national responsibilities to maintain the forests which they possess.

It is but three months ago that the newspapers recorded the facts of high floods in England, France, and Italy, accompanied with most serious damage in various places. That these floods, primarily due to excessive rainfall, are aggravated by the more general drainage which the improved agriculture of the present day has introduced, there is no doubt, but it is equally certain that the denudation of the mountain tops has greatly contributed to this result, and with the removal of their verdant clothing, we have to regret not only the washing away of soil from the slopes once covered with forest, but to mourn over homesteads and villages once smiling and now abandoned, and vast areas of richly cultivated land overwhelmed and made barren by the *detritus* of mountain torrents in their now aggravated impetuosity. It is the destruction of forests which has led to this desolation.

How vast is the influence of the forests of a country! They affect the humidity of the air and earth; they influence the temperature; they afford important shelter from the east winds, the *mistral* and the *sirocco;* they create springs, and they tend to control the flow of rivers. The teaching of "savans" (Humboldt, Herschel, and Arago), the records of travels (Marsh, Pallas, and Sandys), the sufferings of nations (Italy, Spain, and Greece), have sadly demonstrated these facts, even in very recent times.

In what way forests arrest the progress of flights of locusts in the East, of coffee-borers and other noxious insects, has now, by careful investigation, been placed beyond doubt; and it is believed by many that they set a limit to malarious vapour, and also to rust spores which infect cereal crops. The productiveness of grain fields is increased by establishing plantations, the health of the cattle is improved, the evil of drifting sand is checked, as for example by planting the *Pinus maritima* on the dunes of France; thus in many ways the material prosperity of a country is bound up with the maintenance of a due proportion of woodland suitably distributed.

During the first stage of colonisation in most countries, as for instance Australia, India, and America, and while settlers are thinly scattered, demands on the wood supply are usually so limited as not to cause undue destruction of indigenous forest, nor to occasion alarm for future requirements. But immigration goes on, agricultural industry is extended, railways are formed, all these causing encroachments on the forests to take place, and ultimately denudation follows, with its many attendant evils; and often when it is *too late* the maintenance of forest riches for the first time engages the attention of the legislature.

That such has not been the result in our own country is doubtless due to our insular position, and to our rich resources of mineral fuel. Of the first, and the advantage we thereby possess of being able to draw supplies from all quarters of the globe, nothing short of a convulsion of nature can deprive us; but in regard to the second, the recent disturbance in the labour market may well make us thankful that the time has not yet come when the sinister prognostications of our experts as to the remaining extent of our coal measures have been fulfilled, so far as to oblige us to resort much to vegetable fuel as a substitute. In this connection, I may be permitted to express my conviction that much good may result from the present labour movement in the introduction of coal-cutting machinery, and the consequent diminution of the number of human beings employed under ground, and in the needful economising of the back-bone of our national wealth—*our coal*. And in this last remark, foresters will at once recognise, though indirectly, the importance of their calling. It is where timber is the fuel in use for domestic purposes that the value of the forester's work has come to be most appreciated, and we accordingly find that in foreign countries destitute of coal resources, or backward in their development, the legislature has been compelled to intervene to provide for the maintenance of the forests.

If, then, we would profit to the utmost by the experience of others in this important branch of economics, we must not rest content with a knowledge of the results attained in the narrow sphere presented within our own native land, or of the way in which those results have been reached; most valuable as such knowledge is, the conditions under which it has been accumulated, though diverse, are not sufficiently comprehensive to afford the conclusive data which will be obtained by a study of the matured system of conservancy and reproduction that has grown up in those countries where vast forests are held by the state in trust for the people, and the operations are conducted on a scale commensurate with the interests involved, not only in the immediate present, but in the long distant future.

Bearing in mind what I have already said as to the circumstances which gradually lead to the ultimate denudation of countries, it will be no matter of surprise to you to learn, that in an empire in which we are all deeply interested, which numbers a population of probably

200,000,000 of people distributed in many parts more thickly than in Lancashire or the country round Glasgow, and in which but few Europeans, and probably not one native, have *ever* eaten a meal cooked with coal, a fuel famine has for years been impending. The introduction into India of railways, and the rapidly increased demand for timber for sleepers and fuel, at length forced the attention of the Government to the vital question of forest management.

In the year 1856, when engaged in multifarious duties as a medical practitioner and Professor of Botany in the medical college of Madras, I was unexpectedly called upon to organise a forest service, and to take charge of the forests in south India, a territory three or four times as large as Great Britain. I had had no training in my youth specially to fit me for such a duty; but the need was urgent, and trained foresters were not to be had; if they had been available, the want of the language and ignorance of the habits and products of the country would have rendered them comparatively useless. It is true that at the time I was engaged in teaching botany, to which I had long devoted much attention, and in my youth I had been accustomed to rural life in Scotland, circumstances which were all in my favour. When, with considerable misgivings, I undertook the duty, the natural forests in most parts of the country had been ruthlessly wasted by felling and burning, and no system had been adopted to regulate the cutting, or to provide for the wants of future generations by preserving existing forests or forming new plantations. Magnificent trees were sacrificed for insignificant purposes, and planks were not sawn, but hewn with an axe, one tree furnishing a single plank. The State therefore stepped in to arrest the waste, and to adopt measures for husbanding the resources for present use, and for the supply of posterity. In course of time, after preliminary explorations and valuation surveys, the country was divided into districts, each of them as large, many of them larger, than Perthshire, and placed under the charge of one assistant conservator or forest ranger.

My duties for twelve years necessitated much and rapid travelling in order to become acquainted with the forests over which I had been called to exercise some control. These forests are scattered over a great extent of country, sometimes dotted here and there in small patches, seldom in compact masses. My duties were to ascertain the proprietary rights (if any existed), or rights of pasturage, which wandering tribes possess, to mark out the first class forests to be reserved by Government, to separate the tracts attached to villages, to frame leases with native chiefs, to establish and inspect depôts for timber, to supply the Indian Navy, the gun-carriage factory, and various public works, and to arrange annual auctions for the general wants of the country.

How different is the experience of foresters in Britain! They are generally engaged, not in the husbanding of state forests, where the good of generations yet to come guides your measures, but in forests belonging to private individuals, where the chief objects are, to meet the current demand for estate purposes, and to yield a good annual revenue. Woodlands in private hands are everywhere managed on the same economical principles as other possessions, and many proprietors will always sell their woods, unless they believe that it is for their pecuniary interest to preserve them.

In no other country of the world is there such careful arboriculture as in Britain; and it is in Scotland that many of the most beautiful and extensive British forest plantations have been formed (such as the famous larch plantations in Blair Athol, superintended by Mr Macgregor). But most valuable as your training has been for the exercise of your calling in Scotland, it can hardly be denied that a training on a more comprehensive system than is possible under the peculiar circumstances of our little island, to which I have already alluded, would be valuable for a larger sphere of action. In this I think you will agree with me, although the conditions of my connection with forest management (to which I am indebted for this opportunity of addressing you) are such as naturally predispose me in some measure to look for guidance, where the conservation of forests has been the result of circumstances similar to those of India, and the management of which has grown up under like conditions.

But should I fail to carry your assent to this opinion, you will, I am assured, bear with me, when I say that, considering the responsibilities placed upon a state forest department, we cannot make too sure that the agents employed in it have the widest opportunities possible of seeing forest operations conducted on a large scale, and that their training is arranged so as to take full advantage of the ripe experience available in those countries in which state forests have long existed, as well as of that skill and experience which is to be found at our own doors.

A main essential in forest operations is economy, and it is on the magnitude of the scale on which operations are conducted that economic results largely depend. The adaptation of means to ends is here involved; and though it would be altogether incorrect to say, that what answers on a small scale will not answer, or will answer only in a less degree, on a large scale, there can be little doubt that those who have to administer on a large scale should first study administration on a large scale; for the results of a mistake which on a small scale may be insignificant, may on a large scale be fatal. It is in this view that the differences between the administration of private forests and of government domains are so marked; and whether we confine our view to the more ordinary operations of forest conservancy and working, including the agency by which timber should be got out of the forest, or embrace within our gaze those allied operations, such as the making of forest surveys, the demarcation of forest tracts, the transport and cutting up of timber, the construction of slides and roads, &c., we must feel that in the matter of the adaptation of means to ends, we should lose much experience if we confined ourselves to the experience available in our private forests, or in any one country whatsoever.

I may mention to you some of the most striking differences that occur to me between the management of Scotch and Indian forests. One great point of difference is, that with many of you, much attention is given to ornamental effect; I, on the contrary, had to do with dark unfrequented forests, where there was often no human eye except that of those employed in forest work. Another difference is, that while our forests are subject to depredations by hares, rabbits, and in some places by deer, the Indian forests are exposed to the rooting up of wild hogs, to the browsing of goats, many of the deer tribe, and above all of camels, whose hard palate, strong teeth and jaws, enable them to break off and masticate thorny branches as thick as the finger. Again, from the vast extent and scattered position of Indian forests, to encircle them with fences, living or dead, is almost a physical impossibility; the usual method of demarcation is by the erection of boundary pillars between which extends a broad belt of cleared ground. This has to be cleared annually, and is useful for checking the ingress of forest fires, which are of frequent occurrence, and are often productive of serious damage.

The circumstances regarding the carriage of heavy timber in India are peculiar, and the transport is generally effected by means of trained elephants or buffaloes. The former valuable animals are now becoming scarce, and it is for many reasons desirable, if not essential, that foresters for India should acquire some experience in moving long and heavy logs over difficult ground, in the formation and use of slides, and in floating timber both in rocky mountain torrents, and in large flowing rivers.

In the Himalayan pine forests, the felling usually takes place in summer, but the slipping and launching of the logs often takes place in October and November when snow is on the ground; consequently there is much that is suggestive for our Himalayan forests in the Swiss and Bavarian Alps. Again, I have no doubt that the timber trade of Norway, and the lumber operations in Canada, where the rafts often contain many hundred thousand cubic feet, would afford much instructive information to those charged with floating operations on our great Indian rivers, as the Irrawady, the Godavery, and the Indus. The floating arrangements in Strathspey, where artificial floods are produced by storing water in a succession of small dams, are very instructive. Most of the youths who have lately gone to India had an opportunity of seeing these operations under the guidance of Mr Grant Thomson, but I know of few forests in India where this identical system of engineering would be found to answer; it would, however, be suggestive to those in similar difficulties. There are various collateral duties falling to foresters in India, which you would scarcely think came within their province. I allude to the preparation of charcoal, and the collection and manufacture of tar and empyreumatic products, which will some day become a matter of great importance in India; further, the collection and manufacture of lac, gums, and resins, as gamboge and kino, the collection of India-rubber, the preparation of potash, and the impregnation of timber by means of antiseptic substances—creosote, chloride of zinc, sulphate of copper, or corrosive sublimate.

At the late meeting in Brighton of the British Association for the Advancement of Science, the grant of L.20 was again renewed, for the purpose of taking observations on the effect of the denudation of timber on the rainfall in North Britain. It is to be hoped that the arrangements for conducting the investigation may be judiciously made and successfully carried out, in correspondence with the energetic secretary of the Meteorological Society.

At the same meeting an instructive paper was read "On the Distribution of Forests in India" by Dr Brandis, Inspector-General of Forests to the Government of India. The writer divides the country into arid, dry, and moist zones, according to the yearly average rainfall in each; and the extent and direction of the several zones were clearly marked out in a coloured map. It was characterised by the *savans* present as a most able and valuable contribution to the physical geography of India, containing truly philosophical views. The paper has appeared in "Ocean Highways," a monthly record of geographical progress. (Oct. 1872, p. 200.)

In England, forest literature has not yet, in my opinion, taken the place which it ought to occupy. In Germany, France, and Italy, there are thousands of volumes and several periodicals, both monthly and quarterly, devoted to sylviculture. There is an annual almanac, giving the names and duties of several hundred forest employés in the service of the state. In these days, when almost every branch of industry starts its own organ, it is not improbable that a Forest Journal may be successfully maintained a few years hence, in which all forest questions could be freely discussed.

I have now, gentlemen, in a cursory way, sketched some of the terrible consequences of neglecting the natural forests of a country, as contrasted with the benefits of careful conservancy. Many of the facts and places alluded to have come under my own observation in the course of duty as a government servant.

I have been favoured with opportunities of visiting the woods of Madeira, the sandy deserts of South Africa, a very large part of British India, the plains of Egypt, the arid island of Malta, classical Sicily, and the rich though sadly denuded shores of Italy. From one and all of these I am ready to acknowledge that I have learned something, both of the difficulties to be overcome and of the success granted to persevering efforts in arboriculture; and were it my lot again to return to India, the remembrance of what I have seen in my various visits to the fine woods of Scotland and the state forests of England, would prove highly useful and instructive.

Every country has its peculiar difficulties, but along with these we see special adaptations to overcome them, and the application of the right means to the end desired is ultimately crowned with success.

II. *On the Quantity of Rain which falls in a Wooded Country as compared with an Unwooded.* By ROBERT HUTCHISON, Esq. of Carlowrie, F.R.S.E.

The important question of the influence of forests upon the rainfall, the temperature, and the humidity of the air in a country is one so complicated, and demanding for its accurate solution observations both extensive and prolonged, that it need not excite surprise that meteorologists hitherto, although admitting the importance of such an inquiry, have taken no practical step towards the solution of this interesting problem.

From time to time, no doubt, attention has been called to the subject, but only in a casual or very general manner; and the fact remains, that in the United Kingdom, redolent as she is with scientific inquiry, no society or institution has as yet given its direct bent to the question of the effects of either the overplanting or the denudation of timber upon the rainfall of the country, and consequently in an indirect manner upon the health of the community. It is, therefore, satisfactory to know that this Society has undertaken such an inquiry, and that through its exertions we may hope for definite action being taken in this interesting and useful line of investigation.

For several years past, both in France and in Denmark, by the aid of the Academy in the one, and of the Agricultural Institute of Copenhagen, and more recently of the Government itself, in the other, organised and complete systems of careful observations have been going on, and already very interesting facts have been deduced.

To some of the general results of these tabulated observations we shall by-and-bye refer in this paper, with the view of directing the attention of members of this Society to what is being done in other countries regarding a matter of equal importance to our own, and which must prove of deepest interest to themselves individually as practical arboriculturists; and it is but fair to state that much of the subject matter of this paper is translated and collated from the French reports of M. Becquerel, who undertook the inquiry and observations for several years in different parts of the arrondissement of Montargis (department du Loiret), and of M. Lacour Danois, who was in 1869 intrusted with a similar scientific mission by the Government of Denmark.

We have abundant authority to prove that the belief in the material influences which a *wooded* district exerts upon the rainfall, and in the equally appreciable effects, though in a diametrically opposite direction, which are caused by excessive denudation of woodlands, exists in the minds of philosophers of acknowledged enlightenment in our own country. For example, Sir John Herschel, arguing that to a very great extent the climate of a country is under man's control, states—"It is chiefly in his clearance or allowance of arborescent vegetation, and in his artificial drainage of the soil that his influence is perceptible." * And again, in his report to the Meeting of the British Association in 1865, "On the rainfall of the British Isles,"† Mr Symons asserts that the annual mean rainfall is decreasing appreciably upon an average of nearly 4 per cent. over the whole area of the country, but especially along a tract of land extending from Cornwall to the Wash; and this deficiency he attributes partly to the extensive clearances of timber, and partly also to the divergence of the flow of the springs by ground drainage, now considered so necessary for the high-farming of the present day, by the advanced agricultural knowledge of the period.

If then it be true, that the overfelling of timber and the excessive drainage of our fields tend to diminish the rainfall, and if a certain quantity of rain at certain seasons be requisite to maintain the equilibrium of healthy climate, and to prevent the recurrence of periodic droughts, and short crops, whether root or cereal, it is then clearly essential that there should be an adequate extent of wooded surface properly distributed over the area of the country. The main questions then come to be, Is it true? And next, What would, for Great Britain, be an adequate and properly distributed acreage of woodland?

As, however, it may be held that as yet the proposition is not proved to be true that in this country the presence of a certain counterbalancing proportion of plantation is requisite to maintain a certain proportion of rainfall over the whole area, it may be as well to defer meanwhile following out this branch of the subject in detail, and we shall, therefore, at present only remark, that taking the total acreage of Great Britain at 57,000,000 acres, of which probably about 2,600,000 are under plantation and woodland, or barely 1½ per cent. we find an amount which, if we except the relative proportion of wooded lands in Portugal, is considerably under that

* Familiar Lectures on Scientific Subjects. Weather and Weather Prophets.
† Proceedings of British Association, 1865.

of any other country ! If we even assume the calculation of Col. Sir Henry James, R.E., chief of the Ordnance Survey Department, who estimates that in England alone the proportion of wooded area is equal to 2½ per cent., we still find a considerable deficiency as compared with similiar areas of other countries, with the one exception already noticed. Thus we find—

Country.	Total Areas.	Wooded lands Areas.	Percentage under Wood.
France,	129,216,000 imp. acres	21,966,720 acres	or 17 per cent.
Germany,	135,738,240 acres	*	*
Austria,	144,799,840 acres	15,850,837 acres	or 11 per cent.
Denmark,	6,849,812 Dan. töndes	319,102 Dan. töndes	or 6·61 per cent.

Therefore it appears that the importance of the subject now under consideration has forced itself upon State notice; and in many countries of the continent,—as, for example, in Germany, France, Hanover, and now also in Italy,—as it is well known, schools of forestry exist, and laws are rigidly enforced in relation to the conservancy of woods. Large tracts of fertile acres, producing the finest cereal crops in the world, now flourish in Hungary, where formerly arid sterility prevailed. This has been brought about by the judicious distribution of plantations in zones, and in large masses in the district of the Vosges; and even in our own Indian empire, so important is it now deemed to conserve the forests of the different provinces, that it forms a separate department of imperial control; and, according to the words of the present Under Secretary of State for India (Mr Grant Duff), "had we known thirty years ago what the importance of forest conservancy is for India, L.30,000 per annum, now requisite for irrigation, would have been saved to the Indian exchequer;" and we may be permitted to add, much of the misery and starvation caused by periodical rice famines would have been avoided. The soil of the Himalayas is very similar to that of a great part of the area of Scotland. The difference consists in climate chiefly, and if the proper distribution of wood and its conservancy can modify and ameliorate the fickle climate of a large portion of India, or at least is considered conducive to such bene-

* Owing to the recent amalgamation of the German Empire these figures cannot yet be quoted.

ficial results, why should steps be neglected at home, or investigations as to the efficacy and value of such steps be overlooked? There are many tracts of land in Scotland which might be advantageously planted up, and thereby, we cannot doubt, the capricious rainfall be modified, and surrounding pastures and fields at higher altitudes brought under the ploughshare. Doubtless in this respect much, very much, has been already done, but still there remains a considerable amount to reclaim, and an undue severity of climate to improve, in many districts. Why is it that at the present day, in Lanarkshire and Peeblesshire, and in other counties also at elevations of 800 and 1200 feet above sea-level, noble specimens of many of the recently introduced *Abies Douglasii* are to be seen? It is entirely due to previous judiciously arranged plantations, having so ameliorated the soil and climate that, interspersed with the native fir or hardy spruce, we now see the Douglas pine vieing with them in luxuriance. And if planting be so important, and plays so prominent a part in those respects we have alluded to, we hold it to be no less essential for the due distribution of rainfall throughout the country, for to a great extent it is regulated by such local influences. But assuming, then, that for climatic purposes, a due balance of acreagé under wood is to be maintained in any country, how is the precise amount of land to be so occupied to be ascertained? This is a very difficult question to solve, and one requiring much careful analysis of the separate individual requirements of different countries and their capabilities. For instance, in one country, whose necessity for wood as its staple of fuel, and whose consumption of such may be an increasing one—as, for example, in Russia—a much larger area would be requisite, unless indeed rapid-growing trees were planted as crop, and felled as they advanced in blocks from year to year. Of course, the larger the body of land the greater would be the amount essential for hygienic purposes, or climatic balance. And again, the other necessities of the economy of the country must be looked to, such as the area for food-producing or flesh-growing crops. Germany, for example, we find requires fully 20 per cent. for agricultural purposes; France in 1868 had 17 per cent. under wood, and for her own requirements this was found much too small a proportion of plantation. To provide for equal rainfall distribution, therefore, the mode that appears most feasible and at the same time consistent (if it is found after sufficient investigation, that a standing area of woodland is essential to the welfare of any country), is for the Government, as in the case of

India, to take the necessary acreage of State forest-land under its control, and to set it apart for the purpose. Were such a plan followed out in England, a Government school of forestry might thus easily be established, and young men trained there for service in the Indian or other colonial forests, instead of, as at present, being under the necessity of sending aspirants to Indian forest vacancies abroad to the schools of Germany or France. If such an establishment be found beneficial for the education of the youth of this country (specially for the Indian *civil* service), as Cooper's Hill College, in London, why should not some similar establishment be organised for the Indian forestry department? This is, however, apart from the immediate subject before us, and to return from such a digression, we may remark, *a propos* of the necessary quantity of land required for plantations properly distributed over the area of the country with a view to equal distribution of the rainfall, that the present condition of England may safely be assumed as a basis, and her present supply of woodland as at least a fair normal one; and since we find that, as there are estimated to be in England 2,600,000 acres under wood, against a total of 57,000,000 acres, it follows that we may assume 1 acre in 22 as a fair requisite proportion for shelter, health, and climate.

Having thus far noticed the general aspect of importance which the subject presents, and passing over, in the meantime, the burden of proof that trees and plantations *do* exert those influences upon the rainfall of a country, which it has been asserted pertain to their presence or absence, we may take up the question, what *does* influence the rainfall of a country?

So numerous are the causes which lend their influences to affect, for increase or decrease, the quantity of rain that falls over any large surface, such as the area of a country, that it is very difficult to state one *a priori.* Even if we were in possession of an accumulated mass of facts and statistical observations extending over several years, such as have been collected in France and Denmark, we should find that many purely local or casual circumstances intervene to throw doubts upon the results deduced from even the most carefully ascertained hygrometric observations. Taken in the abstract, however, we may mention what we consider the four *primary* elements at work in increasing or diminishing rainfall generally:—1. Atmospheric pressure; 2. Neighbourhood of the sea; 3. Prevailing winds, according as these are dry or moist; and, 4. Altitude. But while these all act more or less powerfully according to circumstances in producing rainfall, there must always be others, which, although entirely local, and probably therefore more difficult to define or specify, are nevertheless of considerable potency in their agency, and these must be known before we can determine the climate of any locality with regard to humidity. In fact, curious and conflicting discrepancies may ffequently be observed between the quantity of rain which falls in two situations proximately situated to each other, and at the same altitude, at the same distance from the sea, and exposed to the same wind, which will then force upon us the undeniable conclusion that the variation is due to *local* shelter, or from the one situation being exposed (while the other is not) to moist winds, being situated on a height, or in a valley. We may here mention a fact which has been frequently observed. When the clouds, wind-driven, and careering along at no great elevation above the earth's surface, approach or encounter a mountain, or sometimes even a small hill only, they are seen perhaps to rise, and attaining thus to a colder stratum of air, they become condensed into rain; and may we not, therefore, believe that forests or plantations of timber, when the clouds are very low, produce the same results, varying probably with the seasons? Of course, any such influence will be intensified, and rendered the more sensitive, in proportion to the area of the plantation or forest, and as the masses of woodland are more or less considerable. Upon this point, however, until the contemplated hygrometric observations from a variety of stations under suitable conditions have been obtained and tabulated, it is impossible to speak with anything like certainty; and it is just one of those many interesting points which, apart from all theory or preconceived notions on the subject, it is desirable to settle conclusively if practicable, and that can only be done in any complicated problem or dark unsolved mystery, by applying to it the lantern of experiment and careful observation. This necessitates the establishment in different parts of the country of observatories, in each of which daily records must be made of the temperature of the air and of the sun, as well as of the quantity of water which falls *under woods*, on the margins of the same plantations, and at distances more or less remote from these woods. For a society like the Scottish Arboricultural Society, it may be perhaps better, at first, at all events, to confine the registers of its observers only to the rain-gauges in these situations, leaving those concerning the thermometers, *as optional at present*, upon those willing to undertake their registration.

Something of this description has been undertaken several years ago in France by M. Becquerel, who in 1868 had established, with the help of the academy, five observatories in different parts of the arrondissement of Montargis (department du Loiret), in each of which daily observations have been made since the month of July 1868, until, we presume, the ill-omened recent Franco-German war put a stop to all such peaceful study. The results of these observations, however, we are unfortunately unable at present to communicate in this paper. They will, however, be obtained and published at a future opportunity.

In Denmark also, the Agricultural Institute of Copenhagen have obtained similar observations, taken at fourteen different stations in the interior, near forests, and at a distance from them; and more recently, in 1868, M. Lacour Danois was entrusted with a similar and more minute scientific mission by the Danish Government. The results arrived at by the various observations contained in the tables annexed to his report are briefly as follows :—

The localities in which the observations were made form two distinct groups,—the first, in Jutland; the second, in Zeeland. The one consists of ten observatories, the other of four. The observations were first commenced in September 1862, and were continued till 1869. Their discussion has shown that the quantities of water which fell at 9 leagues and at 2 leagues, differ from each other from 243 to 129 millimetres; whilst in other localities, in the middle of the forests, on the outskirts, at 5 leagues distant, and in an unwooded country, the differences do not exceed above 30 millimetres. Similar results were obtained from the Zeeland groups of observatories, with regard to the quantity of rain which fell in forests, and 2 leagues distant. These are differences too small to justify us in concluding that in Denmark more rain falls by reason of forests than at a distance from them. In inquiring whether the seasons do not influence the distribution of rain, it has been ascertained that, generally speaking, the rainfall of summer and autumn is nearly double that of winter and spring. Denmark is in the region in which the summer rains are prolonged into autumn; we have besides discovered this fact which is not without interest, that in six localities there falls a little more rain in summer and in autumn than in winter and spring in the middle of the forests and on their borders than at a distance of from 2 to 5 leagues distant. In other localities the reverse is found to be the case. Ought this fact to be attributed to local causes? It is impossible to tell. The observations made bring out distinctly the facts above related. We may, however, remark that Denmark, being situated between two seas—the ocean and the Baltic—possesses a very damp climate, which, of course, renders local influences less powerful.

Passing now to the observations made in five localities in the department du Loiret, from August 1865 to April 1868, in a circle of about 20 kilometres ($12\frac{1}{2}$ miles), in the middle of woods, under trees, on the outskirts, and in unwooded positions; and upon a comparison of these with similar registers taken at Paris, it is found that in a space of eight months, one-fourth more rain fell in wooded than in unwooded localities. But whether or not this is an infallible fact, it is premature as yet to assert from the absence of a sufficient number and variety of observations.

M. Becquerel also compared the quantities of rain which fell in places shaded by trees with what fell in places outside the woods, in order to ascertain how much water was retained by the branches, according as they were or were not in leaf, and he proved the following fact, which of course was to have been expected, that the portion retained by the branches is greater in proportion as the rain is less heavy. When the branches are in full foliage, there was 0·47 of the quantity of water which falls in an unwooded plain so retained, while it is about one-half of that quantity in winter, the effect varying according as the leaves are more or less shaken by the wind. "What then becomes," he asks, "of the water retained by the branches and leaves?" and answers his query, as follows:—"It is probable that the portion which escapes evaporation descends by the trunk and the roots into the soil and subsoil, where it supplies the lower springs." Without venturing upon more definite statistical data, for want of a sufficient number of observations, in 1868, M. Becquerel came to the fair conclusion that, throughout the arrondissement du Loiret more rain falls in wooded than in unwooded districts, a conclusion which, there is little doubt, will be amply verified by his subsequent collection of observations, under the same conditions, not only in the same department, but also in different parts of France and abroad. These observations he contemplated combining with others on temperature, from researches conducted by means of instruments for determining the degree of humidity in the air above trees and under them. What these researches have resulted in, we shall be obliged, from the length of this paper, to delay to another occasion.

Suffice it to say, that all such undertakings, however initiatory even, are laudable in themselves; and with a mass of such accurate details as this indefatigable Frenchman has so interestingly collected and recorded, and with his observations to aid in guiding us to similar researches in the wooded districts of Scotland, useful documents may be obtained for the solution of the important question of the influence of forests and trees upon the rainfall, the temperature, and the humidity of the air in a country.

III. *Report on an Arboretum at Cluny Castle, Aberdeenshire.*

By William Gilchrist, Forester.

The premium offered by Messrs Lawson and Sons being for a "Report on the most extensive, complete, and judiciously arranged Arboretum," it is well to state at the outset that the arboretum at Cluny Castle cannot lay claim to the two first requirements, and the third is partly a matter of taste guided by local circumstances. However, as it contains upwards of 360 varieties of ornamental trees and shrubs, I submit a report thereon. It consists of two detached divisions; in the one, the plants are grown singly, to promote and exhibit their ornamental capabilities; in the other, most of the same species are mingled with ordinary forest plants, so that their value as timber-producing trees may be compared with the varieties now in general use when grown under the same circumstances. The planting of both divisions was begun in the spring of 1868, and the principal plants were planted in the spring of 1869; but as the results are already somewhat different, it will be better to note each division separately.

1. The division containing the ornamental specimens may be described as a belt about 400 yards long, with an average breadth of 21 yards, in the form of an easy reversing curve, exposed to the south-east, and sheltered on the north-west by an almost parallel belt of hardwood trees. The elevation is from 280 to 350 feet above sea-level, as per Ordnance Survey. The soil is a light brown loam, and the subsoil gravelly, of variable depth. In some parts it is very hard, and almost impenetrable at from 12 to 15 inches from the surface. Previous to being planted, it was old pasture land with a rough foggage. There are a few old stone drains; but as the ground has a rather steep declivity to the south and south-east, and shows no symptoms of undue wetness, it was not thought necessary to put in more drains. In December 1867, the ground was trenched from 15 to 18 inches deep, at a cost of about L.11, 10s. per acre, and a few of the specimen trees planted without any particular arrangement. During the early spring of 1869 all the plants were replanted, and arranged in the following order:—

A gravel walk, $4\frac{1}{2}$ feet wide with grass borders, runs through the centre, and on each side of the walk there are three parallel lines. The first line is on the south-east or outside, and consists of deciduous shrubs; the second line, of coniferous trees and shrubs alternately; the third line, next to the walk, of dwarf evergreen shrubs; the fourth line, on the other side of the walk, is similar to the third, and the fifth line to the second. The sixth line is composed of hollies, hawthorns, and some of the newer varieties of dwarf-growing deciduous trees. A portion near to the centre being broader than the average, the fifth and sixth parallel lines are slightly deviated from. Between the parallel lines and the hardwood belt on the north-east side is a strip of mixed trees and shrubs planted closer than the others, to form a background and screen from the old belt.

In the parallel lines the plants are 15 feet apart, and generally single specimens, except some of the smaller varieties, which are in groups of three or four plants. The whole are arranged so that the shrubs and dwarf varieties may be grown as underwood, and the larger varieties allowed sufficient space for development.

The first or outside line contains specimens of *Berberis Darwinii*, *dulcis*, and *vulgaris; Cornus* (dogwood) *alba*, *mascula*, *variegata*, *sanguinea; Cotoneaster Simonsii; Deutzia corymbosa* and *scabra; Genista*, varieties; *Hippophae rhamnoides* (buckthorn) and *salicifolia; Leycesteria formosa; Lonicera xylosteum*, and *tartarica; Philadelphus coronarius*, *grandiflorus*, *latifolius*, *nanus*, *verrucosus*, and *Zeyheri; Potentilla fruticosa*, *Ribes aureum*, *Menziesii*, *sanguineum*, *atro-sanguineum*, and *flore albo; Spiræa adiantifolia*, *ariæfolia*, *callosa*, *corymbosa*, *Douglasii*, *Foxii*, and *opulifolia; Symphoricarpus occidentalis* and *racemosus; Syringa Josikæa*, *persica*, *alba*, *Charlemagne*, *Charles X.*, *grandiflora*, *Triomphe d'Orleans*, and *Prince Nottiger; Viburnum Opulus*, *rosea*, and *sterilis*, double Guelder rose.

The second and fifth lines and the broad portion in the centre are composed of specimens of *Abies Albertiana*, *canadensis*, *Douglasii*, *excelsa*, *firma*, *inverta*, *monstrosa*, *pendula*, *Menziesii*, *orientalis*, *Smithiana; Araucaria imbricata; Biota orientalis; Cedrus atlantica*, *Deodara* and *Libani; Cupressus Lawsoniana*, *stricta*, *macrocarpa*, and *nutkaensis; Juniperus chinensis*, *hibernica*, and *recurva; Picea amabilis*, *bracteata*, *Cephalonica*, *Fraseri*, *grandis*, *lasiocarpa*, *magnifica*, *nobilis*, *Nordmanniana*, *Pichta*, *Pinsapo; Pinus austriaca*, *Benthamiana*, *Cembra*, *excelsa*, *Laricio*, and *ponderosa; Retinospora obtusa*, and *pisifera; Wellingtonia gigantea* and *variegata; Taxus fastigiata* and *Nidpathensis; Thuja gigantea*, *Lobii*, *occidentalis*, and *Warreana*.

In the third and fourth line on each side of the walk are *Abies clanbrasiliana; Biota aurea* and *elegantissima; Cephalotaxus* *drupacea; Cryptomeria japonica* and *Lobbii; Juniperus canadensis, caucausica, rigida, drupacea, excelsa, excelsa stricta, argentea; Retinospora filifera, plumosa,* and *squarrosa; Sequoia sempervirens; Taxus elegantissima,* variegated silver and golden; *Alaternus,* two varieties, green-leaved and variegated; *Arbutus,* several varieties; *Aucuba japonica,* male and female; *Azalea,* six varieties; *Buxus* (boxwood), several varieties not named; *Daphne Laureola, Mezereum, atropurpureum* and *alba; Ilex,* variegated hollies, twelve varieties; *Laurestinus,* varieties; *Ligustrum japonicum* and *ovalifolium; Mahonia aquifolia* and *japonica; Pernettya floribunda* and *mucronata; Tamarix gallica; Rhododendron* (hybrid), twelve varieties. Besides these, it is intended to introduce 100 named varieties of rhododendrons during the incoming season.

In the sixth line are specimens of *Acer Negundo, rubrum* and *stricta; Betula asplenifolia, laciniata, pendula* and *populifolia,* varieties of double-flowering cherries; *Cratægus* (flowering thorns), varieties, including *coccinea, Douglasii, latifolia, Macnabiana,* and *odoratissima,* Paul's new double crimson, *reginæ pendulæ purpurea,* single and double scarlet, double pink and white. These are planted alternately with varieties of hollies, including *Ilex angustifolium,* blotch-leaved, *Dowingtonense,* Dutch, *Hodgensii,* hedgehog, *hybridum, latifolium, laurifolia, myrtifolium, nobilis, regina* (Queen), gold and silver, *serratifolia, pictum, tricolor, Scotica,* yellow-berried, &c.; *Quercus austriacus, Fordii* and *Lucombi.* In the strip of mixed trees and shrubs between the sixth parallel line and the belt of hardwood trees are, *Acer campestre, austriacum, circinatum, colchicum, Douglasii, eriocarpum, Leopoldii, macrophyllum, monspessulanum, Neapolitana, opalifolium, pensylvanicum, Pseudo-Platanus, burettia, purpurea, albo-variegata, Corstorphine, saccharinum, tartaricum; Æsculus* (horse-chestnut) *Hippocastanum coccinea, flore pleno, rubra, spectabilis* and *rubicunda; Alnus americana, cordifolia, glutinosa, asplenifolia, Hudsonica, incana, orientalis, ovata, serrulata,* &c.; *Amygdalis* (almond) *dulcis, pedunculata, persica flore pleno* and *alba; Betula* (birch), several varieties; *Carpinus* (horn-beam) *americana, betulus, heterophylla* and *incisa; Carya* (hickory tree) *alba* and *amara; Castanea* (chestnut) *Americana, vesca, asplenifolia, cochleata* and *crispa variegata; Cytisus* (laburnum), several varieties; *Fagus* (beech) *asplenifolia, cristata, pendula, purpurea,* &c.; *Fraxinus* (ash) *Caroliniana, aurea, aucubæfolia, integrifolia, nigra, sambucifolia; Juglans* (walnut); *Liriodendron tulipifera; Mespilus* (medlar); *Morus* (mulberry) *nigra* and *rubra; Platanus* (plane) *nepalensis, acerifolia, occidentalis, orientalis,* &c.; *Populus* (poplar) *alba,* new variety, *Abele, balsamifera, canadensis, canescens, cordata, Caroliniana, dilatata, Lindleyana, nivea, tremula, pannonica,* &c.; *Pyrus,* several varieties not named; *Rhamnus catharticus* and *frangula; Salix acuminata, alba, pendula,* and new silvery, *amularis, argentea, Babylonica, caprea,* Kilmarnock and American weeping, *pentandra,* golden, Huntingdon, Bedford, &c.; *Sambucus* (elder), scarlet-fruited and other varieties; *Tilia* (lime) *alba, europæa, asplenifolia, grandifolia,* &c.; *Ulmus* (elm) *crispa, fastigiata, gigantea, purpurea,* Camperdown, weeping, *pendula,* &c. Besides these, there are common and Portugal laurels, Scots yews (varieties), hollies of sorts, *Pinus montana* and *maritima,* and other forest trees, as also small plants of the commoner coniferous trees and shrubs, mentioned as being in the parallel lines.

These trees are planted too close to remain permanently, but they are regularly root-pruned, so that they can be removed at any time, the chief object being to test the hardiness and suitableness of the different sorts for the district, and to have specimens of as many varieties as possible, so that they may be permanently planted in suitable places when their individual characters are known. A number of the hardier varieties have already been removed, and others substituted in their places. Some of the willows and poplars are not expected to become large trees, as the situation is not suitable; but some of the specimens are so interesting that it is thought desirable to grow them for a time for reference and as a contrast with the other varieties.

There are two small rockeries (one at each end), and growing in these and on a stone wall adjoining are varieties of ivy, lonicera, brambles, briars, &c.

As the planting has been done at different periods, the exact cost cannot be stated, except for the spring of 1869, when the division was laid out and the plants arranged. During that season the wages for work in connection with planting, &c., amounted to L.38, 10s.; and during each season since there has been about L.4, 15s. expended (exclusive of cleaning) in root-pruning, replanting, &c. The original cost of the plants is shown in the annexed table.

The result of the planting of this division in 1869 may be said to have been a complete success, as only one of the conifers (*Abies Smithiana*) was lost. A few of the deciduous plants went back, but have sprung again from the root. During the first winter most of the doubtful varieties were protected from frost by spruce branches, and each succeeding winter the small tender plants have been protected by the same means. In the spring of 1871, *Picea Pichta* was slightly frosted, and *P. Pinsapo* and *cephalonica* lost their leaders from the same cause, but they have again got leading tops. The late frosts this spring (1872) slightly affected some of the larger varieties, including *Picea nobilis*, *glauca*, but the damage has not been followed by serious results. Two of the best *P. nobilis* had 14 inches broken off their main leaders in the month of July last, when they were in full vigour, and the young shoots in a brittle state. Heavy birds alighting on the tops were supposed to be the cause, and to prevent this occurring to any of the others, small wood stakes were attached to the main stems, reaching above the tops, so that birds might alight on the stakes and not on the tops. No similar accidents have occurred since.

Some of the *Cedrus Deodara* and *Libani* were overgrown and bushy before planting, and required severe pruning before leaders could be procured, but with these exceptions, and the removal of double leaders and foreshortening with the finger and thumb of extraneous lateral shoots when in a young and soft state, these plants have received no other treatment.

II. The second division is about 500 yards to the west of that already described. The form is triangular, containing about 3½ acres. Elevation, soil, and subsoil similar to No. 1. Exposure to the west and north-west; sheltered from the south-east. Previous to planting, it was old pasture; but it was deep-ploughed and thoroughly harrowed before being planted in the spring of 1868 with a mixture of ordinary forest trees at about 3½ feet apart. The plants and planting cost about L.6, 10s. per acre. The ornamental trees, to which I shall refer, were planted in the spring of 1869, their introduction being an afterthought, consequent on the planting of division No. 1, the object being to test them along with the ordinary forest trees.

It would be useless to enumerate all the plants in this division, as, with the exception of some of the newer and rarer sorts, most of the varieties planted in No. 1 occur also in No. 2, with the addition of *Pinus Jeffreyii*, *monticola*, *Murrayana*, *Pallasiana*, and *pyrenaica*. The shrubs and dwarf varieties are arranged on the south-west side (parallel to which a carriage-drive passes), and the taller varieties to the background. The coniferous trees are planted at 30 feet apart, and the principal hardwood trees in the centres. For the first two years the ground was kept regularly cleaned, but for the last two years only about eight yards in width, next to the carriage-drive, has been dressed, the plants being closely met on the rest of the ground.

The ordinary hardwood trees, as also the spruce, larch, and Scots fir, are making rapid growth; but it will be seen from the annexed table that some of the ornamental varieties are doing better, especially *Picea grandis* and *nobilis*, *Abies Douglasii* and *Menziesii*. The true pines were all very small when planted, but they are also doing well, particularly the Austrian, Corsican, *ponderosa*, and *pyrenaica*. Some of the Wellingtonias had the points of their lateral shoots frosted on the 8th of October, and less slightly, *Abies Menziesii* and *Smithiana*, *Picea nobilis* and *magnifica*. Some of the Acers were also slightly touched, but no trees appear to be materially damaged, except the Wellingtonias; however they may soon regain their appearance, as the tops are not affected. At the same period none of the plants in the other division were the least injured. The whole of the shrubs along the side of the carriage-drive, although fully exposed, are doing remarkably well; but being chiefly the same varieties as in the other division, the names are not repeated in the table, as it is only for the timber-producing trees that this division is noticed.

It will be seen from the table that the coniferous trees in this division are making greater top growths than in No. 1, but less laterals or spread of branches. No doubt this is owing to the confinement, but as they are all taking girth of stem along with top growths it will be interesting to compare and note progress. In the meantime, it is well to keep in view that in No. 1 the plants were much larger when planted, and all selected; while in No. 2 they were much smaller, and not particularly selected. The column stating the cost of plants shows a great difference in original prices.

All the trees in both divisions were planted by pitting in the usual manner, without manures or artificial stimulants of any kind. Owing to the ground having been trenched or ploughed, the rough turf was generally brought to the surface in making the pits, but it was carefully chopped up before being put into the pits again. As a matter of course, the best of the soil was put next to the roots of the plants, and great care was taken to place the roots at the proper depth and as naturally as possible.

The names of the coniferous plants in No. 1 division are shown in enamelled letters on "Maw's terra-cotta labels," suspended by galvanised wire stakes in front of each plant. The names of the others are written on zinc labels, with a preparation sold for the purpose, and the labels are, as a rule, attached to one of the branches of each plant by copper wire.

Seeing that this "arboretum" has been recently formed, and that new varieties are being constantly added, it would be premature to state how the different sorts of plants are likely to succeed. However, the annexed tables give a comparative view of their progress, and affords some criterion as to the prospects of future success :—

Note.—Since the above was written the following sorts have been added to the collection .—*Abies Englemanii, Biota semperaurescens, Cephalotaxus Fortunei, Juniperus filicoides, Sabina, Schottii, virginiana, glauca; Taxus adpressa, glauca, Dovastonii, erecta, ericoides*, and others; *Thuja occidentalis, pendula; Arbutus*, 12 named sorts; *Buxus pendula, variegata*, and 6 named sorts; *Berberis Belstaniana, Jamiesonii, empetrifolia; Cerasus Azoricus*, and *myrtifolia, Corylus*, 14 sorts named; *Quercus coccinea, Rubus leucodermis*, &c.

[TABLE.

TABULATED STATEMENT OF PLANTS IN ARBORETUM AT CLUNY CASTLE.

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
CONIFEROUS ORNAMENTAL TREES AND SHRUBS.			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Abies alba	1869	1/	4	12	16	16	...	...	...	...	6	3	0	6½	4	0	11	Thriving plant, but only grown here for variety.
Albertiana	1869	5/	7	20	34	33	...	...	...	...	11	6	0	11	10	0	12	Both graceful, and growing remarkably well.
do.	1869	5/	10	18	34	36	...	...	...	...	12	3	1	3	9	0	12	
do.	1869	3/6	...	...	...	...	8	14	20	18	8	6	0	8	6	0	10	Not so graceful, chiefly owing to the confinement.
Canadensis	1869	/6	3	7	8	8	...	...	...	...	3	0	0	6¾	5	6	10	Inclined to be shrubby; best specimen in No. II. Division.
do.	1869	/6	...	...	...	...	4	8	10	12	3	6	0	6¾	5	6	10	
Douglasii	1869	10/6	6	18	30	30	...	...	...	...	11	0	1	2	10	0	12	These are not so dark green as some others, and appear to be a different variety.
do.	1869	4/	7	18	20	21	...	...	...	...	10	0	1	3	9	0	10	
do.	1869	4/	10	20	8	24	...	...	...	...	9	6	1	0	7	6	10	Transplanted in 1871, and is bearing cones this season.
do.	1869	1/	8	12	24	24	...	...	...	...	8	6	1	0	8	0	9	Dark green, and glaucous in appearance.
do.	1869	1/	...	...	...	..	6	16	30	42	9	9	0	11½	8	0	9	
excelsa	1869	/3	6	12	10	10	...	...	...	...	6	0	0	6½	5	0	10	Both plants look well, but that in Division No. I. promises to be the most ornamental.
do.	1869	1/6 p. 100	...	...	...	...	4	8	12	15	4	3	0	5	3	6	9	
inverta	1869	21/	6	9	8	4	...	...	...	...	9	6	0	6½	2	6	15	Said to be the two best specimens in Scotland.
do.	1869	21/	5	11	9	5	...	..	...	...	11	0	0	8	3	0	15	
do.	1869	3/6	...	...	...	...	4	12	6	9	7	0	0	6	2	0	10	Not so graceful as the two former, but apparently more healthy.
monstrosa	1872	3/6	...	...	...	6	...	...	...	...	2	6	0	4½	2	6	6	A good contrast, but not considered ornamental.
do.	1872	3/6	...	...	...	...	...	...	...	7	2	7	0	4½	2	6	6	
nigra (Blk. American)	1869	1/	4	18	8	8	...	...	...	...	5	6	0	6½	3	0	11	Growing in the shade; soil apparently too dry.
do. do.	1869	1/	...	...	...	...	4	16	14	14	6	0	0	6½	3	0	11	Much healthier in appearance than the former.
firma	1869	5/	2	8	10	5	...	...	...	...	3	5	0	8	2	0	12	Not looking so well as some of the others.
Menziesii	1869	7/6	12	24	44	40	...	...	...	...	16	4	1	3½	9	6	14	Situation too shaded, and soil apparently too dry.
do.	1869	7/6	10	20	18	33	...	...	...	...	12	0	1	5	10	0	14	
do.	1869	1/	...	...	...	...	8	18	30	33	10	6	0	8	7	0	11	Growing on the outside of the enclosure.
do.	1869	1/	...	...	...	...	6	18	24	34	9	8	0	7	5	0	11	Very healthy.
orientalis	1869	5/	4	6	14	12	...	...	...	...	5	6	0	9	4	0	14	Improved in appearance during the past two years.
do.	1869	5/	4	4	8	13	...	...	...	...	5	9	1	2	6	6	14	
do.	1869	2/6	...	...	...	...	4	6	12	12	4	4	0	6½	5	0	10	Appears to be well adapted for growing amongst other trees.

TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Abies Smithiana	1869	7/6	3	3	6	4	...	...	...	...	5	6	1	0	5	0	12	All have been more or less injured by frost, but those in No. II. Division less so.
do.	1870	7/6	...	4	9	6	...	...	...	...	5	3	1	0½	5	0	12	
do.	1869	3/6	...	...	...	...	4	6	8	6	4	0	0	9	4	6	10	
Araucaria imbricata	1869	10/6	4	6	18	5	...	...	...	...	7	4	0	10½	7	6	14	None of these have ever been injured by frost, while within 600 yards; at an elevation of 250 feet they have invariably failed.
do.	1869	10/6	3	8	14	4	...	...	...	...	6	9	0	11	6	6	14	
do.	1869	4/	...	...	...	...	4	8	6	6	4	0	0	7	3	6	12	
do.	1869	4/	...	...	...	...	6	7	9	3	5	0	0	7½	4	0	12	
Biota orientalis	1869	1/6	3	5	5	4	...	...	...	...	3	6	0	5	1	6	10	Both have suffered slightly from frost periodically.
do.	1869	1/6	...	...	...	...	2	5	4	6	3	0	0	5	1	6	10	
aurea	1871	5/	...	...	2	5	...	...	...	...	2	0	0	4½	15	0	7	Has as yet been protected from frost.
do.	1871	5/	...	...	...	...	...	...	3	5	2	3	0	4½	15	0	7	Do. do.
elegantissima	1871	5/	...	...	3	5	...	...	...	...	2	4	0	4¾	15	0	7	Do. do.
do.	1871	5/	...	...	...	...	...	...	3	5	2	1	0	4¾	15	0	7	Do. do.
Cedrus Atlantica	1869	1/	5	6	10	9	...	...	...	...	5	0	0	8	4	9	10	Backward the first year, but now growing rapidly.
do.	1869	1/	6	10	14	15	...	...	...	...	6	0	0	7½	6	6	10	
do.	1869	1/	...	...	...	...	6	9	16	18	6	6	0	7½	6	0	10	Doing better than the former.
Deodara	1869	5/	6	18	15	15	...	...	...	...	8	0	1	1¾	6	6	12	It has been difficult to get leaders formed in No. I., and some of the plants had to be severely pruned. Leaders have come away better in No. II. Division.
do.	1869	5/	3	8	14	17	...	...	...	...	6	6	1	0	6	0	12	
do.	1869	3/6	4	8	10	16	...	...	...	...	5	3	0	9	5	0	11	
do.	1869	3/6	...	...	...	...	3	9	12	12	5	6	0	9	4	6	11	
Deodara argentea	1869	5/	6	6	10	9	...	...	...	...	5	6	0	9¼	5	0	12	A good specimen, very pleasing and graceful.
Libani	1869	3/6	3½	12	8	6	...	...	...	...	4	9	0	5	5	0	13	Severely pruned in both Divisions, but have now fair leaders.
do.	1869	3/6	...	...	...	...	4	12	9	9	5	3	0	7	4	6	13	
Cephalotaxus drupacea	1871	2/6	...	...	2	4	...	...	...	...	2	0	0	4½	1	3	7	Although protected with spruce branches during winter, have been all injured by frost.
Cryptomeria Japonica	1871	1/6	...	...	3	9	...	...	...	...	2	9	0	4	2	0	7	
Lobbii	1871	2/	...	...	3	6	...	...	...	...	2	3	0	4	2	0	7	
Cupressus Lawsoniana	1869	7/6	9	12	18	15	...	...	...	...	9	6	1	1½	9	0	13	Have never received a check, are growing beautifully, and seem well suited for the situation. Various in habit.
do.	1869	7/6	7	13	15	12	...	...	...	...	9	0	1	2	10	0	13	
do.	1869	3/6	...	...	...	...	6	11	12	8	6	0	0	8	4	6	11	
do.	1869	3/6	...	...	...	...	7	10	14	12	6	9	0	9	5	3	11	
do. compacta	1869	7/6	4	7½	8	10	...	...	...	...	5	6	1	0½	2	0	12	A very distinct variety, and keeps its character well.
do. stricta	1869	5/	5	8	8	12	...	...	...	...	7	0	1	1	2	6	12	One of the varieties sent out from the Perth Nurseries.

TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I. 1869	1870	1871	1872	Annual Growth of Division No. II. 1869	1870	1871	1872	Present Height. Ft.	In.	Girth at Surface. Ft.	In.	Spread of Branches. Ft.	In.	Age. Years.	Remarks.
			In.	In.	In.	In.	In.	In.	In.	In.								
Cupressus Lawsoniana variegata aurea	1872	5/	...	...	...	3	...	...	...	...	1	9	0	4½	1	3	7	Made very little progress this season, but is an acquisition.
macrocarpa	1872	3/6	...	...	...	6	...	...	...	...	4	6	0	5¾	2	0	7	Former plants have not stood this climate.
Nutkaensis	1869	5/	4	10	12	18	...	...	...	...	8	6	1	4	7	6	11	All growing vigorously, but the lateral shoots seem as if they require to be kept in check.
do.	1869	5/	6	9	15	19	...	...	...	...	9	0	0	10	6	0	11	
do.	1869	2/6	...	...	...	...	7	13	10	12	6	6	0	6	4	0	9	
do.	1869	2/6	...	...	...	...	8	13	13	11	7	0	0	7	4	6	9	
do. viridis	1869	5/	4	8	10	8	...	...	...	...	5	9	0	8	6	0	11	
Juniperus Canadensis	1869	1/6	3	4	7	7	...	...	...	...	4	9	0	9½	2	6	10	Backward the first two years, but now doing better.
do.	1869	1/6	...	...	...	...	3	3	7	6	4	8	0	9	2	6	10	
Chinensis	1869	2/6	6	9	12	9	...	...	...	...	3	9	0	6½	3	6	10	These have all done well, and in different situations have stood frost with impunity.
do.	1869	2/6	7	10	10	11	...	...	...	...	6	4	0	7½	5	0	10	
do.	1869	2/6	6	12	10	10	...	...	...	...	6	2	0	7	3	6	10	
do.	1869	2/6	...	...	...	...	7	9	10	10	6	6	0	7	4	0	10	
communis compressa	1872	2/6	...	...	...	3	...	...	...	...	1	3	0	3½	0	9	6	A fine distinct variety, and an acquisition if it succeeds.
Hibernica	1869	1/	4	6	8	8	...	...	...	...	5	9	1	1	1	6	9	Both are doing well—*Suecica* appears to be the most tender.
Suecica	1869	1/	5	6	8	6	...	...	...	...	4	9	0	6½	2	6	9	
rigida	1871	5/	...	...	3	6	...	...	...	...	2	6	0	4½	1	3	8	Appears well suited for the situation.
drupacea	1872	21/	...	...	...	4	...	...	...	...	3	6	0	5½	1	3	8	A very fine variety, if it succeeds and stands the climate.
excelsa	1869	2/6	6	8	7	8	...	...	...	...	5	0	0	6½	4	0	9	Several plants of this variety have been lost by frost.
do.	1869	2/6	5	8	8	9	...	...	...	...	5	1	0	6½	4	0	9	
do. stricta	1869	12/6	2	3	5	3	...	...	...	...	3	4	0	7	2	0	9	Apparently hardier than the former.
argentea	1869	2/6	3	3	5½	5	...	...	...	...	4	0	0	6¾	3	0	9	A pleasing variety; seems well suited for the situation.
recurva	1869	5/	6	7	10	8	...	...	...	...	6	6	0	7¼	6	6	10	Both very pleasing and distinct varieties, and doing remarkably well.
pendula	1869	2/6	6	6	7	10	...	...	...	...	5	10	0	6¾	6	0	11	
Picea amabilis	1869	30/	6	2	2½	2½	...	...	...	...	9	0	1	4	5	6	11	Some of these varieties have been injured by autumn frosts, but none of them have been affected in spring.
do.	1869	30/	4	7	10	8	...	...	...	...	4	9	0	10	4	0	11	
do.	1869	20/	...	...	...	...	4	8	12	12	5	0	0	10	4	0	11	Inferior plant to the former when planted, but fast gaining on them now.

TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Picea bracteata	1869	5/	4	6	12	12	...	...	...	...	3	0	0	8	4	3	9	Appears to be healthiest in No. II.
do.	1869	5/	...	...	...	...	3	7	12	15	3	3	0	7½	4	0	9	
Cephalonica	1869	4/	2	6	14	13	...	...	...	...	4	8	0	8	4	0	9	Lost leader in the spring of 1870, but now quite recovered.
do.	1869	4/	...	...	...	...	3	6	20	18	5	6	0	8	2	6	9	The points of lateral growth slightly frosted on 8th September, leader uninjured.
Fraserii	1869	4/	3	6	18	6	...	...	...	...	5	10	0	10	4	6	9	Lost leader in the spring of 1872.
do.	1869	4/	...	...	...	...	2	4	11	25	7	0	0	7½	4	6	9	Doing remarkably well.
grandis or Lowii	1869	42/	12	24	40	39	...	...	...	...	15	5	1	6½	10	0	13	Remarkably fast-growing symmetrical plants; foliage generally slightly browned in spring.
do.	1869	42/	8	12	30	36	...	...	...	...	12	3	1	7	9	0	13	
grandis (true)	1869	12/6	6	15	33	36	...	...	...	...	11	8	1	4	8	0	9	Foliage darker green and more glaucous than the former; most extraordinary rapid growing plants; seem quite at home.
do. do.	1869	12/6	...	...	...	...	6	18	42	46	13	2	1	3	9	0	9	
lasiocarpa	1869	30/	8	12	20	30	...	...	...	...	8	6	1	1¾	7	6	11	All very fine thriving plants, and have all along taken well to the situation.
do.	1869	30/	4	6	18	26	...	...	...	...	8	0	1	4	6	6	11	
do.	1869	15/	...	...	...	...	3½	14	21	21	6	11	0	9¾	7	0	9	
do.	1869	15/	...	...	...	...	4	12	10	22	6	10	0	10	6	6	9	
magnifica	1869	42/	3	9	18	20	...	...	...	...	7	2	0	11	4	6	11	Very symmetrical, and improving fast.
do.	1869	42/	4	8	15	14	...	...	...	...	6	2	0	11½	5	3	11	
do.	1869	21/	...	...	...	...	2	6	16	19	6	0	0	8	4	0	10	Inferior to the former when planted, but now fast gaining on them.
do.	1869	21/	...	...	...	...	2	6	15	17	6	0	0	8	4	0	10	
nobilis (seedling)	1869	105/	2	8	24	34	...	...	...	...	11	2	1	7	7	6	13	Very fine specimen, and doing well.
do. do.	1869	10/6	2	3	8	10	...	...	...	...	3	6	0	7½	3	6	9	Doing rather best in No. II. Division.
do. do.	1869	10/6	...	...	...	...	3	3	5	11	3	6	0	7	3	0	9	
nobilis glauca	1869	63/	5	20	29	38	...	...	...	...	11	6	1	4½	9	0	13	One of the most handsome specimens in the collection.
do.	1869	63/	10	24	32	12	...	...	...	...	11	0	1	6	8	0	13	This plant had 14 inches broken off the leader this season.
do.	1869	42/	...	...	...	...	4	5	12	18	7	10	1	4	5	0	13	These are growing rather fast at the top, but quite healthy.
do.	1869	21/	...	...	...	...	2	7	29	33½	8	0	0	9½	5	0	9	
Nordmanniana	1869	42/	3	9	13	12	...	...	...	...	7	1	1	0½	6	0	11	Very ornamental; clothed with branches to the ground. Lost one plant in 1870 with white scale.
do.	1869	42/	4	10	24	24	...	...	...	...	10	3	1	3	7	9	11	
do.	1869	10/6	4	6	15	18	...	...	...	...	5	0	0	9	5	0	9	

TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I. 1869	1870	1871	1872	Annual Growth of Division No. II. 1869	1870	1871	1872	Present Height. Ft.	In.	Girth at Surface. Ft.	In.	Spread of Branches. Ft.	In.	Age. Year	Remarks.
			In.	In.	In.	In.	In.	In.	In.	In.								
Picea Nordmanniana	1869	10/6	...	...	...	...	2	3	14	$9\frac{1}{2}$	4	0	0	$8\frac{1}{2}$	3	6	9	As timber trees, these seem to be improved by growing amongst other varieties.
do.	1869	10/6	...	...	...	...	2	2	15	21	5	6	0	9	5	0	9	
pichta	1869	4/	4	4	7	12	...	...	...	...	3	6	0	$10\frac{1}{2}$	3	6	10	Both slightly frosted during first two years, but now doing well.
do.	1869	4/	...	...	...	...	2	3	7	11	3	0	0	9	3	0	10	
Pindrow	1869	4/	...	...	...	...	2	2	7	8	3	6	0	4	2	0	9	Did not succeed in No. I., but doing fair in No. II. Division.
Pinsapo	1869	15/	4	13	12	16	...	...	...	...	6	9	1	0	6	0	10	A fine thriving plant.
do.	1869	10/	2	6	8	6	...	...	...	...	5	0	0	10	6	0	10	Lost leader twice, but is still very ornamental.
do.	1869	5/	...	...	...	...	4	6	11	11	3	6	0	$8\frac{1}{2}$	4	0	9	All fine thriving plants, seem quite at home.
do.	1869	5/	...	...	...	...	2	5	11	15	4	0	0	6	4	0	9	
balsamea	1869	1/	4	6	10	20	...	...	...	...	5	10	0	7	4	6	9	Lateral growths generally slightly frosted during spring.
do.	1869	1/	...	...	...	...	4	6	12	24	6	6	0	7	4	6	9	
pectinata (common silver fir)	1869	2/ p. 100	2	2	6	9	...	...	...	...	3	0	0	$4\frac{1}{2}$	1	6	9	Compared with the others, doing as well as could be expected.
do. do.	1869		...	...	...	...	2	2	8	10	3	4	0	$4\frac{1}{2}$	1	6	9	
Pinus Austriaca	1869		2	3	12	14	...	...	...	...	4	0	0	$5\frac{1}{2}$	3	0	8	Small when planted, but growing very rapidly. Doing best in No. II.
do.	1869		...	...	...	...	2	3	13	21	4	6	0	$6\frac{1}{2}$	3	0	8	
Benthamiana	1869	5/	2	6	12	12	...	...	...	...	5	10	0	9	4	0	10	Has been too much drawn before being planted.
do.	1869	3/6	...	...	...	...	2	2	7	12	3	6	0	4	2	6	8	A very fine plant.
Cembra	1869	1/	3	4	6	12	...	...	...	...	3	6	0	5	1	6	8	All doing very well in both Divisions.
do.	1869	1/	5	7	12	15	...	...	...	...	4	7	0	$6\frac{3}{4}$	2	0	8	
do.	1869	1/	...	...	...	...	1	2	9	10	3	0	0	6	2	0	8	
Jeffreyii	1869	5/	3	6	8	13	...	...	...	...	5	8	0	8	3	0	10	Has been too much drawn before being planted.
do.	1869	3/6	...	...	...	...	1	3	12	12	3	0	0	5	2	6	8	A fair proportioned plant.
Laricio	1869	12/6 p. 100	2	6	12	18	...	...	...	...	4	9	0	6	2	6	8	All small plants when planted, doing best in No. II.
do.	1869		...	...	...	...	2	5	18	23	5	0	0	6	2	11	8	
do.	1869		...	...	...	...	4	7	22	27	6	2	0	$6\frac{1}{2}$	3	10	8	

TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872								
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Pinus excelsa	1869	5/	5	8	7	16	...	...	...	...	4	6	0	6½	3	0	10	Seemed rather backward the first year, but are now doing well.
do.	1869	5/	3	8	12	12	...	...	...	...	4	6	0	6¼	2	6	10	
do.	1869	3/6	...	...	...	...	3	5	12	8	3	8	0	7	3	4	9	Very fine specimen, but has lost its leader this season.
monticola	1869	3/6	2	7	6	7	...	...	...	...	3	4	0	6	2	6	9	Both plants similar when planted, but the one in No. II. Division is now the best specimen.
do.	1869	3/6	...	...	...	...	4	10	8	15	4	10	0	6½	2	6	9	
Murrayana	1869	3/6	...	...	...	...	2	3	5½	7	2	9	0	4½	1	10	9	Small plant, but thriving well.
ponderosa	1869	5/	4	6	15	13	...	...	...	...	7	0	0	11	5	0	11	A very ornamental variety, but rather too much drawn.
do.	1869	3/6	...	...	...	...	2	2	10	12	4	0	0	5	2	6	9	A more ornamental specimen than the former.
Pallasiana	1869	3/6	...	...	...	...	3	3	10	13	3	6	0	5½	3	6	9	
Pumilio	1869	5/ p. 100	3	5	6	6	...	...	...	...	2	6	0	4½	2	6	9	Are very thriving, but grown only for variety.
do.	1869		...	...	...	...	3	5	6	6	2	6	0	4½	2	6	9	
Pyrenaica	1869	3/6	...	...	...	...	2	3	17	19	4	7	0	6	3	6	9	Small plant, but fine specimen.
Retinispora filifera	1871	5/	...	...	3	6	...	...	...	...	2	9	0	4	1	3	7	Stood unprotected last season and is uninjured.
obtusa	1869	21/	4	6	12	14	...	...	...	...	5	6	0	6¾	6	6	10	Particularly handsome, and doing well.
do. nana	1871	7/6	...	...	2	4	...	...	...	...	2	0	0	3½	1	0	7	Stood unprotected last season.
pisifera	1869	21/	4½	8	8	12	...	...	...	...	5	6	0	7¼	6	6	10	Very fine variety; quite hardy and doing well.
do.	1871	7/6	...	...	3	9	...	...	...	...	3	0	0	4	1	2	7	Stood unprotected last season.
aurea	1871	5/	...	...	2	4	...	...	...	..	2	0	0	4	1	0	7	These were all unprotected last season.
Plumosa	1871	5/	...	...	3	4	...	...	...	...	2	6	0	4	0	10	7	
squarrosa	1871	3/6	...	...	2	2	...	...	...	...	2	0	0	4	0	10	7	
do. argentea	1871	3/6	...	...	1	3	...	...	...	...	1	10	0	3½	0	9	7	
Sequoia sempervirens	1870	2/6	...	4	6	10	...	...	...	...	3	6	0	5¼	1	6	8	Stood unprotected during last winter.
Wellingtonia gigantea	1869	10/6	9	18	18	21	...	...	...	...	9	0	0	10	7	6	12	Very fine specimens, apparently well adapted to the situation.
do.	1869	10/6	8	27	33	24					12	9	2	2	7	6	12	
do.	1869	10/6	...	...	...	...	6	14	16	20	9	3	1	5	7	6	12	Fine specimen plant; has not been injured by frost.
do.	1869	3/	...	...	...	...	6	18	26	28	9	0	1	0	6	3	10	A beautiful plant, but the points of lateral branches are frosted.
do. variegata	1872	21/	...	...	...	6	...	...	...	...	2	3	0	5½	2	0	6	Will be an acquisition if hardy.

TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I. 1869	1870	1871	1872	Annual Growth of Division No. II. 1869	1870	1871	1872	Present Height. Ft.	In.	Girth at Surface. Ft.	In.	Spread of Branches. Ft.	In.	Age.	Remarks.
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Taxus baccata	1870	/9	..	4	7	10	...	...	...	...	3	0	0	4	1	9	8	Small plants, but growing luxuriantly.
do. variegata argentea	1871	5/	...	...	6	8	...	...	...	...	3	0	0	4	1	3	8	These have all stood unprotected during last winter.
do. do. aurea	1871	5/	...	...	6	8	...	...	...	...	3	6	0	4½	1	4	8	
elegantissima	1871	3/6	...	...	3	4	...	...	...	...	2	4	0	4	1	6	8	
fastigiata	1869	3 6	4	6	6	10	...	...	...	...	6	3	0	8	2	0	11	Very healthy and thriving.
Nidpathensis	1869	1/6	4	6	8	11	...	...	...	...	4	0	0	5½	4	6	9	
Thuja gigantea	1869	5/0	4	8	7	8	...	...	...	...	5	6	0	9½	4	0	11	Beautiful varieties, but apparently slow growers.
do.	1869	5/	4	8	8½	9	...	...	...	...	6	0	0	9½	4	6	11	
do.	1869	5/	...	...	...	...	3	8	9	11	6	2	0	9	4	0	11	
Menziesii or Lobbii	1869	7/6	12	18	30	30	...	...	...	...	13	9	1	5½	7	6	14	Very rapid growers, called "Gigantea" by some.
do.	1869	7/6	10	24	30	36	...	...	...	...	11	3	1	2½	7	0	14	
do.	1869	3/6	...	...	...	...	6	10	24	22	8	3	0	9	5	0	9	
occidentalis	1869	1/	3	10	12	14	...	...	...	...	8	6	0	10½	4	6	10	A very fine specimen; previous to planting had been trained in a fastigated form.
do.	1869	/9	3	5	5	14	...	...	...	...	4	0	0	6	4	0	8	Small when planted, but growing remarkably well.
do.	1869	/9	...	...	...	...	2	5	4	16	4	0	0	5½	3	6	8	
plicata or Warreana	1869	1/	3	3	5	4	...	...	...	...	3	3	0	6	2	0	9	Very distinct variety, and apparently well adapted for situation.
do.	1869	1/	...	...	...	...	3	3	5	8	3	6	0	6	2	0	9	
Thujopsis dolabrata	1872	7/6	...	...	...	3	...	...	...	...	1	6	0	3½	1	3	7	Apparently well adapted for situation. Stood unprotected last winter.
ORNAMENTAL TREES AND SHRUBS.																		*Note.*—Small plants and varieties with more than one stem are not girthed at surface.
Acer campestre	1869	/6	6	8	12	12	6	10	14	14	7	0	0	6½	6	0	8	
colchicum	1869	/9	8	10	10	12	6	10	12	18	8	6	0	8	6	0	8	
do. rubrum	1870	/9	...	6	14	15	...	...	...	...	7	3	0	8	5	6	8	Growing too tall for its present situation.
macrophyllum	1870	1/	...	5	12	18	...	...	...	...	7	6	0	7½	5	0	8	
negundo	1869	/6	6	4	12	12	6	6	12	16	7	0	0	7	5	0	8	
stricta	1869	/6	4	4	14	12	4	6	12	16	6	6	0	7	4	6	8	
Platanoides	1869	2/6 p. 100	12	15	24	30	15	24	26	36	12	6	0	10	6	0	8	Growing very fast and proportionate, especially in No. II. Div. Some of the annual growths are upwards of 6 feet.
Pseudo Platanus	1869		6	4	8	14	6	12	12	20	9	6	0	9	4	6	10	

TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I. 1869	1870	1871	1872	Annual Growth of Division No. II. 1869	1870	1871	1872	Present Height.		Girth at Surface.		Spread of Branches.		Age.	Remarks.
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Acer Pseudo purpurea	1869	1/	4	6	8	10	...	...	...	...	9	0	0	$6\frac{1}{2}$	4	6	10	Not exactly true to name, but a fine plant.
do. alba variegata	1869	1/	4	4	6	4	...	...	...	...	5	9	0	8	4	0	8	Healthy, but making little progress.
do. Corstorphine	1869	1/	4	3	4	10	...	...	...	...	6	1	0	$8\frac{1}{2}$	4	6	9	
other 10 varieties	1872	1/	...	...	...	6	...	...	...	...	5	0	0	$6\frac{1}{4}$	2	6	7	
Æsculus Hippocastanum	1869	/6	4	6	12	24	4	6	18	26	6	0	0	7	3	6	8	All growing freely, especially in No. II. Division.
coccinea	1869	1/	3	8	6	12	6	6	10	15	6	6	0	6	2	6	8	
flore pleno rubra	1869	1/	3	6	10	16	4	6	8	18	6	6	0	8	4	0	8	
spectabilis	1872	2/6	...	...	...	6	...	...	...	...	4	6	0	7	3	6	5	
rubicunda	1872	/6	...	...	...	5	...	...	...	...	4	0	0	7	3	6	5	
Alnus Americana	1869	2/6	6	12	12	18	...	...	...	...	10	0	0	10	7	0	8	Though growing well, apparently prefer a more moist soil and situation.
incana	1869	/3	4	10	8	11	6	6	8	12	6	6	0	7	4	0	8	
Hudsonica	1871	1/6	...	...	6	10	...	...	...	...	6	0	0	$6\frac{1}{2}$	2	6	6	All distinct varieties. If they succeed and grow to a moderate size, will be an acquisition amongst ornamental trees.
ovata	1871	1/6	...	...	6	13	...	...	...	...	5	6	0	$5\frac{3}{4}$	2	6	5	
other 6 varieties	1872	1/	...	...	...	6	...	...	...	6	5	0	0	$4\frac{1}{2}$	2	0	5	
Amygdalus communis	1869	/6	4	4	10	8	...	...	...	...	6	0	0	7	2	6	9	Kept for the sake of variety. It is doubtful if all will stand the climate.
dulcis	1869	/6	3	6	6	11	...	...	...	...	6	3	0	7	2	6	9	
other 3 varieties	1872	1/	...	..	...	4	...	...	...	...	4	6	0	5	2	0	7	
Arbutus, varieties,	1869	1/6	3	4	4	4	...	...	...	...	2	6	...		2	6	10	
Aucuba Japonica (com.)	1869	/6	2	2	3	3	2	2	3	5	2	0	...		2	6	10	Planted in groups adjacent to each other.
male and female var.	1872	1/6	...	...	...	2	...	...	...	...	2	0	...		2	6	8	
Azalea (Ghent), var.	1869	1/6	2	2	3	5	...	...	...	...	2	0	...		2	3	10	
Ponticum	1869	1/	2	4	4	6	2	4	4	6	2	6	...		2	0	9	
Berberis Darwinii	1869	/6	4	6	18	20	6	6	18	22	5	0	...		3	0	8	By far the best of the varieties, and a great acquisition.
dulcis	1869	/3	6	6	12	12	6	10	12	16	4	6	...		2	6	8	
vulgaris	1869	/3	4	6	12	10	6	10	12	12	4	6	...		2	6	8	
Betula asplenifolia	1869	2/	6	8	14	18	...	...	...	...	7	6	0	6	2	6	10	A very pretty foliage. and growing well.
laciniata pendula	1870	2/	...	6	10	18	...	...	...	...	8	6	0	$5\frac{1}{2}$	3	0	10	
populifolia	1870	1/	...	15	18	24	...	...	...	...	9	0	0	6	7	0	9	Growing too tall for its present position.
other common var.	1869	/3	6	12	16	18	6	12	18	30	10	0	0	9	6	6	9	Fine varieties of the White Bark Weeping, and doing well in both Divisions.
Buxus, several varieties	1869	/6	3	3	4	4	3	3	4	4	2	0	...		2	6	9	
Carpinus, Americana	1869	/9	6	8	12	14	8	7	14	16	6	6	0	$6\frac{3}{4}$	3	0	8	Doing very well in both Divisions.
Betulus	1869	/9	6	8	14	12	8	10	14	18	6	6	0	7	3	6	8	

TABULATED STATEMENT —*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I. 1869	1870	1871	1872	Annual Growth of Division No. II. 1869	1870	1871	1872	Present Height. Ft.	In.	Girth at Surface. Ft.	In.	Spread of Branches. Ft.	In.	Age.	Remarks.
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Carpinus incisa	1870	1/	...	4	6	10	...	...	...	...	4	0	0	5	2	0	8	
heterophylla	1872	1/	...	...	...	4	...	...	...	...	3	6	0	4	1	6	6	
Carya, 2 varieties	1872	/9	...	...	...	4	...	...	...	...	3	6	0	4	1	3	6	
Castanea Americana	1870	/6	...	4	6	10	...	4	7	12	3	6	0	4	1	3	6	Grown principally for ornament, but some of the varieties are good timber trees.
Vesca	1870	1/	...	3	8	10	...	...	...	...	4	0	0	4½	1	3	6	
other 3 varieties	1872	1/	...	...	...	4	...	...	...	...	3	0	0	3½	1	0	5	
Cerasus, Bay Laurel (com.)	1869	/6	6	8	8	12	6	10	12	14	3	0	...		3	9	9	Remarkably vigorous in growth.
Caucasica	1872	1/	...	...	...	4	...	...	...	...	1	4	...		1	6	5	Stand frost better than the former, and are pretty plants.
Colchica	1870	1/	...	4	7	7	...	...	...	...	2	0	...		2	0	7	
Portugal Laurel	1869	/6	4	7	12	12	4	6	10	10	3	6	...		4	0	9	Growing very luxuriantly, especially in Div. I.
Padus (bird cherry)	1869	/6	5	10	10	15	...	...	...	...	7	0	0	8	4	6	8	
sylvestris flore pleno	1869	1/6	6	10	12	12	6	10	12	14	7	6	0	10	5	6	9	
Cornus alba	1869	/4	8	18	18	24	...	...	...	...	5	0	...		10	0	9	An extraordinary plant to grow; seems well adapted for underwood.
variegata (standards)	1869	2/	4	6	6	8	...	...	...	...	7	0	...		1	3	9	Beautiful plant, but the laterals are periodically frosted back to the head.
do. mascula	1869	1/	4	6	8	6	...	...	...	...	5	0	...		2	0	9	Stands exposure much better than the former.
sanguinea	1872	/6	...	...	...	6	...	...	...	...	2	0	...		1	3	5	
Cotoneaster buxifolia	1871	/6	...	...	6	6	...	...	...	...	...		...		2	0	6	Grow on the rockeries and wall adjoining.
microphylla	1871	/3	...	...	4	6	...	...	...	...	...		...		2	6	6	
Simonsii	1869	/6	8	10	12	14	10	12	12	16	6	6	...		6	0	8	A free growing plant, but rather straggling in habit.
Cratægus coccinea	1869	/9	4	6	10	8	...	...	...	...	7	0	0	7½	3	6	9	Most of these are becoming top heavy, and require to be reduced in size.
latifolia	1869	/9	4	4	7	11	...	...	...	...	7	0	0	7	3	0	9	
pendula	1869	2/	8	10	12	12	...	...	...	...	6	6	0	7	5	0	9	
Paul's new double	1869	5/	6	8	16	16	...	...	...	...	8	6	0	10	6	0	9	
other common var.	1869	/9	6	8	14	15	...	...	...	...	8	6	0	9	6	0	9	
4 new var.	1872	1/	...	...	...	6	...	...	...	...	5	0	...		2	0	5	
Cytisus, several var.	1869	/3	8	12	12	15	6	10	14	16	7	0	0	8	5	0	9	
Daphne Laureola	1869	/6	3	4	4	4	...	...	...	...	2	0	...		3	6	9	Not to be relied upon as perfectly hardy, still they deserve a place, as the two latter are very ornamental in spring.
Mezereum	1869	1/6	2	2	4	4	...	...	...	...	2	0	...		2	0	9	
Atropurpureum	1869	1/6	2	2	4	6	...	...	...	...	2	6	...		2	0	9	
alba	1869	1/6	2	1	1	1	...	...	...	...	1	2	...		1	0	9	Has been frosted periodically—much injured.
Deutzia corymbosa	1869	/9	6	12	12	18	...	...	...	...	4	6	...		3	0	8	Fine ornamental and hardy plants.
scabra	1869	/6	6	12	12	16	...	...	...	...	4	6	...		3	0	8	

TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I.				Annual Growth of Division No. II.				Present Height.	Girth at Surface.	Spread of Branches.	Age.	Remarks.
			1869	1870	1871	1872	1869	1870	1871	1872					
			In.	In.	In.	In.	In.	In.	In.	In.	Ft. In.	Ft. In.	Ft. In.	Years.	
Escallonia, varieties	1869	/6	...	...	...	...	5	10	10	18	5 0	...	2 6	9	
Fagus asplenifolia	1869	1/	2	6	6	14	...	...	...	...	7 0	0 7	3 6	10	These made little progress till this year, but seem to take well with the ground now.
cristata	1869	1/	4	4	10	12	...	...	...	...	6 6	0 7	4 0	8	
pendula	1869	1/6	3	4	8	6	...	...	...	...	7 0	0 8	3 0	9	
purpurea	1869	1/	6	12	10	18	8	10	14	16	9 6	0 7½	5 6	9	Many of these are light copper coloured.
Fraxinus excelsior	1869	3/ p. 100	4	8	12	16	6	12	10	18	9 6	0 7½	5 6	9	Making rapid progress, and is healthy in both Divisions.
aucubifolia	1869	1/	6	8	12	12	...	...	...	...	7 0	0 6½	2 0	8	
integrifolia	1869	/9	6	6	8	7	...	...	...	...	9 0	0 9½	4 0	10	Transplanted from an adjoining belt to this enclosure.
nigra	1869	1/	6	4½	6	6	...	...	...	...	8 0	0 9	3 6	9	
other 4 var.	1872	1/	...	...	...	4	...	...	...	...	5 0	...	1 9	9	
Genista, var.	1869	1/	4	13	12	12	...	...	...	...	4 6	...	2 0	9	
Hedera Helix (ivy)	1870	/6	...	6	12	18	...	...	...	...	6 0	...	...	6	Growing on the rockery and adjoining wall.
Hippophae rhamnoides	1870	/3	...	4	6	12	...	...	...	...	2 6	...	2 0	7	Growing almost as freely as willows.
salicifolia	1870	1/	...	6	8	11	...	...	...	...	2 0	...	2 0	7	
Ilex (holly), Queen golden	1869	21/	8	12	18	18	...	...	...	...	9 1	0 11	3 6	12	This is the centre of a group of holly near the middle of the ground.
do. silver	1869	2/6	2	6	12	12	...	...	...	...	3 6	...	2 0	9	
other 10 var., green leaved	1869	3/	4	6	12	14	...	...	...	...	5 0	0 9	5 6	11	All growing freely.
other 10 var. variegated	1869	1/6	4	6	12	20	...	...	...	...	5 0	0 6½	4 0	9	
Evergreen Oak, 2 var.	1869	2/6	6	6	10	12	...	...	...	...	3 0	...	2 6	9	
Juglans (Walnut)	1872	1/6	...	...	...	4	...	...	...	...	4 6	0 6	2 0	6	
Leycesteria formosa	1869	/9	12	18	24	24	...	...	...	...	3 0	...	2 6	9	Generally frosted to near the ground periodically.
Ligustrum, 2 var.	1869	/6	6	14	14	18	8	12	16	18	4 6	...	2 6	7	Both varieties before the common sort, and as easily cultivated.
Liriodendron tulipifera	1872	1/	...	...	...	6	...	...	...	...	4 6	0 6½	2 0	6	
Lonicera, var.	1869	/6	6	6	12	12	...	...	...	...	5 6	...	3 6	9	
Laurestine, var.	1869	/4	4	6	6	6	...	...	...	...	3 0	...	4 0	8	Growing well in both Divisions, apparently quite hardy.
Mahonia Japonica	1869	1/	4	7	6	6	...	...	...	...	3 0	...	2 0	9	A fine variety, but rather tender.
other 2 var.	1869	/3	3	7	7	10	...	...	...	...	2 6	...	4 0	9	
Mespilus (Medlar)	1872	1/	...	...	...	4	...	...	...	...	4 6	0 6	2 0	6	Grown chiefly for variety and ornament.

TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I. 1869	1870	1871	1872	Annual Growth of Division No. II. 1869	1870	1871	1872	Present Height. Ft.	In.	Girth at Surface. Ft.	In.	Spread of Branches. Ft.	In.	Age.	Remarks.
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Morus (Mulberry), 2 var.	1872	1/	...	...	...	7	...	...	...	...	5	0	0	6½	2	6	6	Grown chiefly for variety and ornament.
Pernettya floribunda	1869	/10	3	8	3	6	...	...	...	...	1	6	...		2	6	8	
mucronata	1869	/10	3	3	6	12	...	...	...	...	2	6	...		3	6	8	
Philadelphus grandiflorus	1871	/6	...	...	8	12	...	...	...	...	5	0	...		2	6	8	All free growing, and some of them very ornamental.
other 5 var.	1869	/6	6	6	12	12	...	...	...	...	5	6	...		3	0	10	
Platanus occidentalis	1870	2/6	...	4	6	10	...	4	5	9	5	8	0	7	2	6	8	Healthy, but not growing so fast as the commoner varieties.
orientalis	1870	2/6	...	6	7	13	...	6	9	15	6	6	0	7	3	0	9	
other 2 var.	1871	1/	...	...	6	6	...	...	...	...	4	6	0	5½	2	0	8	
Populus alba (new var.)	1869	1/6	9	12	18	18	6	10	18	24	9	0	0	8	5	0	8	All are very effective, and have a striking appearance amongst the other trees. They are free growers.
abele	1869	/6	10	12	18	30	10	15	24	30	10	6	0	8½	7	0	8	
nivea	1869	/6	8	8	12	12	6	10	12	17	7	0	0	6½	3	0	8	
tremula	1869	/3	4	6	10	8	6	8	10	13	7	0	0	5½	4	0	8	
other common sorts	1869	3/ p. 100	8	18	24	32	10	18	24	30	12	0	0	11	7	0	8	
other 10 var. (new)	1872	1/	...	...	...	6	...	...	...	...	4	6	...		2	0	5	
Potentilla fruticosa	1869	/6	2	2	6	6	...	...	..	...	1	9	...		2	6	8	
Pyrus, several var.	1872	1/	...	...	...	5	...	...	...	...	4	6	0	5½	2	0	9	Cultivated chiefly for the appearance of their foliage in autumn.
Quercus cerris (Turkey)	1869	/6	6	8	14	18	6	10	14	16	8	0	0	9½	6	0	9	Growing remarkably well, especially in No. II. Division.
Lucombeana	1869	3/	4	16	8	10	...	...	...	...	3	6	...		5	0	10	Has been twice cut to the ground.
pedunculata	1869	2/6 p. 100	4	8	10	12	4	10	10	14	6	6	0	7	5	0	9	Thriving, but not growing so rapidly as the Turkey oak.
Rhamnus, 4 var.	1869	1/6	6	10	10	10	...	...	...	...	3	6	...		4	6	9	
Rhododendron Ponticum	1869	/6	4	6	6	8	4	4	6	8	3	6	...		3	0	9	Growing as luxuriantly as if they were on moss.
hybrid	1869	2/6	4	6	7	6	...	...	...	...	3	6	...		3	6	9	
hirsutum	1869	1/	...	...	...	...	...	...	...	...	1	0	...		1	6	9	Not very suitable for this situation.
Ribes aureum	1872	/6	...	...	...	6	...	...	...	...	2	0	...		2	0	5	
other 4 var.	1869	/3	6	12	24	24	6	10	18	26	5	6	...		8	0	8	Has a tendency to overgrow and break down.
Salix, common var.	1869	4/ p. 100	9	12	10	18	9	18	24	30	12	0	0	9	7	0	8	
Kilmarnock Weeping	1869	1/6	6	8	10	10	...	...	...	...	6	0	0	7	3	0	8	
American Weeping	1869	1/6	6	10	8	12	...	...	...	...	7	0	0	8	3	6	8	

TABULATED STATEMENT—*continued.*

Names of Plants.	Year when Planted.	Cost.	Annual Growth of Division No. I. 1869	1870	1871	1872	Annual Growth of Division No. II. 1869	1870	1871	1872	Present Height. Ft.	In.	Girth at Surface. Ft.	In.	Spread of Branches. Ft.	In.	Age.	Remarks.
			In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Years.	
Salix, other 6 new var.	1872	1/	...	...	...	12	...	...	...	...	5	6	...		2	0	5	Particularly interesting, but doubtful if they will become trees.
Sambucus nigra (common Elder)	1869	/3	6	8	14	18	6	12	18	18	6	0	...		5	0	8	
scarlet fruited .	1869	/6	8	12	24	36	12	24	36	42	10	0	...		9	0	8	An extraordinary fast grower. Too large for this collection.
Spiræa adiantifolia .	1869	/6 each	6	12	10	12	...	...	...	...	7	0	...		4	6	8	Very pretty and graceful when in flower.
ariæfolia . .	1869		4	10	10	12	...	...	...	...	7	0	...		5	0	8	
callosa . . .	1869		6	10	12	12	...	...	...	...	6	6	...		7	0	8	Flowers freely.
corymbosa . .	1869		6	8	12	18	...	...	...	...	6	6	...		4	6	8	
Douglasii . .	1869		6	8	14	18	...	...	...	...	6	0	...		4	0	8	
Foxii . . .	1869		6	10	8	14	...	...	...	...	5	0	...		8	0	8	Flowers freely during great part of the season.
Opulifolia . .	1870	1/	...	6	12	18	...	...	...	...	5	6	...		2	6	7	
Symphoricarpus, 2 var.	1869	/3	8	12	18	18	...	...	...	...	5	6	...		5	0	8	
Syringa Josikæa . .	1869	/9 each	8	12	18	18	...	...	...	...	5	6	...		5	0	8	Flowered this season.
Persica . . .	1869		6	8	13	13	...	...	...	...	4	6	...		4	0	8	Do. do.
Charlemagne . .	1869		6	10	10	10	...	...	...	...	5	0	...		4	0	8	A fine formed plant, but has not flowered.
Charles X. . .	1869		4	10	8	10	...	...	...	...	4	6	...		3	6	8	Flowered during the last two seasons.
grandiflora . .	1869		4	12	12	14	...	...	...	...	5	6	...		3	0	8	Flowered this season.
Triomphe d'Orleans	1869	1/	4	8	14	15	...	...	...	...	5	0	...		4	0	8	Neither of these plants have flowered.
Prince Nottiger .	1869	1/6	6	8	8	14	...	...	...	...	4	0	...		3	6	8	
Tamarix gallica . .	1870	1/	...	12	18	18	...	...	...	...	2	6	...		1	0	7	Cut to the ground by frost almost periodically, but grows freely.
Tilia Europæa . .	1869	/3	6	12	12	18	6	12	14	20	8	6	0	8	6	0	9	Several varieties, all growing very well.
alba . . .	1872	1/6	...	...	...	3	...	...	...	...	2	6	...		1	0	5	Fine varieties, but plants as yet are small.
asplenifolia . .	1872	1/	...	...	...	6	...	...	...	...	3	0	...		1	0	5	
grandifolia . .	1872	1/	...	...	...	6	...	...	...	...	3	0	...		1	0	5	
Ulmus montana . .	1869	2/ p. 100	6	14	18	30	8	14	24	33	11	6	0	10	7	0	8	Growing very well, especially in No. II. Division.
Camperdown . .	1869	1/6	6	8	10	10	7	8	11	13	7	0	0	9	5	0	9	All grafted, and most have wide-spreading heads.
several pendulas .	1869	2/6	6	6	10	13	6	8	12	10	8	0	0	10	5	0	9	
other 4 new varieties	1872	1/	...	...	...	6	...	...	...	...	5	0	0	$4\frac{1}{2}$	2	3	5	
Viburnum, varieties .	1869	/6	6	10	12	12	...	...	...	...	5	6	...		3	0	8	Grows freely, and quite hardy.

IV. *Report on the Houston Pinetum.* By WILLIAM TIVENDALE, Forester, Houston, Paisley.

In the spring of 1867 we were allowed to take about two acres of ground to be planted as a Pinetum. It is situated at an elevation of nearly 100 feet above the level of the sea, and has a north-eastern exposure. The soil is a good light loam, of considerable depth, resting partly on gravel and partly on sand, and is very well adapted for growing most of the coniferous trees. This piece of ground had formerly been enclosed by a dry stone dyke on the south and east, by a stone and lime wall 6 feet high on the west, and by a strong wire fence on the north. The stone and lime wall being on the public road, and in good repair, was allowed to stand, as also the wire fence; but the dry stone dyke, being no longer required as a fence for cattle, &c., was removed, the small stones being left for bottoming the walks of the pinetum. A row of old hardwood trees being on the side of this fence, under the drop of which pines will not grow, we had to trench a border about 24 feet wide, and as deep as possible, without injuring the roots of the trees. This being done, we proceeded to make the walks; the soil was taken out to the depth of 12 inches, and 48 inches wide, and put on the trenched border which was to be planted with evergreens. 6 inches of small stones were put in the bottom of the walk, which were blinded with an inch of engine ashes; 3 inches of fine gravel was laid on the top of the ashes, leaving the edge of the walk about 3 inches high.

As it was necessary to keep out hares and rabbits, we put up wire netting, the posts for which were cut from matured larch trees, 4 feet long, and 3 inches by $2\frac{1}{2}$ inches square. They were driven 1 foot into the ground, at 6 feet from post to post; 6 inches of soil were taken out with the spade all along the outside of the row of posts, and a rafter of larch was nailed to the posts under the natural surface of the ground. A No. 8 wire was threaded through the top meshes of the netting as it was being rolled out along the side of the fence; this wire is strained at the ends of the fence; the netting is then tightened, and the wire is stapled to the posts, about 2 feet 10 inches above the ground, leaving about 2 inches to be stapled to the rafters under the surface, which prevents rabbits from creeping under the wire netting. The soil taken out for the rafter is again put in, and made firm by tramping with the feet, and all made level.

A *Pinus excelsa*

B *Pinus insignis*

C *Araucaria imb*

X *Evergreen Hol*
(*Ilex Aquifolium*)

V *Maple, English*
(*Acer campestre,*

W *Chestnut Spanish*
(*Castanea Vesca*)

+ *Weymouth Pine*
(*Pinus Strobus.*)

O *Portugal Laurels.*

O *Austrian Pine*
(*Pinus Austriaca*)

I *Silver Fir*
(*Picea pectinata*)

• *Corsican Pine*
(*Pinus Larilio.*)

° *Rhododendrons.*

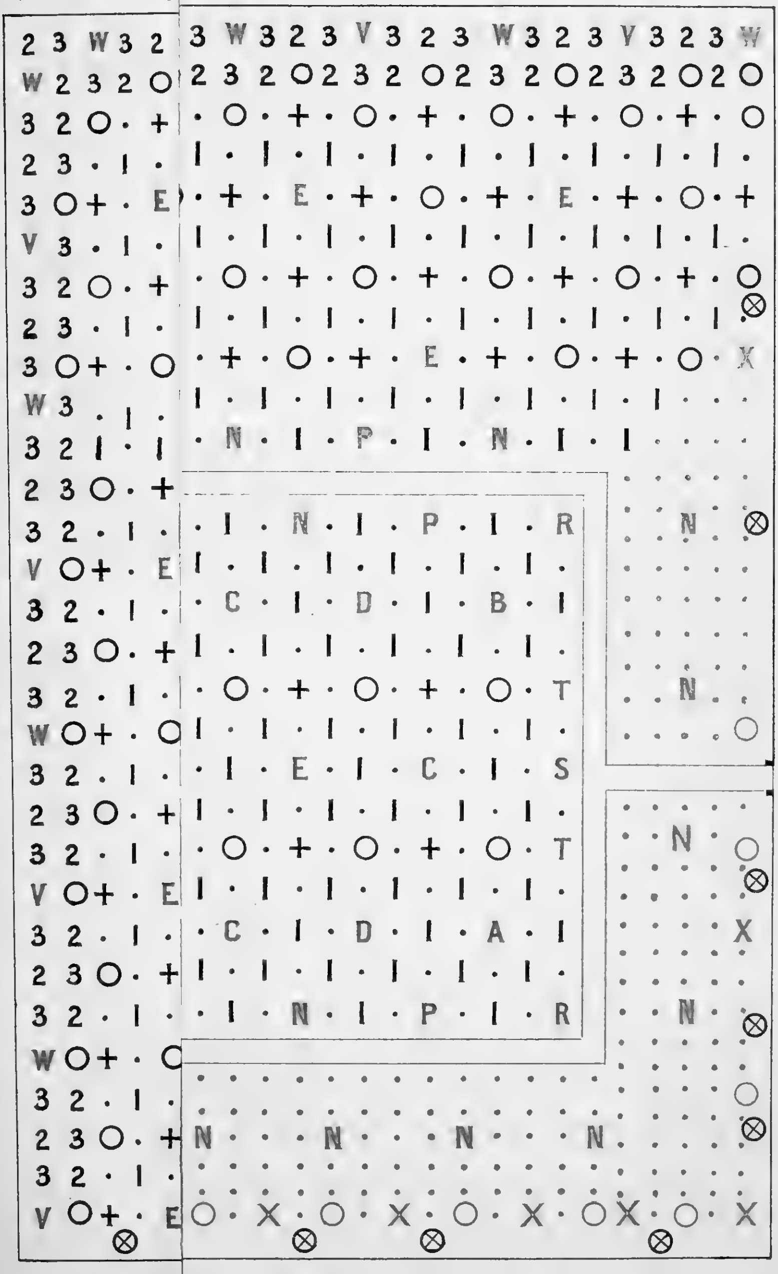


DIAGRAM.

A *Pinus excelsa*
B *Pinus insignis*
C *Araucaria imbricata*
X *Evergreen Holly* (Ilex Aquifolium)

D *Picea nobilis*
E *Wellingtonia gigantea*
F *Cedrus Deodara*
⊗ *Old Trees*

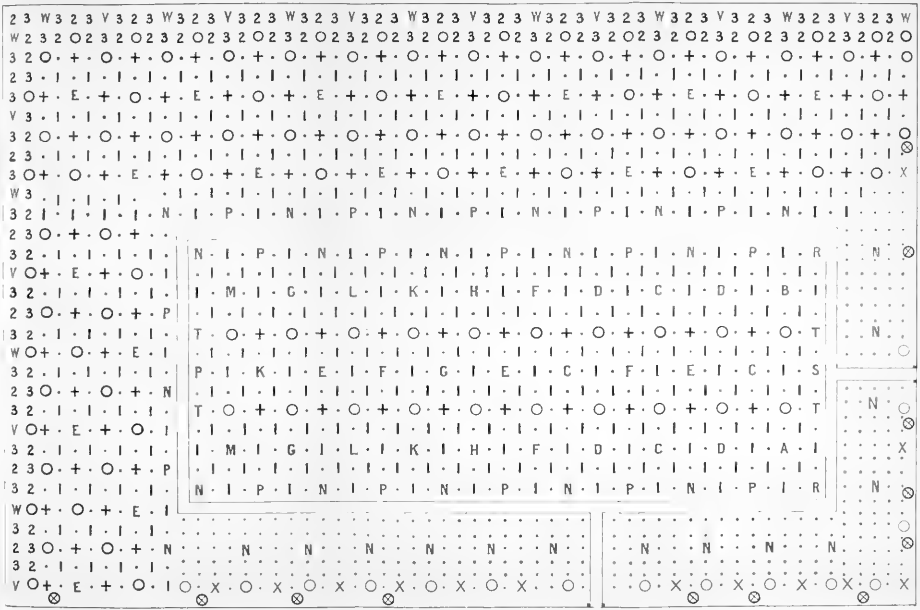
G *Abies Douglasii*
H *Picea Cephalonica*
K *Pinus Taurica*
2 *Scots Fir* (Pinus sylvestris)

L *Pinus Pinsapo*
M *Pinus ponderosa*
N *Cupressus Lawsoniana*
P *Thujopsis borealis*

R *Irish Yew* (Taxus fastigiata)
S *Pinus Albertiana* (Abies)
T *Thuja Craigiana*
3 *Spruce, Norway* (Abies excelsa)

V *Maple, English* (Acer campestre)
W *Chestnut Spanish* (Castanea Vesca)
+ *Weymouth Pine* (Pinus Strobus)
○ *Portugal Laurels*

O *Austrian Pine* (Pinus Austriaca)
I *Silver Fir* (Picea pectinata)
• *Corsican Pine* (Pinus Laricio)
• *Rhododendrons*



Wire netting was also put on the posts of the wire fence on the north side, and done in the same manner, only the netting was put on inside the posts here, in order to prevent it from being damaged by cattle grazing in the adjoining field.

These operations being completed, we next proceeded to make the pits for the principal or ultimate crops: these were round, 3 feet in diameter, and 18 inches deep. After the turf was neatly taken off, and the soil thrown out to the desired depth, the bottom of the pit was dug all round the full depth of the spade; 6 inches of the soil taken out was then put into the pit, and a couple of handfuls of hot lime added, and thoroughly mixed with soil (this is the best thing we know of for the making of fibre). All the pits being made in this manner for the principal trees, we next made pits for the nurses: they were 18 inches in diameter, and 12 inches deep, stirred in the bottom with the spade, and 6 feet from pit to pit, all over the ground. The plants, which varied in height from 1 to 2 feet were then brought forward, and all the principals were planted first with every care and caution. No tramping with the feet was allowed until the whole of the soil was replaced; then it got a gentle tramp all round, and the plant made firm at the neck, which is all that is necessary. The nurses were then pitted in the same way, and all finished in a satisfactory manner. The border was next proceeded with, and finished. We refer the reader to the diagram for the kinds of plants, and the arrangement on the ground. They are all represented by different characters (letters, &c.). The plants have all done admirably well, excepting *Pinus Pinsapo* and *Picea cephalonica;* these have not grown more than 2 inches a year since they were planted, till this year, when they have made a little more. The other plants have made an average growth of 7 inches; *Abies Douglasii* and *Pinus Laricio* have succeeded best, some of them having 26 inches growth this year (1872). No deaths have occurred among the pines, but about 5 per cent. of the silver firs died, which were at once removed, and others put in their place. The whole are now looking well, and promise to become trees of considerable size. Of course we do not expect them to attain the gigantic size in this country which they reach in their native land, and have kept the principals a little closer than some people do in consequence.

V. *Report on the Comparative Advantages of the different Methods of Pruning.* By ANDREW GILCHRIST, Forester, Urie House, Stonehaven.

Notwithstanding the existence for the last eighteen years of an Arboricultural Society, the primary object of which is by the offering prizes for practical essays and reports, to endeavour to disseminate a knowledge of the principles and practice of arboriculture, so that we may attain, as far as practicable, to a uniform and sound method of practice in the planting and rearing of forest trees; and also the very commendable manner in which the Highland and Agricultural Society that has encouraged writers to send in reports, and the many articles have from time to time appeared in the agricultural section of the public press;—although all these engines have been at work, there is still not a few of the departments of modern forestry on which there exists a considerable difference of opinion. If we are not mistaken, the great arboricultural want of our day is a correct and comprehensive knowledge of the first principles of arboriculture. At present there is no want of empirical rules, founded on a practice that is supposed to be successful; but, as a general rule, these empiric systems are not reliable. And the man with a scientific knowledge always doubts them until he has fully tested them, and found them in harmony with the laws of vegetable physiology. A thorough knowledge of these laws, and then the earnest endeavour to harmonise our various operations, so that they may become as mild in their opposition to these laws as possible, is beyond all question the proper method to obtain a uniform and definite system of practice, founded on accurate and undoubted first principles.

The pruning of forest trees is one of those branches of modern forestry which is uniformly important, whether we consider it from a scientific or a practical point of view, and regarding which there is an absolute necessity that sound and definite first principles should exist. During recent years the discussion of this subject has attracted much attention; but though often discussed and studied even by men with a first-rate scientific knowledge and a sound practical experience, and who have had good opportunities of investigating, and without prejudice recording their conclusions, still many conflicting opinions prevail. Theory is opposed to theory, and the methods of operating are the same. If we begin to discuss the subject with foresters here and there throughout the country, we not only find that many diverse opinions are held, and the most opposite methods practised, but also that some of the various modes of operating are founded not on sound principles, but on the most incompatible theories.

In pruning, perhaps more than any other department of practical arboriculture, we have it within our power to adopt an almost uniform system of operation; but for want of due attention being paid to sound and definite fundamental principles, there is scarcely a point on which absolute unanimity of opinion or practice exists. We do not mean to assert that an absolute law could be laid down that would be applicable to every peculiarity of kinds and ages of trees, so that the precise time to operate at the first and all subsequent prunings could be determined without first having examined and acquired a knowledge of the trees to be operated on. A certain amount of practical skill, along with an intimate knowledge of general first principles, is essential to determine this in a judicious manner. But we consider it quite possible to attain to absolute unanimity in regard to the system of pruning that is to be adopted; and, in fact, we would almost say that the Scottish Arboricultural Society has but very inadequately fulfilled her mission so long as there exist so many conflicting opinions in regard to this subject.

An impartial inquiry into the advantages of the different methods of pruning will doubtless be well calculated to assist in arriving at the best system. By testing the one system against the other, we may find how far each can be applied judiciously and successfully to the various peculiarities of individual trees, so as to best bring about the fundamental object of pruning, which is the ornamental appearance, or the production of the greatest amount of thoroughly sound and clean timber. By thus as it were comparing the capabilities and the results of the application of the one system with the other, we may be able to discover which is most conducive to the direction of the nutritive energies of the tree, so that the greatest proportion of the nutriment will be appropriated to the elongation and increase of the circumference of the stem, rather than to the production of contending leaders and strong side branches. If this be (as it doubtless is) the primary object of pruning, then the great art of the pruner is to prevent the formation of these overstrong side branches, and by timely checking to restrain and control them, so that they may become subservient to the extension of the stem, and be made to contribute to the growth and production of a sound bole of timber, and not be left to increase their own growth to an extent that will be prejudicial to the tree. In order that any system of pruning may contribute in the highest possible degree to the attainment of the fundamental object, it is absolutely necessary that it be in harmony with the laws of vegetable physiology; and it is only by having an intimate knowledge of the structure and functions of the different organs of trees, that any method of pruning can be founded on sound and definite first principles.

In trees, as in all other plants, the nutritive organs are the roots, the stem (with the branches), and the leaves. The sap, which is imbibed by the spongioles at the extremities of the roots, ascends the trunk, and enters the branches, at last reaching the leaves, where it combines with the sap which is absorbed from the atmosphere through the pores of the leaves; and here the leaves transpire all the fluids that are not essential to vegetation, and it is through their instrumentality that the sap is elaborated and changed into the nutritive food of the plant.

Having given the above statement in regard to the ascension of the sap and the uses of the leaf, we now proceed to compare the system of severe close pruning (*i.e.*, clearing off a great number of the branches from the stem without doing anything to check the growth of contending tops) with the system of foreshortening. The leaves being part of the vital energies of the tree, it follows that to cut off the greater part of the branches and the leaves is just removing a number of the most essential organs, and thereby diminishing the rate of growth to a considerable extent. Close pruning utterly fails in bringing about the object in view, namely, the production of the greatest quantity of sound and clean timber,—

1*st*, Because it tends to reduce the vital energies of the tree.

2*d*, It does not check the growth of contending leaders or overstrong side branches, nor prevent them from appropriating the nutriment to increase their own growth rather than that of the stem.

3*d*, It tends to deteriorate the quality of the timber; for when the wounds made on the stem are greater than can be healed over during the first or second season's growth, the exposed surface gradually becomes less succulent, and ultimately loses its vitality before it can be healed over. When this is the case, the wounds may be healed over, but no union can take place between the decaying surface and the enclosing sapwood; and this must unquestionably cause a blemish, if not a serious defect, in the quality of the timber. And, again, the healing of these wounds is an additional tax on the energies of the tree, which have already been considerably impaired by the removal of so many of the leaves.

The system of foreshortening has many advantages over close pruning:—

1*st*, The growing energies of the tree are not weakened to any great extent. When foreshortening is judiciously performed, there is so little of the branch removed that the loss is scarcely ever felt by the tree.

2*d*, It prevents a waste of energy, and keeps the branches from diverting too much of the nutritive food from the stem. When a judicious method of foreshortening is carried on with due caution and discrimination, and in a timely and progressive manner, it prevents rival leaders and strong side branches from increasing their own strength, so as to detract from the growth of the stem; and it also keeps the tree to one leading shoot (or top), and that shoot in supremacy of all the others; and thus the main stem is enabled to appropriate the greatest proportion of the nutritive food for its own increase. Another aspect in which this system has considerable advantages over severe close pruning, is in the rearing of trees for the combined purposes of ornament and profit. The trees can be reared under this system with a natural and shapely though not formal appearance (unless it be desired). Close pruning clears the stem, but it makes the tree bare and unsightly, and does nothing to check the growth of rival leaders, or to prevent the tree from being dismembered by heavy, ill-placed branches breaking off during a storm.

In order to prove the suitableness of foreshortening for this purpose as compared with close pruning, we may report the following as an example:—Some years ago a gentleman asked us to inspect the plantations on his estate, and report our opinion regarding them. We found that he was specially anxious about the condition of an ornamental plantation through which the principal drive to his mansion-house passed. This plantation was composed of oaks, elms, limes, and horse-chestnuts, with firs for nurses,—except at the sides of the drive, where, as the proprietor was anxious to form an avenue of lime trees, the ground had been planted with these trees from 9 to 12 feet apart, without any nurses. These trees were about 14 years planted, of a branchy habit and a vigorous growth; most of them had several contending tops. A year previous to our visit, the forester was instructed to prune these trees for the first time. This man understood no other method but close pruning. Accordingly, he started to clear the branches off the stem to nearly a half of its entire height. There were only a few trees pruned when the proprietor saw the bare and unsightly appearance that they had, and at once advised the forester to stop. In the month of May we sent a suitable man to prune the trees after the following method. Wherever there were two or more contending tops, he was to select the straightest and best as the leader, and shorten all the others by cutting off about a fourth part of their length, and slightly check the strong side branches, always paying the most particular attention to cut over neatly by a branchlet, that would have a tendency to hide the cut, and be inclined to take a horizontal rather than a vertical direction of growth. The pruning was not to be severely done, and no branches were cut off close by the stem. Two years after this they were again slightly pruned, and *one* or *two* of the branches on the lower part of the stem cut clean off, and the wounds made then were nearly healed over during the first season's growth. Ever since, the same method has been carried out with those trees that required to be pruned, and regular attention has been paid to keep the leading top of each tree in the ascendancy of all others, and to make sure that the vigour of the tree was not impaired. These trees have thriven vigorously, and have now a natural and stately appearance, while the few that were close pruned are only recovering from the severe check that they sustained, and thus they exhibit the advantages of foreshortening.

Foreshortening has also peculiar advantages over close pruning in treating neglected hardwood plantations. We have had several instances of success by treating them in the following manner:—By first selecting the trees most suitable for the permanent crop, they were slightly pruned, shortening any strong branch that was wide spread or like to take a vertical direction of growth, and reducing all rival leaders to about three-fourths of their length, in some instances just a mere point being cut off. In two or three years this treatment is again repeated, endeavouring to bring the tree a little into shape and to keep it to one leading top. If at all possible, we remove no branches close by the stem till the trees are fairly recovered from the effects of their neglect. In 1860 we had occasion to prune a few acres of oaks twenty years planted, and the above was exactly the method of treatment that we adopted. Some years previously this plantation had been overthinned, consequently many of the oaks were of a rather branchy habit. But the cautious method of foreshortening gave them a shapely appearance without causing any visible check to their growth. It was very different with a part of this same plantation that had been close pruned the previous year. The trees that were thus operated on received such a severe check to their growth that they made little progress, and for some years had such a stunted, unsightly appearance, that it was thought most profitable to cut them down; the situation being a little exposed, there was small chance of their ever becoming healthy, good-looking trees. The original object of the proprietor in planting was chiefly ornament and shelter. The acorns from which these trees were raised he had gathered with his own hands in another country, and all along he had been interested in their progress; but in the case of those that were close pruned, his object was utterly frustrated.

Another example, almost parallel to the above, came under our observation four years afterwards. In this case the close pruning had been performed under the supervision of two foresters. The plantation consisted chiefly of oaks twenty years planted, and the most thriving part had been operated on by No. 1 forester in a most barbarous manner. The branches had been chopped off with a light axe, and the bark on the stem had been much slashed by the axe after it had passed through the branch. In fact, a more ruthless case of close pruning never came under our observation—what with a little caution might have been fine oaks, were actually left with only three side branches, and some but two. This severe treatment had been performed three years previous to the time when we saw them, and they had not during that time made much progress, except the growth of some dwarfish spray on the bare stems. No. 2 forester came, and two years afterwards pruned another portion of this same plantation. His system was a little more refined when clearing the stem. Any very strong upright growing branch that came in his way he did not cut off, but cleared off the branchlets from it to the same height as he did on the main stem, namely, about three-fourths of the stem bared. It is almost needless to say that this method also reduced the vital energies of the tree, and checked its rate of growth to a great extent. These portions, after being left for seven and five years respectively, and making but little progress, were cut down, and the bark peeled and cured; but we found many of the trees so deficient in circulating sap, that it was impossible to get the bark *profitably* taken off. Altogether it was a bad quality of bark. The exterior was rough; and, though carefully dried, the inner bark contained but little astringent matter.

A year after the second portion of this plantation was pruned, a number of oaks grown under similar conditions, and about the same age (in fact, growing about 500 yards' distance from these), were foreshortened, and a few branches were cautiously from time to time removed from the stem; and these oaks are now worthy of being termed naturally handsome and thriving trees.

There is yet another instance in which the two methods can be contrasted, namely, in the rearing of trees in a nursery for the purpose of planting them out as hedge-rows or in the park. By foreshortening we get a *stout* well-proportioned stem, able to overcome the effects of transplanting and withstand the influence of the wind; while by the other we get a slender, weakly stem that makes but little progress for a few years after being planted out. For example, some years since, when planting a row of lime trees (from 6 to 8 feet high) on the side of a drive, we found ourselves short of a sufficient number of home-reared trees, and wrote to a very respectable nurseryman to supply us. He replied, stating that the trees he had of that size were bought in and were barer in the stem than he would have liked, but he could get no other. As soon as they came, we at once saw that they had been very much over-pruned. There were several wounds on their slender stems, scarcely healed over. Seeing this, we planted them very carefully, causing a portion of leaf mould to be mixed with the soil from each pit. Notwithstanding, the home-reared trees that had been foreshortened made more progress the first season than the others did in four, and the latter still have a very bare appearance.

We come now to compare the advantages of nature's pruning with foreshortening. Some years since a number of articles appeared in the "Scottish Farmer," that were apparently written by a *theorist.* He denounced pruning totally and vehemently, as unfit to be practised. But notwithstanding all that was then written, it can be easily shown that the actual evils of pruning have originated from the abuse of the practice, and the mistaken use of it, as in the case of excessive close pruning. But beyond the *overdoing* or the *undue repetition* of foreshortening, all other disadvantages are entirely imaginary. No real bad effects whatever can be fairly chargeable against *judicious foreshortening,* when conducted on sound principles, except it be the incidental ones of its affording those who are *uninitiated* in the first principles, or unpractised in the art of foreshortening, a temptation of overdoing, and thereby maltreating, trees. It is, we think, the enormous mischiefs that have attended and followed the practice of severe close pruning that have led some writers to speak currently against the practice of any pruning whatever. But the bad effects must be charged against a faulty method, and not against every system of pruning. There are several disadvantages that follow the entire absence of pruning, and some think, that in the case of rearing hardwood trees with nurses, these disadvantages can be obviated by proper attention to thinning. But in our opinion it is impracticable to rear a crop of hardwood trees as judiciously and *profitably* by merely thinning, as when attention is paid to check rival leaders and strong side branches. Delaying the removal of any one of the nurses may cause the decay of a number of the side branches, but it cannot arrest the progress of a contending leader; on the contrary, it tends to encourage it. When thinning is unduly delayed, the nurses have a tendency to force the side branches to grow upwards; and thus ill-placed limbs and double tops are formed. And it also makes a bare, slender stem, by causing the branches to decay and fall off, generally leaving a piece of decayed stump on the trunk of the tree. Nature at once of herself endeavours to remove these, and unaided she will effect it, but not certainly without causing a greater defect in the timber than sawing off the stumps would do. Nature carries on the amputation and healing-over process at the same time; and the new collapsing sapwood, in endeavouring to accomplish this, encloses a portion of the decayed branch. Thus a protuberance is produced, and the piece of decayed branch that is enclosed will, beyond all question, cause a flaw in the timber.

Recently the following example came under our notice:—Two plantations, consisting chiefly of ash and elm, were thinned at one time. Though on different estates, these plantations were adjacent to each other, and the age, soil, situation of both were alike; but the method of rearing had been very different. No. 1 had been occasionally pruned and regularly thinned, and the "root-cuts" of the trees that were taken from it at this time sold readily at 1s. 6d. per foot in the plantation. No. 2 plantation had been utterly neglected in pruning, and the thinning had not been timeously performed, and the root-cuts of the trees sold with difficulty, after being *carted to the road*, at 1s. 1d. per foot. "The tops" or second quality of timber in both plantations were sold to the same wood merchant at 12s. per ton delivered. He cut them into barrel staves, and kept the produce of each plantation separate. At the time of sawing, No. 1 plantation produced more staves per ton of rough timber than No. 2 did. After the staves were dried, they were sold, and about one-fourth of those cut from No. 2 were rejected, and disposed of at less money, owing, as the wood merchant said, to the "black knots falling out of them;" and that these were pieces of decayed branches that had been enclosed during the growth of the tree there can be no doubt. We went and compared the staves together, and found that there was scarce a flaw in those cut from No. 1 plantation, while many of the others were much discoloured, and in some of them there were holes about a half-inch in diameter, from which the pieces of decayed branches had fallen. An examination of the trees showed the same results; many of the trees in No. 2 were partially covered with tumours, and the timber of many had a blackish appearance to the very root. And there can be no doubt that this was caused by the admission of water through the cavities that had been formed by the fall of decayed branches. In this instance, the attempt to produce a *clean* but *sound* bole of timber, by delaying thinning until, from confinement, the branches had decayed and fallen from the stem, and so rendered pruning unnecessary, proved abortive. The method of treatment followed in rearing these plantations was very different, and so was the quality of timber produced. The best timber, and therefore the most profitable crop, was produced by No. 1, which had been reared under a moderate system of pruning, when in its most rapid state of growth.

These examples prove the inadequacy of nature's pruning to produce a sound bole of timber; and they also, we think, show that timely foreshortening would frequently prevent the decay of branches, and thus avert the formation of cavities in the stems of the trees. It is well known that severe thinning produces a coarse, branchy stem; for, unless they be pruned, there is nothing to prevent the branches from having their own way without restraint, and they thus absorb too much of the nourishment from the stem. These branches are frequently improperly attached to the trunk; and being heavy, they often splinter off, and thereby destroy the ornamental appearance of the tree, and deteriorate the value of its timber. Trees brought up under these conditions are generally short in the stem, with large wide-spread heads, that occupy more space than if they were reared under a proper system of pruning and thinning. Judicious foreshortening enables the trees to economise space and the benefits of the atmosphere: timely checking of rival shoots and strong side branches restrains the natural bent of the tree, and thus they are kept within due bounds, without being subjected to an over-reduction of the vital functions. Each individual tree is enabled to participate in the advantages that are to be derived from equal exposure to the influences of solar light and heat. Brought up under these conditions, there is a sufficiency of light admitted equally all round each tree; consequently they will grow faster, and for a much greater length of time, without unduly pressing on each other, than if left without any pruning whatever. Four years since an ornamental plantation, composed chiefly of lime trees, horse chestnuts, sycamores, and maples, planted about 9 feet apart, came under our observation. They had been ten years planted; and as it was the intention of the party who was entrusted with the rearing of these trees to produce an ornamental tree *without any pruning whatever*, not a branch had been touched. Consequently most of the trees had several contending tops, and the whole of them were of a wide-spread and very branchy habit; so much so, that many of them were pressing on each other. These trees were cautiously foreshortened in 1869, and in the springs of 1870 and 1871 they received a slight pruning, just sufficient to keep them to one leading top, and restrain the strongest of the side branches, so that they might be very gradually brought into a shapely, but natural and ornamental appearance. This has now been to a great extent accomplished, and the trees all the time kept in a rapid growing state; and if they are now judiciously cared for, it will be some years before any thinning is required. And we are much deceived if they do not ultimately become very stately and ornamental trees. Believing that the idea of rearing these trees, whether for ornament or profit, without any pruning whatever, was utterly absurd, and wishing to prove it, we left a few unpruned, and as yet they have made little progress in the way of becoming anything like trees; in fact, we anticipate that they will become nothing more than huge bushes, unsightly in appearance and unprofitable as a crop. We might give more examples illustrative of the defectiveness of nature's pruning as compared with foreshortening; but we forbear, believing that we have said sufficient to prove the advantages of foreshortening. And to show that when this system of pruning is adopted in preference to nature's, those evils that alike follow over-crowding and over-thinning are averted.

We have yet to consider the method of "snag pruning"—*i.e.*, cutting over the branch from a few inches to about a foot from the stem. The effects of this method on the energies of the tree are similar to those that follow close pruning, the rate of growth is diminished, and nothing done to prevent the growth of rival tops. The leaving of this stump is no advantage whatever; it becomes an incumbrance to the tree similar to what a decayed branch would be, and its effects on the quality of the timber are identical with those we have already described as following nature's pruning. Consequently, we consider it sufficient to say that it has no *real advantages*—*it lacks the good effects* of foreshortening, and has all the *bad effects* of the method of close pruning, as also those of nature's pruning.

Another advantage of foreshortening is, that it can be applied to *Coniferæ*, in the form of pinching or disbudding. This very often secures a suitable leading top for those trees that have lost their leader by accident or otherwise. We can point to several examples where, by a little attention, good leading shoots have been produced by pinching back the upper tier of lateral branches *except one.* When this is done, nature comes to our aid, and gradually, as the branch grows, she turns it in an upward direction, until it becomes vertical. This is often done with such a nicety, that in a year or two the tree has scarcely any appearance of having ever lost its leader. In 1870, a *Pinus Laricio* lost its leading top after it had grown a few inches. We cut this broken top out by the joint, and pinched all the lateral branches on the uppermost tier, except one, which was left as a top, and it grew about 6 inches that season, and in 1871, 24 inches, and gradually came into the place of the leader. This season it has again added 24 inches to its height. We could give similar examples, with specimens of *Picea nobilis*, *Abies Douglasii*, *Pinus excelsa*, and many others that have been brought into a proper form of growth by timely pinching.

In pruning deciduous trees, when we are forced to take a suitable lateral as the leader, nature lends us her aid, and by degrees assists it into the proper form and place. And again, when we shorten a rival top, she comes to our assistance by causing the lateral branches that grow out above the shortened branch (or top) to bend down, and grow in a rather more horizontal direction, and thus, as it were, assist us by overshadowing the shortened leader.

Before concluding this paper, we wish to say that foreshortening can be *overdone*, and we want it to be distinctly understood that we are no advocate for the system of shortening the most of the horizontal branches, and thus, as it were, cropping the head of the tree into a formal or conical shape to please the eye. This ought to be considered a matter of secondary importance, for when it is severely carried out it is little better than close pruning. We have seen several instances where it was so much overdone, that the energies of the trees were very much checked. When the branches are too much curtailed at one operation, foreshortening becomes positively detrimental to the health and growth of the tree at any age.

The great art of foreshortening is to shorten only contending leaders, and those side branches that are so strong as to detract from the growth of the stem, to about one-fourth or one-half of their length. In this manner, pruning only those trees that require to be pruned, we go over the plantations every second or third year till the trees have reached to about 30 feet high. When such a system of management is adopted little close pruning is required, as the nutritive energies are directed more to the extension and formation of the main stem than to the growth of the lower side branches. This appropriation of the greatest proportion of nutriment by the main stem has a tendency to keep the side branches slender; and gradually as the tree increases in height, this, combined with the influence of the nurses, causes these branches to become less vigorous. When close pruning is necessary, it should be done sparingly, taking care not to remove too many branches at one time; and before removing any, pay particular attention to the appearance of the tree, to see that it is so abundantly supplied with healthy leaves as to be able to spare one or two of the side branches without its rate of growth being very much checked. And endeavour to make sure that the wounds made on the stem by the removal of these branches is not greater than the tree can heal the first, or at *longest* the second, season. It is during the growing season that pruning can be best performed, as the wounds are begun to be healed up before winter sets in.

Having given the above outline of the method of pruning, we would only add that foreshortening is beyond all question the most advantageous method to adopt wherever pruning is required. And we would recommend every forester to test it for himself by actual experiment, and communicate the result to the Scottish Arboricultural Society, and thus establish a uniform method of pruning based on sound and definite principles.

VI. *On the Value of the Corsican, Austrian, and Douglas Firs, as timber trees in Great Britain, and on their Adaptation to different Soils and Situations.* By Robert Hutchison of Carlowrie, F.R.S.E.

Since the outbreak and general spread of the larch disease in many wood-producing districts of the country, by which confidence in that valuable conifer has been shaken, attention has been directed towards finding a substitute, alike rapid in growth, suitable for a variety of situations, of equal durability as a timber-tree, and adapted to a similarly wide range of economical uses.

The three varieties of fir, distinct and widely different in their natures and habits, which form the subject of this paper, have been successively brought under public notice as valuable trees for British culture, and worthy of extensive cultivation. Introduced at different dates, and consequently with a considerable difference of years' experience from which to judge of their respective merits, as worthy successors to the fine old larchwood of which the country could formerly boast, there can be no doubt that all three have proved to be well adapted for culture in Great Britain, and also suited to a variety of soils and situations.

The three varieties now under consideration present individually distinct characteristics; and although the Corsican and Austrian pines resemble each other, they are quite distinct species. The *Pinus austriaca* has sometimes been styled "*quasi Corsica*," a name to which it is not entitled, for its distinguishing features from *Pinus Laricio*, or Corsican pine, are observed to be *constant* in the growing state, and when compared as timber in the sawn plank, there is a marked difference. The *Pinus Douglasii*, on the other hand, more nearly resembles the common silver fir (*Picea pectinata*,) in colour of foliage and bark, with somewhat of the habit of the spruce in outline. The comparatively recent introduction of this last-named pine renders it more difficult to speak with certainty of its value as timber, seeing it has not yet been tested as a timber-yielding tree; and where specimens have been cut down, the rapidity of growth in early years prevents such cases being fairly cited as any criterion of what the species may prove, when felled in a ripe state, and with fully developed timber.

Considering, then, the three pines which form the subject of review, we notice first the Austrian pine (*Pinus austriaca*).

This conifer is generally admitted to have been introduced into this country about the year 1835. Its native habitats are Lower Austria, Styria, Moravia, Corinthia, Transylvania, and the south of Europe generally. It is a most useful variety, whether shelter, timber, or ornament is the object mainly in view in planting. In its young state it is of rapid growth, acquiring in a few years a heavy rounded head, and being rather weak-rooted, like most of the fast growing pines, it is apt to become "*winded*" in exposed situations in rich soil. In fact, an old and *hard-headed* Scotch forester once remarked to us, referring to *Pinus austriaca*,—"Eh, sir! it's hard to keep *her* on her feet, when young, in exposed bits!" This habit of forming a dense, heavy top when young is productive also of another evil, for such a mode of growth must engender the formation and encouragement of many side branches, and so detract from the value and bulk of wood in the trunk. As an ornamental pine, *Pinus austriaca* is undoubtedly a great acquisition; its dark, rich green foliage, its dense head of massive contour, its strong side-shoots, and its rapid rank growth, all contribute to render it a tree of desirable habit for effective purposes; but we fear that when compared *for economic purposes* with the other two species referred to in this paper, it will be found deficient in quality, texture, and durability.

The soil in which *Pinus austriaca* flourishes in its native habitats is a thin cold dry soil, of sandy or gravelly tendency; and in such situations it will thrive admirably, and succeed as a timber tree, much better than in rich alluvial deep soil, although more sheltered. In fact, it appears impatient of mild sheltered positions, preferring those apparently less suitable for the growth of timber. As already stated, it is not so well adapted for situations much exposed to heavy prevailing winds, being weak and shallow-rooted in its younger state, and at the same time densely clothed with close umbrageous foliage, which renders it not unfrequently what might be termed "*top-heavy.*"

In localities suitable for its development, and not exposed to heavy winds, *Pinus austriaca* will attain a greater height than the Scots fir (*P. sylvestris*), and is of equally, if not more, rapid growth. The wood is inclined to coarseness, but is tough and firm in texture, rather knotty, but of more commercial value for country purposes than the timber of equal age of either larch generally or the Scots fir. As compared with the Corsican pine (*P. Laricio*), the growth of the Austrian pine is not more rapid, and it is less suitable for exposed situations. *Pinus austriaca* in habit and value more nearly resembles *Pinus Pallasiana*, but both are inferior *as wood* to *Pinus Laricio*. The leaves of the Austrian pine are easily distinguished from those of the Corsican, by their being rather longer, and devoid of the twisted appearance which those of the latter present. As a tree to employ as a nurse in sheltered valleys it is invaluable, owing to its dense head, spreading arms, and rapid growth; and to be cut out when it has not attained full size, it is more valuable than the Scots fir, as it can be profitably used for country purposes at a younger age than almost any other fir. Lamp-black and charcoal of excellent quality can be obtained from its branches, and the thinnings are in its native country much sought after by coopers and carpenters.

We proceed now to consider the Corsican fir (*Pinus Laricio*), and its suitability for general and extended cultivation in this country. This pine was first discovered in dense forest masses in Corsica, whence it was introduced into this country towards the end of the eighteenth century. It has since been found over several countries of Southern Europe, including Spain, Greece, and Italy, and it abounds on the mountain lands of Calabria. In these, its native habitats, it attains to a height of 140 feet, and forms a noble tree of bold, erect, open habit. The wood is extremely resinous, tough, and, although tending to coarseness, not so brittle as Scots fir or Austrian pine of equal age, but is elastic and durable; under the tools of the carpenter, it works smoothly and easily, and is much prized for many outdoor or constructive purposes. Felled when about seventy or eighty years old, the wood is found to be well matured, and of a whitish colour, and brown near the heart.

In this country, the Laricio has been extensively planted during recent years as a timber crop, and since the larch failure, probably this conifer more than any other has been substituted for it. It thrives in almost any soil where the Scots fir or spruce succeeds, but will not attain its full development at the higher altitudes, preferring a rather good deep soil and sheltered situation in its younger stages; for being of very rapid growth and early vigorous habit, like *P. austriaca*, it is apt to form a top rapidly, which the slower formation of roots cannot support during high gales of wind. In this respect, however, it does not equal the Austrian pine, and is materially assisted by its characteristic tendency to throw the vigour of its growth more into the trunk and terminal leader, than to form a dense head or many heavy side branches. Another benefit accruing from this erect or fastigiate habit is the ultimately enhanced value of the timber, by its being less knotty and of better texture. In general appearance when young, the *P. Laricio* somewhat resembles the Scots fir of the old Strathspey indigenous type, but it is more open and longer between the tiers of branchlets. Its value as timber is not so superior when the tree is young, for thinnings of *Laricio* are found to be soft, and less durable than *larch*, but *when old* it is reported to be remarkable for its toughness, and it is strongly impregnated with resinous sap. Numerous groups and specimens of the *Laricio* 40 feet in height exist in various parts of the country; and in Perthshire, at 600 feet elevation, in a loamy soil and gravelly subsoil, it proves itself equal to any indigenous fir, resisting alike the gale and winter's storm, and rapidly shooting above contemporary trees of Scots fir, larch, and *austriaca.* It may indeed be described as a tree consisting of the *bole* of larch, with the lateral branchlets and foliage of Scots fir.

One qualification of considerable importance possessed by the *P. Laricio* should not be overlooked—namely, its distastefulness in its young state to hares and rabbits. Without positively asserting that ground vermin will absolutely shun the young Laricio, if mixed with other conifers in a plantation, it may be safely asserted that they will nibble away everything else before they will touch it. An experiment to test this was made some years ago at Tortworth Court in Gloucestershire, where Lord Ducie, of whose interest in arboricultural matters this Society is well aware, planted a young *Laricio* in the centre of a rabbit-warren, and which, until the ground was quite covered with snow, the teeming population of the spot did not touch; and even then, when starving, and naturally less capricious in their bill of fare—after an attempt to consume the young needles of the buds—they abandoned the experiment, and sought some less bitter and astringently resinous food. In like manner, *Pinus Laricio* is less liable than any other pine to suffer from the ravages of insects or such like enemies, which infest and disfigure many of the coniferous family. Although we have said that the *Laricio* exhibits a preference for a deep, good soil, it thrives in almost any other description, if we except soft, spongy, and undrained marshy ground. Being of a deep tap-rooted habit, in such a situation the spongioles of the main radicle get chilled and water-logged, and hence the tree will not succeed. Throughout the country it has within the last thirty years been freely planted in all sorts of soils and elevations, and has been proved to be perfectly hardy, and altogether such a variety as ought to be more generally cultivated; for while it is a rapid grower and a handsome tapering tree, it is well calculated for planting in masses, as a crop to produce not only *quantity* within a period of forty years, but quantity *of heavy size*, and timber of excellent quality. Although in its native country it is felled about eighty years old, it may be profitably used at even thirty years. It may be seen luxuriating, and of considerable height, at Dolphinton in Lanarkshire, at an altitude of 900 or 1000 feet above sea-level; and in many other counties in the north of Scotland, specimens of the *P. Laricio* show that it is suited to the climate of Scotland. From the long tap-root of this pine, it is, unless frequently and regularly transplanted when young, somewhat difficult of removal, and when forming plantations small plants should be used, as they will ultimately succeed better than those that have had their tap-roots cut or lacerated when young. The true variety of *Pinus Laricio* was somewhat scarce two or three years ago, and as there are several other varieties which when young closely resemble it, care is requisite to obtain the true kind, where the *Laricio* is desired for ultimate profit and for heavy timber purposes.

The other conifer which, at the outset of this paper, it was proposed to notice, is *Pinus Douglasii*, or *Abies Douglasii* as it is more correctly called. This now well-known tree is probably the most popular of the many excellent introductions of its original and ill-fated discoverer, whose name it so appropriately bears. Its first appearance in Great Britain was about the year 1827, when it was raised from the seeds of cones brought by Douglas from the banks of the Columbia river, where it abounds in immense tracts, covering the lofty hill sides, and appearing near the summits of the Rocky Mountains no larger than a mere bush, and gradually increasing in its proportions until in the valleys and at the foot of the mountain ranges it attains a height of 200 feet, with a straight noble stem fully 10 feet in diameter. It is common also in California, and in Mexico a variety of smaller growth, and with longer leaves of a deeper green colour, is found.

In Scotland, this fir has proved perfectly hardy, of very rapid growth, a most graceful tree for ornamental or park purposes, and a valuable timber producer. It has been planted in every conceivable soil and situation, and adapts itself to almost any description, provided the drainage of the subsoil be porous, so that it does not become "water-logged." It thrives at any elevation, and the only drawback is its tendency to lose its leading shoot in early spring, or liability to have it broken over, by any bird alighting upon its sap-surcharged stem. This is, however, in a great measure only of secondary importance, for the rapidity with which the Douglas fir repairs the damage is amazing; and we do not think, unless in very exposed open situations, where it is liable to receive the full force of the west and south winds, which are so prevalent in Scotland, that this tendency should be any detriment to its cultivation. There are many other important qualifications, superior to both the Laricio and Austriaca, which the Douglas fir possesses, and which will, we think, tend ultimately to its being preferred by planters generally. While we can hardly point to a single specimen of either of the two former named pines in this country of 50 or 60 feet in height, we have instances of the Douglas in many places throughout the country of fully that size. At Dropmore, where one of the original seedlings is luxuriating in a naturally poor soil, this noble tree has already attained an altitude of over 100 feet! In many other situations both in England and in Ireland, we find it, not certainly of the immense height of the famous Dropmore tree, but of large *tree* dimensions, and in all varieties of soil, from sandy light porous earth to deep heavy loam and clayey subsoil. For example, we find at Charlesfort, county Meath, Ireland, one plant in a sheltered site, in good soil, which in the spring of this year measured 40 feet high, and 3 feet 3 inches in girth at 3 feet from the ground, and which has during the past eight years increased by no less than $22\frac{1}{2}$ feet! It is now about twenty years of age. In the same situation the *Wellingtonia gigantea*, now 29 feet 6 inches in height, has only increased during the same period $17\frac{1}{2}$ feet; and the Deodar, now 36 feet high, only $14\frac{1}{2}$ feet. The Wellingtonia, it should be added, is 4 feet in girth at 3 feet from the ground. At Balgowan, and Keillor, in Perthshire, at an elevation of 600 feet above sea-level, we find numerous Douglas firs. Mr Thomson, the enterprising proprietor, an enthusiastic arboriculturist, plants them and the Laricio by the thousand even at that elevation, and finds them invariably succeed rapidly and well. The tallest specimen there is in the Keillor Pinetum, where it has attained a height of 57 feet, and a girth of $5\frac{3}{4}$ feet at 3 feet from the ground. The soil is a good loam on gravelly subsoil; but the situation is not unduly sheltered. It ought, however, to be stated that the altitude of this tree would have been much greater were it not that, equally with the other pines at Keillor and Balgowan, it has suffered occasionally from the damage to its terminal bud and shoot, by black-game and capercailzie alighting upon them. This specimen was planted in 1833. Of the same age we found a magnificent *A. Menziesii*, now 46 feet high and 11 feet 3 inches in girth; also a *P. monticola* of same age, 46 feet high, and 5 feet 6 inches in girth, and all in the highest state of luxuriance and health. These measurements are given for comparison of the growth of those species with that of the Douglas fir, and we may only further add, that there is also in the same situation a *P. nobilis* planted in 1843 (ten years later), now 50 feet high, and 3 feet 9 inches in circumference. At Minto, in Roxburghshire, in good loam and upon a clayey substratum, the *A. Douglasii* planted twenty years ago is now 36 feet in height, and nearly 3 feet in girth at 4 feet from the ground. At Carlowrie, Linlithgowshire, in deep heavy loam resting on clay, there is also one 25 years of age, and 36 feet in height, standing, however, in a rather exposed position for heavy south-westerly winds, from which it seems to suffer, and it has become "lop-sided." At Belstane, on the top of the Pentlands, and at an elevation of about 900 feet, this pine thrives remarkably well. Planted in 1843, they were three years ago fully 50 feet high, and growing in a very poor cold tilly soil. Many other instances might be cited showing the adaptability of *Abies Douglasii* to all sorts of soils and situations in Scotland. The tree at Raith, near Kirkcaldy, in Fife, planted by Douglas himself, is now a splendid specimen, and grows within the influence of the sea-breeze, though in a somewhat sheltered site; and inland, on poor soil at Dolphinton, Lanarkshire, at nearly 1000 feet above sea-level, it is thriving in quantities.

When young, the bark of the *Abies Douglasii* is covered with numerous small blisters surcharged with highly aromatic and resinous sap, and breaking one of these in passing through amongst a group of plants quite perfumes the air around. As the tree grows older, the bark becomes dry, and of a greyish and rough appearance, quite different from the younger stages of its growth. The wood is reported to be very durable, tough, elastic, beautifully grained, and susceptible of a high polish. No doubt, the utility and beauty of the fibre of the wood in old specimen sections, point it out as suited for either constructive or decorative purposes; and the beauty, symmetry, and gracefully branching habit of the dark green-clad branches and side shoots, combined with its rapidity of growth, render it equally well adapted in the live state for either ornament or profitable planting.

Considering, then, the prospective value of the timber of these three pines respectively in Great Britain, we are inclined to assign the first rank as a valuable and useful wood of high quality to *A. Douglasii*, as it will to all appearances prove generally suitable for nearly every economic purpose; next may be ranked *P. Laricio*, as a very useful wood also, but coarser in texture and of less quality than the Douglas fir; and to the third place we assign *P. austriaca*, which should rather plant as an effective "massing" tree for park or drive decorative purposes, or for dense cover for background effect in ornamental planting. The timber is more adapted for common local country uses, than for sale as a wood for either useful or decorative household purposes.

VII. *Report on a Collection of Geological Specimens, with an Outline of the Geological and Arboricultural Features of Buteshire.* By JAMES KAY, Forester, Bute Estate, Rothesay.

As this paper combines two distinct subjects, Geology and Arboriculture, I shall advert to them separately, and give—

1. OUTLINE OF THE GEOLOGY OF BUTESHIRE.

The following are the numbers and names (so far as known to me), with the localities where the specimens accompanying this Report were collected:—

No.	Names.		Where obtained.	
1.	Granite,		Roza Burn,	Arran.
2.	Granite Crystals,		Globe Hill,	,,
3.	Granite,		Ploverfield,	,,
4.	Junction of Granite and Slate,		Globe Hill,	,,
5.	Slate Rock,		Roza Burn,	,,
6.	Old Red Sandstone,		Auchnagallan,	,,
7.	Barytes,		Glen Sannox,	,,
8.	Old Red Sandstone Conglomerate,		Corrie,	,,
9.	Carboniferous	Sandstone,	Brodick,	,,
10.	,,	Sandstone,	,,	,,
11.	,,	Sandstone,	,,	,,
12.	,,	Hematite,	,,	,,
13.	,,	Sandstone,	Invercloy,	,,
14.	,,	Shale,	Corrie,	,,
15.	,,	Stigmaria,	,,	,,
16.	,,	Ironstone,	,,	,,
17.	,,	Ironstone,	,,	,,
18.	,,	Limestone,	,,	,,
19.	,,	Limestone,	,,	,,
20.	,,	Limestone Coral,	,,	,,
21.	,,	Productæ,	,,	,,
22.	,,	Productæ,	,,	,,
23.	,,	Limestone with Productæ,	,,	,,
24.	,,	Conglomerate,	Scriden,	,,
25.	,,	Conglomerate,	,,	,,
26.	Claystone Porphyry,		Kilpatrick,	,,
27.	,,	,,	Craig Dubh,	,,

No.	Names.	Where obtained.	
28.	Claystone,	Lamlash Burn,	Arran
29.	,,	,,	,,
30.	Pitchstone,	,,	,,
31.	Pitchstone Porphyry,	Brodick,	,,
32.	Trap Rock,	Dippin,	,,
33.	,,	,,	,,
34.	,,	Lamlash,	,,
35.	,,	Ascog,	Bute.
36.	Mica Schist,	—	North Bute.
37.	,,	—	,,
38.	,,	—	,,
39.	Felspar,	—	,,
40.	Clay Slate,	—	,,
41.	Greywacke,	—	,,
42.	Columnar Sandstone,	—	South Bute.

Instead of attempting any generalisation of the geology of Buteshire on my own part, I beg to offer a few extracts from Dr Bryce's Work on the Geology of Arran and Bute:—

Island of Bute.—The length of Bute from Garrochhead to Buttock Point is $14\frac{7}{8}$ miles, and the average breadth about 3 miles. The total area, including Inchmarnock, is 31,835 acres. Three deep depressions or valleys traverse Bute perpendicular to its longer axis, dividing the island into four portions, and marking the boundaries of distinct geological formations. They terminate on either side in bays or indentations of the land, formed here, as in most other cases, at the points of least resistance, the junctions, namely, of dissimilar strata. Those on the east side are the well-known bays of Kames, Rothesay, and Kilcattan. The low tracts in question show no rock *in situ*, but are filled with shingle and alluvial deposits, concealing the junctions, strata of peat, and occasional shell beds. The elevation above the sea-level nowhere exceeds 30 feet; and as this is also very nearly the height of the terrace encircling the island, it appears that when the sea stood at that ancient level, Bute consisted of four islands separated by narrow channels.

The various strata exhibited in Bute are the terminal portions of those great bands of rock, sedimentary and igneous, which extend across the country from sea to sea; mica slate occupies the northern portion, between the Kyles on the north and Kames and Ettrick Bays on the south. The rock has its usual character and aspect, and rises into hills of nearly 1000 feet elevation. The district south of this, bounded by the Rothesay valley, consists of the two upper slates, the common clay and chloritic. Subordinate to these are great beds of quartz rock, the most considerable of which forms the high ridge called Barone Hill. The portion extending from Rothesay Valley to Kilcattan is occupied by red sandstone; and finally, the southern portion, with a substratum of red sandstone, consists mainly of various rocks of the trap family, erupted through and overlying the sandstone. The accompanying outline of the island (fig. 1) shows the relation of these strata to the valleys or depressions, which are obviously a part of the system of parallel fractures ranging N.E. and S.W. across Scotland, and probably due to the upheaval of the mountains of the Central Highlands.

The sandstone is in the place of the old red, as succeeding the slates, and has much of the mineral character of this formation in other districts. Along the eastern shore in several places, and again at Kilcattan, beds of limestone occur subordinate to it; but unlike the Arran limestones in the same subordinate positions, they have no fossils containing much siliceous matter, they are of little economic value, and thus have many analogies with the cornstones of the old red, such as occur near the base of Ben Lomond, and in several localities in Arran, the march of Achab Farm, the Fallen Rocks, Glen Loig, and Kilchattan.*

Fig. 1.

a, Kames Bay ; *b*, Rothesay ; *c*, Kilcattan ; *m*, mica slate ; *n*, clay and chlorite slates ; *s s*, red sandstone ; *t*, trap ; *r*, the terrace.

The dikes of Bute are composed of greenstone or basalt, and are very numerous, especially on the east coast. They traverse the strata in various directions, and in some cases can be traced for several miles continuously, preserving nearly the same width and direction throughout. The north shore of Bute is classic ground in the history of the glacial beds of Scotland. It was from an examination of the shell beds found here that Mr Smith of Jordanhill was first led to recognise the arctic character of these deposits.

Arran.—The island of Arran is 20½ miles long from N.N.W. to S.S.E., 10½ miles broad, and with the Holy Isle and Pladda

* Professor Geikie considers all the sandstones to be newer than the old red.

includes an area of 103,953 acres. The number of rock formations, sedimentary and plutonic, which are found within this limited space is truly remarkable, perhaps unparalleled in any tract of like extent on the surface of the globe; while the varied phenomena which they present in their mutual contacts and general relations to one another are of the highest import in theoretical geology.

A line running from the north angle of Brodick Bay almost due west to Iorsa water foot divides the island into two nearly equal portions, strikingly different in their geological structure and in their outward features. The northern half consists of a mass of peaked and rugged granite mountains, intersected by deep wild glens, which diverge from a common centre and open seaward on a narrow belt of low land. This belt forms a terrace marking the ancient sea-level, and is bounded inland by cliffs pierced with caves and otherwise sea-worn.

The southern half of the island consists of a rolling table-land, bleak and unpicturesque inland, but breaking rapidly down seaward into a coast border of great romantic beauty. The general elevation is from 500 to 800 feet, and the irregular ridges which traverse it, most usually in a direction nearly east and west, rise from 1000 to upwards of 1600 feet.

The granite nucleus occupies the central and by far the greater portion of the northern half of the island. The three mountain groups already described, with the glens and valleys penetrating and dividing them, consist entirely of this rock. It is remarkable, however, that at no point does the granite reach the coast. It is everywhere enclosed by a narrow band or framework of clay slate, of the second or dark-coloured variety, which completely encircles the nucleus. On the east side of the granite nucleus, above Corrie, this slate band is extremely narrow. On the western side it is much broader; but the lower micaceous band appears only in patches in the promontories; west of Catacol it is not seen in any great bodies till we pass into Cantire.

The encircling band of clay slate is succeeded on the east and south by a band of Old Red Sandstone, which, like the slate band, is of irregular breadth. It begins to overlie the slate at the Fallen Rocks on the north-east coast, and occupies the shore thence to the march of Achab Farm, half-a-mile north of Corrie. Here it retires inland, the Carboniferous formations taking its place on the shore, crosses in a narrow band to the west of Maoldon, and stretches thence continuously westward, around the border of the slate, to the mouth of Muchrie Water. Between this point and Dougrie, near Iorsa water foot, it attains its greatest breadth. A line from the north side of Brodick Bay to Dougrie very nearly marks out its line of junction with the slate.

The southern half of the island, southward of the Old Red Sandstone boundary above defined, that is, from the String Road and valley of Muchrie Water to the south end, is composed of several members of the Carboniferous series, broken through and overlaid by various igneous rocks, chiefly those of the greenstone type. The prevailing rock and substratum of the whole southern plateau is red sandstone, varying from a fine compact structure to that of a coarse conglomerate. A band of this sandstone extends also along the eastern shore northwards to Corrie, and again from the Fallen Rocks northwest to the Scriden, at the northern extremity near the entrance of Loch Ranza. Subordinate to this sandstone are beds of limestone abounding in fossils of true carboniferous types, with beds of shale and coal, in which are found fossil plants and shells such as characterise these strata in the basin of the Clyde.

Arran is extremely rich in rocks of the trapean order; most of the known species occur, and also those numerous varieties by which they graduate into one another. They form great overlying masses, capping the sandstone of the southern plateau, and rising into the highest hills of this division of the island. They are interposed amid the sedimentary deposits, in huge sheets or beds conformable to the stratification, and cut through all the rocks alike, from the lowest to the highest in vertical or slightly inclined dikes, which range continuously across great horizontal distances.

The trap rocks of Arran may be arranged in three classes, according to their composition:—The Felspathic, comprising porphyry, claystone, compact felspar, and pitchstone; the Hornblendic, as diorite and amygdaloid; the Augitic, as basalt and dolerite.

Great Cumbrae.—This island is three miles long, and one and a-half broad. The surface rises gently towards the middle, and the height nowhere exceeds 500 feet; the southern shore presents some low rocky cliffs; on the other sides the ground descends by grassy slopes and sandstone ledges. Great Cumbrae corresponds in geological structure with the middle region of Bute, and consists of red sandstone having a slight northerly dip, traversed by numerous trap dikes, invaded by sheets of the same rock, but not overlaid by trap except in one spot on the west coast, where a small patch occurs. The sandstone is generally of a deep red colour, almost the only exception being found in the small islets forming the harbour of Millport, which consists of white and grey sandstone. Strata of conglomerate structure are occasionally met with; and the ridges on the west formerly showed some thin limestone beds interstratified with sandstone, but these have been worked out. No fossils have been met with; but there can be little doubt that the sandstone is of the same age as that of South Bute, most probably lower carboniferous.

Little Cumbrae.—The Lesser Cumbrae is about two miles long and one mile broad, and in its bolder outlines strongly contrasts with the sister isle; its highest point has an elevation of about 800 feet. In geological structure and in altitude it corresponds with the southern division of Bute.

Pladda.—This islet is attached to Arran by a whin dike, over most parts of which there is broken water at low tide. The island consists almost wholly of a dark-coloured trap rock, the sandstone foundation appearing only on the north-eastern shore.

II. Arboricultural Features of Buteshire.

Island of Bute.—The extent of enclosed plantations in Bute is about 1600 acres. The principal portion is the policy woods of Mount Stuart, the remainder being a number of detached belts and plantations in the south and north parts of the island.

The plantations to the south of Rothesay rest on the carboniferous formation, those to the north on the slate formation. Though there is a considerable breadth of trap rock in the middle and south portions of the island, there is no wood of any consequence to afford conclusive evidence of the advantages or disadvantages of such underlying formation to the growth of trees. At the same time, from the character of the herbage, the dry nature of the soil and substratum, caused by the numerous intersects with which the underlying rock abounds, we should suppose that trees would grow well where there is sufficient depth of soil.

The policy woods of Mount Stuart have an elevation of from 10 to 150 feet, with an east exposure, and are completely sheltered from the west storms. The portion immediately round the mansion-house is of considerably older date than the outer portions, in all probability dating back to the commencement of the mansion-house —1712—which gives an age of 160 years. The outer portions average from 30 to 62 years old. The part of the policy woods along the sea-shore rests at the bottom of the old sea terrace, and is very few feet above high-water mark. The rock in a great many parts is within less than a foot of the surface. The soil is a deposit of gravel or gravelly soil—the remains of the ancient sea beach—and is damp from imperfect drainage in a great many places. Still the trees have grown remarkably well. Though the surface is naturally flat and damp, yet in long-continued droughts the soil becomes exhausted, as was evidenced four years ago (1868), when several fine spruce firs succumbed for want of nourishment.

The higher portion of the policy woods is principally composed of mixed hardwoods, with a few Scotch, spruce, larch, and silver firs, and stands above the level of the ancient sea-cliff (from 40 to 80 feet above present sea-level). The soil varies from a sandy loam to a gravelly clay. There are some fine trees in this portion of the woods. Spanish chestnut thrives remarkably well, and the lime-tree avenue and beech walk are specially admired. The latter, according to the old fashion, is perfectly straight, and of considerable length, and lies betwixt the cliff and the sea. The beeches are from 100 to 120 feet high, and resemble a vast Gothic arch when viewed from one end. There are also several specimens of rare and beautiful plants in the flower-garden; and such is the mildness of the climate, that exotics, which are raised in few places in Britain, are found here in a vigorous state. Miss Sinclair alleges that they have mistaken Bute for the tropics, and continues:—"Cape heaths flower luxuriantly in the open air, remaining out all winter, as well as standard plants of the *Magnolia grandiflora*, which have risen to the height of 18 or 20 feet. Sweet almonds ripen; geraniums are on fire with scarlet flowers; fuchsias and camellias have been enlisted among the hardy plants; and we observed two thriving cork trees. In short, it seems that that which flowers once a year elsewhere blossoms twice here; and what grows 6 feet high in other places of the empire grows 12 in this more favoured spot."

The outer and detached portions of plantations to the north, south, and west of Mount Stuart are composed principally of larch, Scotch and spruce firs, and have mostly a south or south-west exposure, with an elevation of from 50 to 500 feet. The soil varies from a clayey loam to a thin gravelly till with a rocky bottom (conglomerate). Where the situation is sheltered, with a fair depth of soil and perfect drainage, the trees have generally grown well. Where the situation is exposed to the west winds, the trees are considerably inferior, the larch, more especially along the exposed sides, being much blasted.

The plantations in the northern half of the island rest on the slate formation. The greater portion is composed of larch, with a mixture of spruce and Scots firs. Exposure—north and north-west, with an elevation of from 50 to 500 feet. The soil generally very thin; but where the surface is of a loose rocky nature, and the drainage naturally perfect, larch trees grow well, and are generally more healthy than those grown on the carboniferous formations, or south portion of the island.

There are several portions of coppice wood in the middle and north end of the island; but these are of comparatively little value, and the land could be turned to more profitable account if cleared, drained, and planted with larch, Scots and spruce firs. Along Ascog shore, east of Rothesay (carboniferous formation), there is a fine margin of wood along the sea-cliff. There are also several specimens of the rarer coniferæ in the villa gardens here and near Rothesay; and at Kames Castle, North Bute, there are a number of fine old park trees.

Inchmarnock.—This island is of the same formation as North Bute. The soil is of a clayey nature with a tilly bottom. With the exception of a margin of birch and hazel scrubwood along the east side and south end of the island, there is no wood of any note. The small scrub is cut and used as firewood or for fencing purposes by the farmers on the island.

Great Cumbrae.—The wooded portion of this island lies along the east and west sides of the road leading from the south to the north end, and extends to about 90 acres of mixed plantation, 45 years old, with an elevation of from 50 to 184 feet above the sea-level. The greater portion has a south-west exposure, and the soil (except in the hollow parts) is very thin, with a rocky bottom. The Scots and silver firs have grown best. On some of the poor and rocky parts, the larches are not more than 4 inches in diameter. On the best ground the largest Scots and silver firs average 12 to 15 inches in diameter at 5 feet from the ground. In the college grounds near Millport there are a number of fine araucarias, about 14 years old, averaging from 9 to 16 feet in height.

Little Cumbrae.—There is no wood on this island, only a scanty herbage.

Pladda.—This is only a rocky islet.

Arran.—The extent of enclosed plantations on the island of Arran is about 1250 acres, of which 800 acres are from 42 to 60 years old, and 450 acres from 14 to 25 years old. With the exception of a few scattered portions of wood, planted within the last twenty years, the greater portion of the enclosed plantations is in the immediate neighbourhood of Brodick Castle. The wood round the castle, with the exception of a part of the wood at the mouth of Glen Roza, which rests on the Old Red Sandstone, is all on the Carboniferous formation. Exposure—east, with an elevation of from 50 to 500 feet.

The wood to the west of the castle is composed of larch, Scots and silver firs, about 45 years old. The soil varies from a peaty soil to a clayey loam, intermixed with freestone and slate shingle, with granite boulders. The Scots firs, though having been pretty close drawn up, are rather coarse grown; and though there are several fine Scots firs in this portion of the plantation, the larches are generally the largest trees and the most thriving. To the north of the castle, along both sides and to the north of Merkland Burn, the wood consists chiefly of oaks, which are not in a thriving state, being much fogged and stunted, which no doubt is much aggravated by the damp state of the ground. To the south of the castle, on north side of Roza Burn, the wood is composed principally of Scots and spruce firs, 42 years old. To the west of this part of the wood is principally larch, with a row of planes on the west or storm side. The trees, though evidencing the effects of the storm at the mouth of Glen Roza (leaning very much to one side), are remarkably healthy:—no dead tops are to be seen. Though there are a number of larch and spruces which measure 15 inches in diameter 5 feet up, the greater proportion would class under the largest size of propwood. On the south side of Roza Burn there is a fine clump of mixed wood; and, with the exception of a few trees in the north-west corner of the plantation, they are equally healthy to the last.

It may be noted that the junction of the Carboniferous and Old Red Sandstone is somewhere near the centre—south and north of this plantation, also through the upper corner of the last-mentioned plantation—on north side of Roza Burn. The junction is not definitely seen, the bottom of the burn being obscured with gravel and granite boulders.

There is also a piece of fine wood, composed principally of larch and Scots fir, with a few silver firs, oak, and beech, about 60 years old, between Brodick church and school-house. The larch and Scots fir average 9 to 16 inches in diameter 5 feet up. Immediately behind the castle there is a plantation, about 25 years old, with a few old Scots fir and silver firs as standards. Several of the silver firs are 120 feet high. There is also a clump of larch about 12 years old, planted in the centre of the old wood to the west of the castle; but the greater proportion have been destroyed by the deer, which are very numerous here. With the exception of a small portion of wood to the east and west of Invercloy, this comprises the principal portion of the wood round Brodick Castle.

The plantations in the south end of the island have been mostly planted within the last fifteen years. Exposure—south and south-east, with an elevation of from 100 to 500 feet. With the exception of the young plantation at Lag, the larch of which seem to be in an unhealthy and diseased state, they are all remarkably healthy, though much in want of thinning.

At Lamlash and neighbourhood, the glens are more or less fringed with a margin of natural wood, composed of plane, birch, alder, and elder. At White House there are a number of fine silver firs, and some fine shrubs; also, near the north end of Lamlash village there are several fine araucarias, about 15 feet high. Near the shore, along side of the road leading from Lamlash to Brodick, there are a number of beech and Scots firs about 80 years old.

The next to be noticed is a margin of birch coppice-wood, along the sea-cliff from Brodick woods to Glen Sannox, and from Loch Ranza to Dugarry. Hazel is very scarce in most parts. Though the above are the principal localities of the birch or coppice wood, straggling trees are seen more or less in all the glens near the shore in Arran.

On the west side of the island, immediately above the shore, we observed numbers of elder trees more than a foot in diameter.

The only piece of wood of any note on the slate formation is 35 acres of young plantation, 25 years of age, immediately above the shore, at Whitefarland, on the west side of the island, which has an elevation of from 20 to 300 feet, with a full west exposure to the sea. It is composed principally of larch, with a few ash and alder intermixed, with a double row of planes along the shore. Considering the nature of the ground, which is a rough rocky face, and exposed as this plantation is to the storms of the Atlantic, the trees are remarkably healthy. The planes are *very healthy*, averaging 9 inches in diameter 5 feet up. The hills rising immediately behind this plantation must act an important part in warding off the storm from the lower ground.

As evidence of the mildness of the climate on the east side of the island, Dr Landsborough remarks, "that in Cromla garden (near Corrie) the oleander (*Nerium oleander*) stood a winter in the open air, without protection of any kind, and flowered well in the greenhouse the following summer. The gorgeous *Rhododendron nobleanum* is in bloom the whole winter; so also is *Genista Atleana*, (5 feet in height). A myrtle, planted out in 1862, now 8½ feet in height, and more in circumference, flowers magnificently every season. This year (1871) there were planted *Cyathea dealbata*, perhaps the most beautiful of tree ferns. An Australian gum tree, and also the beef-wood or she-oak (*Casuarina quadrivalvis*), the most singularly picturesque tree of the Australian flora, being a tree paddock pipe."

I visited Cromla garden in October 1872, that I might see for myself, and beg to testify that the plants, with the exception of the gum trees (*Eucalyptus*), which have been injured in some way, are equal to all that has been stated regarding them, though the garden is now much neglected.

For the sake of comparison, I append the following dimensions of the most noteworthy trees in Buteshire:—

Name.	Where Growing.	Age.	Height.	Circumference at 5 feet.	
Ash (common), . .	Mount Stuart	160	...	9 ft.	3 in.
*Ash, "Adam," . .	Rothesay	220	...	17	5
*Ash, "Eve," . . .	do.	...	...	12	0
Beech (common), .	Mount Stuart	160	...	13	0
Birch, ...	do.	...	...	7	6
Oriental Plane, . .	do.	...	...	8	0
Lime Tree, . . .	do.	...	...	10	5
Tulip Tree, . . .	do.	...	...	5	0
Evergreen Oak, . .	do.	160	...	9	6
Hornbeam, . . .	do.	160	...	6	0
Sweet Chestnut, .	do.	160	...	11	9
Oak, ...	do.	160	...	9	6

* "Adam" and "Eve" are two remarkable old ash trees on the roadside, a little to the south of the town of Rothesay. The largest, "Adam," having become much decayed, the trunk completely hollowed out, and only a thin shell of wood and bark on the one side keeping it in life, the largest limbs, some of them 3 feet in diameter, had to be cut off three years ago, to prevent it from being blown down. The first and second year after the limbs were cut off, it gave signs of vigorous life by sending out several shoots from 2 to 3 feet in length; but last year (1871) its race seems to have been run, and it now stands a hollow dead trunk, a monument of former greatness. The age of this tree was ascertained by counting the annual rings of one of the limbs. Most of the wood being perfectly sound, part of it was made into seats, which were placed along the shore to the east of the town. "Eve" is still vigorous and healthy, and likely to be so for many years. We have no means of knowing the age of this tree; but it must be considerably younger than "Adam."

Name.	Where Growing.	Age.	Height.	Circumference at 5 feet.	
Turkey Oak, . . .	Mount Stuart	...	...	7 ft.	1 in.
Cork Oak (*Quercus Suber*), ...	do.	36	20	2	9
Abies Douglasii, .	do.	12	33	...	
Abies morinda, . .	do.	36	30	2	5
Araucaria imbricata,	do.	12	9	...	
Araucaria imbricata,	do.	15	15½	1	1
Cupressus macrocarpa,	do.	...	26	...	
Cedrus Libani, . .	do.	...	60	5	10
Larix europæa, . .	do.	...	...	9	3
Picea pectinata, . .	do.	...	96	12	10
Pinus sylvestris, . .	do.	...	91	8	7
Taxus baccata, . .	do.	...	60	8	4
Wellingtonia gigantea,	do.	13	12	...	
Robinia Pseudo-Acacia,	do.	36	43	2	9
Cedrus Deodara, .	do.	36	36	3	0
Cryptomeria Lobbii,	do.	36	33	2	11
Pinus Strobus, . .	do.	...	30	6	0
Araucaria, . . .	Rothesay	18	22	1	10
Araucaria, . . .	Millport	14	16	...	
Araucaria, . . .	Brodick Castle	20	24	1	10
Abies morinda, . .	do.	...	14	...	
Cedrus Deodara, .	do.	...	20	1	7
Pinus austriaca, .	do.	...	...	8	10
Pinus sylvestris, .	do.	...	...	9	3
Larix europæa, . .	do.	...	...	10	9

Where the age is not known, the column is blank.

Though the foregoing is but an imperfect review of the arboriculture of Buteshire, still it is hoped that it may be worthy of acceptance.

VIII. *On Different Modes of Profitably Disposing of Home-Grown Timber.* By DAVID TAIT, Forester, Owston Park, Doncaster.

This subject is one well worthy of the attention of landed proprietors and their foresters. As timber is a crop which occupies the ground about sixty years on an average, it is very fitting that we should consider the different methods in use for disposing of it, and choose the one which will bring in the largest return, as the question of woodlands being profitable may be greatly affected by the disposing of the timber crop.

In considering this subject, I have stated the various methods of disposing of timber with which I am acquainted, and have given my opinion on their respective merits, viz. :-

1*st*, Selling standing timber.
2*d*, Selling fallen timber by auction.
3*d*, Do. do. by tender.
4*th*, Do. do. privately.
5*th*, Do. do. in a manufactured state.

The selling of growing timber, which is very general throughout the country, is a common mode of disposal; but is, I believe, more common in England than in Scotland. Its advantages may be described as follows:—*First*, if the bidding at the sale does not reach the reserved valuation, the timber can be left standing, and if in a healthy condition will improve in value; *Secondly*, the sale can be managed at much less expense than if the timber is cut down previous to being sold. When sold in this way the common plan is to go through and number each tree, and put a valuation on it,—all the propwood or small poles being simply marked and counted, and an average taken of what they contain. A reserve price is then made out; and if the intending purchasers do not bid up to that figure, there is no sale till some future time. After the timber is sold, the purchaser sends men into the wood and has the timber cut down and taken off the ground at his own expense, the conditions of sale generally binding him to have it removed before a certain date, otherwise it becomes forfeited to the vendor. Some "conditions" are extremely binding in this respect, others are quite the reverse, and very much to be condemned. For instance, a sale came under my notice a few weeks ago (in Dec. 1871), the time fixed for having the timber off being March 1873.

A quantity of the wood sold was fast-growing ash, so that besides the damage done to the trees that were to remain, the timber merchant, by letting the timber stand till October 1872, will have several hundred feet of wood more than he had at the time of the sale. I will now state some of the disadvantages of selling timber in this way. When a sale takes place, it is generally in lots valued at from two or three hundred up to several thousand pounds. The higher the value of the lot, the fewer there are who can purchase it, and consequently there is less competition; and it sometimes occurs that there is an understanding among the bidders at a sale which one is to be the purchaser, the others having what they want out of the lot at a certain price; but it may be answered, if the timber brings the reserved valuation, the proprietor will have got its value. To this I would reply, that even the most practical valuer cannot tell within a foot or two what a tree contains; and in large trees the difference is of course greater, and valuators, as a rule, always try rather to keep below than above the exact measure.

If we suppose a fall of timber to be taken down containing 4000 trees, and each of the trees to be 1 foot over the measure calculated to be in it—which would be very near the mark—we have at once 4000 feet of timber, which, valued at 9d. per foot, gives L.150. I consider that to be a very near case. In fact timber-merchants consider their servants have not valued timber properly if a tree when fallen does not yield several feet above what they calculated to be in it. There is a fall of timber being taken down in this neighbourhood at present, where many of the trees are turning out as much as from 12 to 16 feet above the estimated contents. These are all clean grown beech, worth 1s. per foot.

Another great disadvantage of this method is, the letting strange men into the plantation to cut down the timber. I know it is argued by some that this is no disadvantage, as it can be arranged that the proprietor's men shall cut down the timber; but if this is to be done at the proprietor's expense, it should be done previous to being sold; and if at the timber-merchant's expense, the workmen become his servants for the time being.

The common practice with timber-merchants is to engage men to do the work at so much per 100 feet, and the greatest carelessness is the result. I have always found that men working in this way break other trees to any extent, before they would take the trouble of lopping the one they are engaged in cutting down. Then there is the drawing out of the trees with horses. In this operation much damage is often done by carelessness, the men who are doing the work having no interest in being careful. The result is, that many trees get barked to an extent from which they never recover.

I have heard gentlemen who have had large experience in the management of estates, argue greatly in favour of this method of selling timber; but I have never found any practical forester, or wood manager, declare that it was the most satisfactory way of doing the work committed to their charge. The reason it finds favour with estate agents and factors may generally be traced to the cheapness whereby sales conducted in this way can be effected; an argument which should be sufficiently answered by taking into consideration the fact that timber-merchants have generally to pay a higher rate of wages for felling, &c., than landed proprietors are able to do it for; and it is very clear that the expense of such work must be made up in some way.

There are cases where this may be the best way of disposing of a lot of timber. For instance, if it is growing on an outlying estate, where there is not a regular staff of workmen kept, or where there is a difficulty in obtaining the necessary funds for carrying out the work. When it is thought best to sell standing timber, I should recommend selling by tender, for reasons mentioned under that heading.

Selling felled timber by auction.—This is a method of disposing of timber which is pretty general in most parts of Scotland, and occasionally in England; and I consider it by far the most profitable way of disposing of timber. No doubt it is more expensive in the first place; but my opinion is that, when properly managed, it more than repays all expenses in the end.

I have always found this way of disposing of timber gives more satisfaction both to a proprietor and forester, the only objectors to it being extensive timber-merchants.

I offer the following reasons for giving preference to this method:—

1st, In this way trees can be felled much more satisfactorily, being done by the proprietor's own men.

2d, Timber can be properly classed, and sold in lots to suit purchasers.

3d, By selling it in small lots, greater competition is created, and a higher price generally realised.

4th, Being divided among several purchasers, it can be sooner removed off the ground.

On the first reason it is not necessary to make many remarks, as every one acquainted with the matter knows that men who are constantly employed on an estate take an interest in doing their work as well as they can, for the sake of their own character; while timber-merchants' men attend only to their masters' view of the matter; and the only interest they generally show, is in dressing off the end of the tree they have cut down, not caring if, in doing so, they severely injure several other trees.

The second reason stated above speaks strongly in favour of this mode of disposing of timber, as *classing* is what may be called the vital point in this part of a forester's business. There are many different trades carried on, requiring different classes of timber. If a large mixed lot is sold, it is not a consumer, but a dealer, who becomes the purchaser, who then sells it out to different parties as their various wants require. Now by classing the timber and selling it in small lots, this third party is done away with, and different consumers can come forward and buy what suits their purpose. In support of the foregoing statement, I may mention a case that came under my notice a short time ago. The lot offered for sale was mostly plane or sycamore trees, and was exposed for sale by tender. Three timber-merchants gave in offers for it, the highest being L.30; but as that was considerably under the reserved valuation, the timber was kept and sold by auction some time afterwards, when a manufacturer of sycamore furniture being present, it was knocked down to him at L.46. The same party who offered by tender L.30, offered L.45 at the auction sale.

As regards the third reason given above, it is clear that if a lot of timber is sold worth L.1000, the number of people who can make the purchase is very much smaller than if the same quantity of timber was exposed for sale in a hundred separate lots. The class of purchasers who are able to purchase the smaller lots have, where large quantities only are sold, to purchase at a greatly increased price from the larger buyers.

The fourth reason I have given for preferring this method of disposing of timber is of some consequence on estates where the proprietor is in favour of preserving game, as in that case it is a nuisance to have carters coming into the woods to lift timber at certain seasons; therefore, by having say twelve purchasers, the timber can be much sooner removed than if there was only one purchaser for the same quantity.

On the estate where I am at present, the timber was formerly sold standing in one lot; but not proving satisfactory, it has lately been sold by auction in small lots, after being cut down; and since that method was adopted, we have had coal-pit proprietors, contractors, bobbin-makers, boat-builders, pianoforte-makers, mill-owners, &c., attending our sales, and buying what suited their various wants.

To give an idea of the cost of felling and putting the timber into lots, I give a statement of what was paid here this year for that work:—

16,172 feet of timber realised, ...				L.727	0	0
Topwood, ...				23	0	0
				L.750	0	0
Cost of felling, . . .	L.50	10	0			
Cost of putting into lots, including horse hire, ...	19	18	6			
Cost of cutting out topwood, .	5	7	6			
Cost of lotting do. .	3	13	6			
Deduct				79	9	6
Profit,				L.670	10	6

The above quantity of timber was sold in 112 lots. In carrying out the sale, I had every tree measured exactly as it was cut down, and the contents marked on the end of the tree; and afterwards, when they were put in lots, I was enabled to get the exact contents of each lot by copying it off the trees as they were brought forward. I had different sorts and qualities kept in separate lots, the size of a lot varying from 100 to 1200 feet.

No doubt the sum of L.80 looks a large amount to pay for labour, but it would have been impossible for timber-merchants to do it so cheaply; and although there is no way of knowing exactly what the difference would have been had the timber been sold standing, yet, from previous experience, I have no hesitation in saying that we would have got for it much less than the net profit realised.

I will now make a few remarks on the selling of timber by tender. In certain cases I highly approve of this mode of disposing of timber. For instance, if it is a quantity of oak, or Scotch fir, or any other lot of timber of one class; but I certainly do not recommend it where a mixed lot is to be disposed of, as all the advantages which I hold are to be gained from classing the timber are entirely lost.

One great advantage of this method is the cheapness with which a sale may be effected. Of course, I recommend it to be cut down previous to being sold; but where it is desirable to sell a lot of timber standing, I recommend tender instead of auction sale. When sold in this way, the plan generally adopted is to inform the timber-merchants who are likely to become purchasers by circular of the number of trees and quality of timber to be disposed of, and the date by which the offers must be sent in, said offers to be in accordance with conditions of sale specified; and as none but timber-merchants of good standing would be informed of the sale, the highest offerer should become the purchaser, upon agreeing to and signing the conditions mentioned.

Selling Timber Privately.—This mode of selling timber—although adopted on some estates for disposing of large quantities of timber, both standing and fallen—is only suited for supplying a local dealer with a few trees (by privately I mean where only one merchant is invited to become purchaser). As competition is the life of trade, I prefer it in every instance where it can be brought into play. And if a lot of timber reaches the value of L.20, I should certainly say, sell it by tender. When there are only a few trees to be sold, they should be cut down and measured, the market price per foot being charged for them.

Selling Timber in a Manufactured State.—On some estates there is a saw-mill, at which timber is cut up into boards, palings, stobs, pit-props, gate-posts, &c., and sold. Some people recommend this method as a profitable way of disposing of inferior lots of wood; but I think there are stronger reasons against than in favour of it. For instance, to keep the saw-mill going, some trees are very likely to be cut down and sawn up that ought to have been left growing; besides, I have no doubt the extra money got for the wood is spent in manufacturing it, as there are not the appliances or division of labour to work with that are found in an establishment fitted up for that particular trade. I am certainly of opinion that on every large estate there ought to be a saw-mill, especially where water-power is available; but this should be used only to cut up wood for estate purposes, or to supply the tenants with fencing material at market price.

I have not said anything about "conditions of sale," in regard to any of the methods mentioned, as different districts require different conditions; but care should always be taken not to make *too loose* arrangements about the payment of timber, as many people seem to have an idea that timber should almost be given away. Now, as timber is a crop that stands long before giving any return, one would think the very reverse should be the case; yet I am aware of certain districts where there is no difficulty in getting payment in three months from date of sale, or by giving 5 per cent. discount of getting ready money; and still on some estates, in the same district, twelve months' credit, or 10 per cent. discount, is given.

In conclusion, I would say that "the best mode of profitably disposing of timber" is a subject well worthy of more consideration than it generally (or at least often) receives.

Perhaps a few remarks on the disposing of forest produce, that does not come under the classification of timber, as well as the different uses it is put to, may be interesting to some of the members of this Society. In some parts of England there is a ready market for hop-poles, rails, hedge-stakes, rods for scarlet runners, pea-stakes, thatch-pegs, and top-wood, made up in faggots or bundles. In Worcestershire ash is grown as coppice-wood, and cut down at about sixteen years' growth for hop-poles, bean-rods, &c., and is generally sold at about L.14 to L.16 per acre, the purchasers doing all the work, and leaving about sixty plants to the acre to grow to a larger size. Every little piece of wood is used up; and, last of all, the small tops, or brushwood, are tied up in faggots, and sold at the rate of 2s. 6d. per score. These are used in all the west and south of England, and throughout Wales, for heating ovens for baking bread, brick ovens being used in that part of the country. As far as has come under my notice, that appears to be about the general price for faggots. In some places the tying up of the faggots is let by contract, the price paid being about 8d. per score; and in some parts of Wales I have known arrangements made with a dealer who paid 3s. for every 100 bundles he tied up, himself finding men to do all the labour. This, however, was within three miles of a coal pit. In the same neighbourhood rails, net-stakes, &c., are sold at 1d. per yard. In Yorkshire small rods, ½ an inch in diameter and 3 feet long, are sold at 6d. per 100, and are used by farmers in thatching stacks. Stronger rods, and 8 feet long, are used for scarlet runners to climb up, and sell readily at 6d. per score. The same class of rods also sells readily to crate-makers, and picked rods about the same size are sought after by skip-makers, for which a better price can be got. (Skips are a sort of crate, used at manufactories for packing the finer sorts of cloth in.) Hedge-stakes are sold at 8d. per score, and are about 2 inches in diameter and 5 feet long; net-stakes, which are straighter and stronger, sell at 18d. per score; rails sell about 1d. per yard, and may be described as a size less than pit prop-wood. Small wood tied up in faggots is unsaleable in that part of the country, no brick ovens being used. There is a partial call for the small top-wood at 1s. per cart-load. No doubt in future the increased price of coal will create a greater demand for all sorts of firewood throughout the country.

In Scotland there is little demand for small top-wood, which is either burned up or left for game cover. There is also little done in the way of disposing of the rods cut up in brushing a plantation, although there are some exceptions. On some estates I have known pea stakes sold at timber sales by auction. I have also known rods for crate making being sent a distance of forty miles at a remunerative price. There is no doubt that by a little exertion a market might be found for a large quantity of such produce as above described, at least on estates situated near a railway station, within thirty or forty miles of a manufacturing town.

IX. *On the most certain Method of getting rid of Beetles which affect Coniferæ.* By WILLIAM TIVENDALE, Forester, Houston, Paisley.

In the spring of 1865, I was requested by a landed proprietor to look at three young plantations which were very much damaged by the ravages of insects, and to suggest if anything could be done to get rid of them.

On inspecting these plantations, I found that the trees had been three years planted, on ground previously occupied by a crop of trees, principally Scotch pine, and that the insects which had done so much damage to the trees were the wood beetles—*Hylobius abietis* of Germar, and *Hylurgus piniperda* of Fabricius, two of the most destructive pests that arboriculturists have to contend with.

The number of trees destroyed by these beetles exceeded 140,000. In tract No. 1, extent 16 acres, planted with Scotch and Austrian pines, larch, and a few spruce and silver firs, at 3 feet apart, more than half of the trees were completely destroyed; in tract No. 2, extent 13 acres, planted at 3 feet apart, with Scotch pine, larch, and a few spruce, more than two-thirds were rendered useless; and in tract No. 3, extent $14\frac{1}{2}$ acres, not a living plant was seen, save about a dozen of larches in a corner of the plantation which was a little damp, and even these were injured to such an extent that they did not look likely to live over the summer.

On reporting this state of matters to the proprietor, he expressed his determination to get rid of the pests, if possible, in No. 1 and No. 2 plantations; but, as there were no plants in No. 3 worth saving, he put cattle in to graze for a year or two, to see if that would tend to diminish the evil.

Hylobius abietis is $\frac{1}{2}$ inch long, $\frac{1}{8}$ inch in circumference, of a bright grey colour, and beautifully spotted over the cases of the wings. It makes its depredations upon all sorts of Coniferæ, but the Scotch pine is, doubtless, its favourite. In its attack upon the tree, it generally begins immediately above the surface of the ground, and eats greedily the bark all round, and gradually upwards, leaving the trees peeled into the alburnum, when they soon die. In the case of older trees, it makes no attempt to eat the rough bark on the bole, but seeks its way to the branches, and preys upon their tender bark. Here it does not eat the bark all round as it does on the stems of the young tree, but makes an attack here and there on the upper side of the branch, and seldom, if ever, makes a second attack at precisely the same place, which is the cause of their being far less injurious to large than to small trees. I find that the wounds they make in the bark of the branch soon heals, leaving the tree little the worse.

Hylurgus piniperda is a small dark-coloured beetle, $\frac{3}{16}$ inch long, and about $\frac{1}{16}$ inch in diameter. It attacks the young trees in the same way as I have described, but upon older trees it has a different mode of working. It bores into the centre of the last formed terminal shoot, eats through the pith, seldom making its exit till it has arrived at the base of the bud, when it descends in search of another shoot to destroy in the same way; the shoots thus robbed of their pith soon wither, and hang on the tree for months before they drop off. Five years ago, a number of Weymouth pines under my charge were fearfully infested with this insect, fully half of the terminal shoots of the branches were hanging brown, yellow, and sickly by its ravages. I had all the affected shoots cut off with the pole shears, gathered carefully, and burned in a brisk fire. A cure was the result, the trees being now in a vigorous growing state, and apparently none the worse of having had such a quantity of their young shoots cut off.

Having shortly described the two beetles, their modes of operation, and the best method of getting rid of the small beetle upon large trees, I shall now detail our method of getting rid of both kinds of beetles in the young plantations referred to. The first thing I did was to pare off all the grass from 8 to 10 inches round the trees that were not affected, and those that were affected, but likely to recover; this had a considerable tendency to keep the beetles off the trees, and made them easier seen when they were upon them. We then got a few carts of Scots fir branches from a recently thinned plantation, had all the small twigs and the most of the leaves cut off them, then we laid the branches here and there between the plants all over the plantations; the beetles congregated upon and under the branches, and preyed upon them with voracious avidity; a number of boys were set to gather the beetles off the trees and the branches. Each boy was supplied with a small glass phial, suspended by a cord from a button-hole of his jacket to allow the bottle to hang straight while the boy stooped in search of the beetles; each bottle had a wooden stopper. The boys, with a careful old man in charge to see that they did their work properly, searched the branches and trees for the beetles, which preyed in great numbers on and under the branches. Not one beetle of either kind was found upon the young trees for fifty that were upon the branches, which had to be lifted with great care, otherwise the beetles would drop from them among the grass and be lost for the time; the beetles were often found lying on their backs when the branch was lifted, so that it was necessary to look where the branch had marked the grass, for even with the utmost care in lifting it some of them quit their hold. I have seen a boy take 7 beetles, large and small, off one branch, or rather stick, about 3½ feet long; the branches are better to be a little heavy, as they lie more firmly on the grass, and more readily arrest the progress of the beetles in search of food. The beetles generally begin their devastations about the middle of April, and carry on the work of destruction till the middle of June; then few are to be found till the beginning of August, when they again become more numerous till about the middle of September, after which there is scarcely one to be found, even in places where they have not been destroyed. I have heard it said that the best time to gather beetles was at 4 A.M., as that was their principal feeding time. In my experience this is not the case. I have looked for them from between 3 and 4 A.M. to between 9 and 10 P.M., and invariably found them most numerous upon the trees and branches from 8 to 11 A.M., and from 4 to 7 P.M., and on wet days they are only found on the under side of the branches. They keep well in the shade both on the trees and the branches when the heat of the sun is strong; they neither like much heat nor much cold.

We gathered the beetles in the two plantations for 5 weeks in the spring, and 3 weeks in the autumn of 1865, and the number destroyed was 15,100. We gathered again in the following spring, when we captured 2300, and in the autumn we only got 100; total, 17,500 beetles. I do not think we collected more than one small beetle for twenty of the large ones. The beetles were counted by the man in charge, at dinner-time and at night. Each boy's gathering was marked in a book; the boys knew this was done, and it made them strive with each other who would gather most. The beetles were counted upon a large flat stone, and after the number was ascertained they were destroyed with a small flat stone. These plantations were beat up with weeping birch, plane, Scotch fir, and larch, in the spring of 1867, and are growing well without any appearance of beetles.

Plantation No. 3, after cattle being in it for three years, had to be cleared of the beetles in the same way as Nos. 1 and 2. They were only gathered one season, however, before planting. Pits were made for all the principals, which should be done in all old Scotch fir ground; this plantation, too, is doing well.

When it is desired to plant immediately after a crop of Scots fir is cut down and cleared away, it should be proved whether the ground is in a foul state or not. This can be done by keeping a quantity of the branches when burning up all the brush, and have them spread over the ground in spring, when it will soon be seen if beetles are there, and, if they are, gather them during spring and autumn. Plant during the winter months, pit all the principals, *i.e.*, the hardwood and Scotch firs, and slit the larches, strew a quantity of fresh branches over the ground in the following spring, gather the beetles this year again, and there will be little fear of the plants being afterwards injured. I have planted Scotch fir on ground which had been under a crop of Scotch fir immediately after the trees were cut down and cleared away, and none of the plants were injured by beetles; but this plantation was under the management of an able forester, who always kept his woods in first-class order, and never allowed Scotch fir branches to lie and rot on the ground. As a proof that the decaying branches of Scotch fir trees are not only a harbour for, but the origin of beetles, I will give an instance. Six years ago I lifted as many Scotch firs and spruces, out of a plantation which required thinning for the first time, as was sufficient to plant an acre of ground for a screen; after these were lifted, I thinned the plantation, and in consequence of other estate improvements going on, there was not time to burn the branches, and they were left to rot on the ground. I never detected the slightest appearance of beetles in this plantation previous to the thinning, nor after it till this spring, when I found many of the side branches had been attacked by the large beetle—*Hylobius abietis*. If the beetles had been on the trees previous to this thinning, those that were lifted would likely have had them too, but upon those there was not a beetle nor the trace of a beetle to be found. Therefore I advise all Scotch fir rubbish to be gathered and burned up as a great means of getting rid of beetles.

X. *On the Best Modes of Starting from Seed, or Rearing from Cuttings or Grafts the various newer Coniferæ.* By JOHN ALEXANDER, Assistant Forester, Abernethy, Strathspey.

Every plant can be reared from its seed, and, theoretically, this ought to be the best and surest mode of propagation. But as this cannot always be done, other modes of propagation have been resorted to, such as by cuttings and grafts. We at present treat only of the coniferæ or cone-bearing trees and shrubs, and shall refer to them—*First*, of those reared from seeds; *secondly*, from grafts; and, *thirdly*, from cuttings.

1. *Coniferæ from Seeds.*

The cones should be gathered in the winter season, and afterwards exposed to the sun, or to a gentle heat on a kiln, to facilitate the separation of the seed from the cones. In the Scotch fir, and others of like nature, the cones open in a very short time after they are treated as above.

Those of the Weymouth pine, silver fir, and balm of Gilead fir, give out their seed with still less trouble; while, on the other hand, the cones of the *Pinus Pinaster* (cluster pine), *Pinus Pinea* (stone pine), and allied species, do not open their scales for several months, although treated in the same manner. The cones generally opened by kiln heat are those of the Scotch pine, spruce, and larch. But there are others, as those of the cedar of Lebanon, which should be left for a year at least before the seeds are taken out; this being necessary on account of the soft nature of the seeds and the great quantity of resin which the cones contain while growing, and which they discharge on being kept for some time after they are gathered.

A fact which the writer has verified during the last two years may be mentioned as a guide to cone-gatherers. In the year 1870, twenty cones were gathered from each of ten different trees, whose ages were approximately ascertained by counting the concentric circles in other trees felled beside them. The cones were carefully opened, and all the seeds of the ten different sets sown in separate beds, when the following was the result:—

The seeds of 20 cones from a tree

300	years old	produced	10	plants.
250	,,	,,	13	,,
200	,,	,,	50	,,

150 years old	produced	74	plants.
125	,,	,,	106	,,
100	,,	,,	196	,,
50	,,	,,	104	,,
15	,,	,,	46	,,
10	,,	,,	40	,,

The same experiment was tried in 1871 with other trees, when the result was much as in 1870. It would thus appear that the best trees to take cones off for seed are those averaging about 100 years. Above 100 or 120 years the seed becomes less fruitful; at any rate, the fact remains that the cones of trees, when they reach their prime, are more fruitful than those of old ones. April is the best season for sowing all kinds of conifers, should the weather prove favourable, in order that the seeds may sprout the earlier. It is a good plan to place them in a bag, and then have the bag steeped in water for two or three days. After this let the seeds be taken out and dried gently in the sun before being sown. The soil should be soft and rich, mellowed by the preceding winter's frost, and carefully dried, and raked as fine as possible. The rarer sorts are generally sown in pots, but the more common in beds $3\frac{1}{2}$ feet wide. The seeds of the Scotch pine require a covering $\frac{1}{2}$ inch in depth; those of the Weymouth pine $\frac{3}{4}$ inch; and those of the stone pine, $1\frac{1}{4}$ inch. The cedars are generally sown in broad pots or boxes filled with light sandy loam and covered $\frac{1}{2}$ inch. In the case of the larch the seeds require $\frac{1}{4}$ inch, while, again, those of the spruce fir require about an inch. Those of the silver fir and balm of Gilead from $\frac{1}{2}$ to $\frac{3}{4}$ inch. The seeds of the black and white American spruces are smaller than those of any of the preceding species, and therefore require a light covering. It is sufficient to cover these seeds and no more. Strict attention is required, both as to the quality of the soil and the thickness of the covering; for although the plants from these seeds prove extremely hardy when grown up, yet they are very tender in infancy. It is a common practice to leave the plants in these beds for two years, but this is not to be recommended. They should, if possible, be lifted in the end of the first year in March or April, according to the weather, and then bedded out in lines six inches apart with 30 or 40 plants to the lineal foot. At the end of the second year they should be again lifted, and this time lined in rows 9 inches apart, and about 18 or 20 plants to the lineal yard. In the course of the third year these plants are fit for being transplanted into a forest or pleasure ground, as the case may be; they will then be from 6 to 9 inches high, and if larger plants are wanted they may either be left in the lines or transplanted to others.

2. *Coniferæ from Grafts.*

Trees not too full of resin can be propagated by cuttings and grafts, and often make good plants. The process of grafting is well known to every nurseryman, and need not be here explained. But it may be remarked that the graft commonly known as "tongue upon tongue" is superior to the other modes, such as "*side*" grafting, "*cleft*" grafting, and "*crown*" grafting. The great art consists in fitting exactly the inner bark of the scion to the inner bark of the stock, and keeping them in close contact till union takes place; and the "*tongue*" or "*whip*" grafting, as it is sometimes called, answers this purpose best in case of Coniferæ, for among other reasons it admits of being performed even on the smallest twigs. The grafts will not succeed unless the scion and stock be of the same species, or, at least, of the same genus. The scions are generally young twigs of last summer's growth or young branches, and are grafted on to the stocks in the case of Coniferæ, immediately after they are cut from the parent stem. This should be done when the sap begins to ascend freely through the inner bark of that which is to form the stock. The proper season is easily known from a tree putting forth its buds.

Of the Coniferæ from grafts or cuttings all the Picea and Pinus are best from grafts when seeds cannot be got. The Piceas will graft and grow well on the silver fir (*Picea pectinata*). The Pinus genus takes on different varieties of stocks. For example, those that bear a resemblance to the Scotch fir (*Pinus sylvestris*) grow very well on that species as a stock. Varieties such as *Pinus monticola*, *P. Lambertiana*, &c., make the finest trees on *P. excelsa* or *P. Strobus* (Weymouth pine). All the varieties of Abies are grafted on the common spruce, and all the Bitas and *Thuja orientalis* varieties on the Chinese Arborvitæ, and Cephalotaxus on the common yew. The *Cupressus Lawsoniana*, which is easily reared from seed, can be used as a stock for all its varieties and those of allied species.

3. *Propagation by Cuttings.*

These should be taken from the side shoots of plants when the sap is in full motion, as in the case of grafts. They should consist of last year's growth with a small part of the previous year's wood.

The old wood causes them to strike better. The cuttings from Coniferæ will grow in almost any soil, but a loamy and cool subsoil is best for bringing the trees to perfection. The varieties of *Retinospora* make fine plants from cuttings, as also, those of yews and *Thujopsis*. Wellingtonias are reared better from cuttings than grafts, but the variegated forms are commonly grafted on the original species. *Cedrus*, *Cephalotaxus*, *Cryptomeria*, *Dacrydium*, *Podocarpus*, *Prumnopitys elegans*, and *Pseudo Larix*, with many of the cypresses, can be propagated by cuttings. Of Conifers, not already mentioned, the following may be propagated, either by cuttings or grafts—most kinds of junipers, the *Libocedrus chilensis*, *L. decurrens*, *Torreya grandis*, *T. taxifolia*, and the white cedar.

We have now seen how the different varieties of Conifers are propagated from seeds, grafts, and cuttings; and it may be repeated that the first is the best mode of propagation where practicable, and of the other two, rearing from cuttings is generally to be preferred to that from grafts, for the latter often send out lateral instead of upright leaders.

XI. *On the Distribution of Forests in India.* By Dietrich Brandis, Ph.D., Inspector-General of Forests, Calcutta. (With a Map.) This paper is reprinted from "Ocean Highways," Oct. 1872.

In all countries the character of forest vegetation mainly depends on soil, climate, and the action of man. In India the greater or less degree of moisture is perhaps the most important element in this respect. Moisture and rainfall are not identical terms. Dew and the aqueous vapour, dissolved in the atmosphere, or the water derived from the overflow of rivers and from percolation, are sources of moisture as important for the maintenance of arborescent vegetation as the fall of rain and snow. It would greatly facilitate the labours of the forester, and of the botanist who inquires after the geographical distribution of forest trees, if the amount of atmospheric moisture and the formation of dew during the seasons of the year in different parts of India had been sufficiently studied; but, in the present state of our knowledge, we must be satisfied with dividing India into regions and zones according to the more or less heavy rainfall during the year. The arid region, with a normal annual rainfall of less than fifteen inches, occupies a large proportion of the north-west corner of India, from the Salt range in the north, to the mouths of the Indus in the south, and from the Suleiman range in the west to the Aravulli Hills in the east. It includes the southern portion of the Punjab, the province of Sindh, the States of Bhawulpoor, Kairpoor, Bikanir, Jessulmir, and the greater part of Marwar. Throughout this vast region, which covers an area equal to that of the kingdom of Prussia, with a population of about twelve millions, the rains are not only scanty but most uncertain. It is not a rare occurrence for several years to pass in succession without any showers, and then there is a heavy downpour, generally in winter, and occasionally in August or September. There are, however, no regular winter or summer rains. A scanty, thorny scrub on the hills gives ample employment to the botanist, for it is here that the representatives of the Arabian and Persian flora mingle with the vegetation which is peculiar to India; but the work of the forester is mainly confined to the belts of low country along the Indus and its great branches. In Sindh, for instance, the area of forest land at the disposal of the State covers 350,000 acres, all situated on the fertile alluvial soil on both banks of the Indus, some of which is inundated annually by the summer floods of this large river, the remainder being moistened by percolation. In lower and middle

Sindh a large portion of these forests consists of the babool (*Acacia arabica*), more or less pure, with a shade so dense that very little grass or herb grows under the trees. In northern Sindh extensive shrub forests of tamarisk, with standards of acacia and a poplar (*Populus Euphratica*), cover large tracts along the banks on both sides of the river. As the Indus changes its course from time to time, leaving dry last year's bed, and breaking through at another place, forming a new channel, the fresh banks and islands which are thus thrown up are covered at once by a dense growth of self-sown seedlings of tamarisk, with a sprinkling here and there of the acacia and poplar; while in other places large tracts of old forests are carried away by the encroachments of the river. Outside these forests, a little further inland, but still to a certain extent under the moistening influence of the river, are vast tracts of kundi or jhund, an acacia-like tree (*Prosopis spicigera*), *Salvadora*, and an arborescent, leafless Caper (*Capparis aphylla*); and further north, in the Punjab, where the rainfall is more regular, and its annual amount approaches or exceeds ten inches, dry and scanty woods, mainly composed of *Prosopis*, *Capparis*, and *Salvadora*, cover a vast extent of country on the high ground between the rivers of that province. These woodlands are commonly known under the name of rukhs, and they extend far into the second zone, which may be termed the dry region of India, and in which the normal rainfall is between fifteen and thirty inches.

There are two zones of dry country,—one surrounding the arid region on the north and east, in a belt from 100 to 200 miles wide, leaving the foot of the Himalayan range about Umballa, touching the Ganges at Futtehgurh, and including Delhi, Agra, Jhansi, Ajmere, and Deesa. This I propose calling the northern dry zone; its natural forest vegetation is scanty, but better than that of the arid region. In some of the states of Rajpootana there are extensive woodlands carefully preserved, to furnish cover for game, a regular supply of wood and grass, and in times of drought, pasture for the cattle of the vicinity. In the north these woods consist of *Acacia* and *Prosopis;* further south, mainly of a species of *Anogeissus*, a beautiful tree, with small leaves, drooping branches, and dense foliage, which clothes the slopes of the old fort of Chittore and other hills in Meywar, and is the principal tree of the sacred groves of that country. On the Aravulli hills in Meywar, where cultivation mainly depends on the water stored up in tanks, the value of preserving the scanty thorny scrub on the hills, in order to regulate the filling of the tanks from rain, is recognised by some of the larger landholders. Nor must we forget that we owe the maintenance of the forests in Sindh and of the rukhs in the Punjab entirely to the action taken by the former rulers; and that during the first period after the occupation of the country, the action of the British Government has not in all cases been favourable to the preservation of the forests and woodlands in the arid and dry regions of India. Great exertions have, however, been made of late years to make up in some measure for past neglect in this respect, and in the Punjab extensive plantations have been established since 1865, which now cover upwards of 12,000 acres, the main object in the formation of these new forests being to provide fuel for the consumption of the railways, and fuel and timber for the large towns in that province. The first commencement of these plantations was made by Dr J. L. Stewart, the author of several valuable books and papers on the vegetation of North-Western India. There is a second dry region in the Peninsula, comprising part of the Deccan, the Maidan or open country of Mysore, and several districts of the Madras Presidency. Exceptionally moist places are within its limits, such as Bangalore, which, being situated 3000 feet above the sea, has thirty-five inches rain; but upon the whole, and excluding such hills as rise considerably above the tableland of South India, this belt, which stretches from Nassick in the north to Cape Comorin in the south, has a normal rainfall of less than thirty inches. This belt includes Poona, Bellary, and Kurnool in the north, and Madura and Tinnevelly in the south. Over a great part of it is found the sandal-wood (*Santalum album*), a small tree with fragrant heart-wood, which comes up here and there in bushes and hedges, but does not grow gregariously, and does not form pure forests. Large quantities of this delightfully fragrant wood are used for carving and inlaid work, as incense in Hindoo temples, and there is a considerable export of it to China.

Outside these two dry zones the normal annual rainfall exceeds thirty inches, save north of the first great snowy range of the Himalaya, where rain and snow are scanty, and the country consequently arid and bare. The rest of India has a rainfall greater than that of Europe. Yet really thriving forests are only found where the fall exceeds forty inches, and rich luxuriant vegetation is limited to those belts which have a much higher rainfall. It must be borne in mind that the annual mean temperature of Central Europe ranges between 45° and 60°, while that of India is as high as 75° to 85°. Under a higher temperature a larger amount of moisture is required to produce rich vegetation. At the same time, in India, the supply of moisture is unequally distributed over the seasons of the year. In most districts the year divides itself into two unequal parts,—a long dry season, and a short rainy reason. In most provinces of India the principal rains are summer rains, due to the prevalence during that season of the south-west monsoon, and the most humid regions are those tracts which are fully exposed to the influence of these moist south-westerly winds. In addition to these, there are Christmas or winter rains in Northern India, but they only last a few days, or at the outside a week a two, and are, moreover, extremely uncertain and irregular. On the eastern coast of the Peninsula the summer rains are slight, the principal fall coming with north-easterly winds in October and November. But in the greater part of India the dry season lasts from November to May, the rains commencing between May and July, and ending between August and October. In the moister districts the rains commence early and last longer, while in the dry belts there is rain only during two or three months of the year; and in the arid region the rainfall is altogether uncertain.

The temperature during this long dry season is cooler at first and warmer afterwards. The mean temperature of the three months, December, January, and February, generally termed the cool season, ranges between 60° in the Punjab, and 79° in the south of the Peninsula. During these months dew is formed more or less regularly, and contributes much to the maintenance of vegetation, particularly in the dry and arid zones. Radiation is so powerful during this season that frost is not of uncommon occurrence in the plains and lower hills of northern and a part of Central India. These night frosts have interfered much with the satisfactory progress of the plantations in the Punjab, and as far south as Sukkur on the Indus, in latitude 27° 30′, and the Satpoora range in the Central Provinces, in latitude 23°, frost is a serious difficulty in arboriculture. As far south as Calcutta, ice can be made on carefully prepared beds covered with straw, shortly before sunrise on a still, clear morning. The mean temperature of the three months which follow, which are generally called the hot season, is 75° in the Punjab, 85° along the coast line, and 90° in the interior of the Peninsula, and this dry heat, with the hot scorching winds which blow over a great part of India during these months, makes this season extremely trying to forest vegetation.

With the exception of the extensive evergreen forests of the Himalaya, and the limited tracts of evergreen forests in the plains and lower hills of the humid regions, the great mass of forests in

India are deciduous, and they are bare and leafless during the hot season. During this time of the year, the sojourn in the Indian forests is not pleasant. No shade, no protection against the fierce rays of the sun, great scarcity of water in many parts, and a tent or hut with a temperature in its coolest part of 105°,—these are conditions of existence which are not easily forgotten. Deciduous, however, as applied to trees is a relative term. The only difference is, that an evergreen tree retains its leaves longer than one which is called deciduous. Thus the spruce and silver-fir retain their needles from seven to eleven years, the Spanish *Pinus Pinsapo* and the *Araucaria* retain them even longer, hence the full foliage and the dense shade of these trees. On the other hand, the needles of the Corsican and Austrian fir (*Pinus Laricio*) remain three to four years; and the Scotch fir, with lighter foliage, has needles of two or three years only on its branches. The Sal tree (*Shorea robusta*), one of the most important timber trees of India, with strong, hard, heavy wood, which forms extensive forests along the foot of the Himalaya and in the eastern part of Central India, retains its leaves nearly twelve months; the old leaves fall gradually, and the foliage gets thinner and thinner, until the new flush of leaves breaks out in March or early in April. So that although a sal forest is hot during that time of the year, and there is not much shade, yet the tree is never completely bare. The Teak tree, on the other hand, which may be called the king of Indian timber trees, on account of its useful, durable, strong, and yet not very heavy wood, sheds its leaves as early as January, and is leafless for four or five months, though this again depends upon the supply of moisture, for in low humid places the tree often continues green throughout February. Fortunately for foresters in the hot dry provinces of India, there are to be found in most dry deciduous forests one or two kinds which break out in leaf sooner than the others, and I have spent many an hour during the heat of the day under the grateful shade of what we call the forester's friend (*Schleichera trijuga*), a tree remarkable for its extremely heavy wood, the cubic foot weighing, when perfectly dry, over 70 lbs., or nearly three times the weight of common deal.

The grass and fallen leaves, in these dry, deciduous forests, dry up rapidly during this season, and towards March and April everything is so scorched that it is as inflammable as tinder, so that the smallest spark is sufficient to create a conflagration. These jungle-fires are almost a regular annual institution in the deciduous forests of most provinces. In some instances, they are caused by accident, but in the majority of cases they arise from the temporary clearings made by cutting and burning, and the custom of the herdsmen to burn down the old grass in order to cause the fresh tender shoots to spring up as fodder for their cattle. It is true that these fires clear the ground, and make walking through the forest easier; and, up to the present time, many otherwise observant people in India have been of opinion that these fires are not mischievous, and might in some cases be beneficial. The damage, however, done by them defies calculation. Millions of seeds and seedlings are destroyed, trees of all ages are injured, and often killed, the bark is scorched and burnt, the wood exposed to the air, dry rot sets in, and the tree gets hollow and useless for timber. One of the most remarkable facts in the working of the Indian forests in the plains and lower hills has been the large proportion of hollow and unsound trees. In many forests one-half, in others three-fourths of the mature trees are hollow. To a certain extent this is due to the old age of the timber felled; but experience elsewhere proves that old age can only account for a small proportion of the hollow and unsound trees. The annual jungle-fires are the principal cause of this mischief. In this respect all deciduous forests in India suffer alike. With regard to reproduction, that is, the growth of seedlings, some trees are better off in this respect than others. Thus the Sal trees ripens its seed about the commencement of the rains, after the jungle-fires have passed through the forest. The young plants thus germinate at once in great abundance. The jungle-fires of the coming season kill a good many, and cause a large proportion of the others to grow hollow; but in the dense mass of seedlings which clothes the ground under the parent trees in a sal forest, the damage done is comparatively small. This, to a certain extent, explains how the sal forests are nearly pure, the stronger tree in the matter of reproduction predominating over all the rest. The Teak, on the other hand, ripens its seed early in the dry season, the jungle-fires consume large quantities of it; a smaller proportion of seedlings spring up, and these are either killed or cut down to the root year after year by the fires. Meanwhile, the root-stock increases in size every year by the action of the shoots, which come up during the rains, and at last, often after the lapse of many years, it produces a shoot strong enough to outlive the fires. Thus what appears a seedling plant of teak is in most cases really a coppice shoot from a thick gnarled root-stock, bearing the scars of successive generations of shoots, which were burned down by the annual fires.

Protection against fires is not an easy task in our European forests. Many square miles of Scotch fir in Eastern Prussia, where this widely spread tree is the prevailing kind, have at various times been burned down, and in the cork oak and *Pinus maritima* forests of Provence the ravages have been terrible, the long summer drought of Eastern Europe and of Southern France having in this respect the same effect as the long dry season in India. But in India the task has been a particularly difficult one. The first step was to convince people that these fires were injurious, and when that was accomplished, to isolate the tracts to be protected by clearing broad firepaths round them, and burning down, early in the dry season, all grass and leaves in a broad belt surrounding the forest. The credit of having been the first to take in hand this important work on a large scale is due to Colonel Pearson, in those days in charge of the forests in the Central Provinces, and now holding a most important position in the Forest Department under the Government of India. It is mainly due to his energy and perseverance that fires have been kept out for more than six years from a large forest tract of thirty square miles, called the Bori Forest, producing teak, bamboos, and various useful trees, in the Satpoora range. The effect has been marvellous, and if these exertions are steadily continued, this forest promises to become one of the most valuable in the central parts of India.

From what has been said, it will be understood, that in the plains and lower hills of India the annual repose of arborescent vegetation is not caused by the cold of winter, but mainly by the drought of the hot season. Shortly before the rains set in, or with the early showers which precede the monsoon, most trees clothe themselves with fresh green, and in the arid region, where the periodical summer rains are wanting, the summer floods of the river revive the forest growth on its banks after the long drought of the dry season. In those parts of India which have a heavy monsoon, the temperature is generally somewhat lower during the summer months, June, July, and August, than during the preceding hot season. Thus it is that on the western coast of the Peninsula the mean temperature of the hot season is 85°, and that of the three succeeding months, when the sky is overcast with clouds, and the force of the sun's rays is rarely felt, is only between 80° and 82°. On the Burma coast also, in Akyab, Rangoon, and Moulmein, the mean temperature of the monsoon months is somewhat lower than that of the preceding hot season. The relief from the incessant powerful action of the sun's rays, brought about by the storms of the monsoon, and the cloudy and rainy weather which follows, is delightful. It is not the vegetation only which revives; the whole animated nature feels the pleasant change. This relief is denied to the arid region. Here, in the north-west corner of India, the temperature continues to rise higher and higher with the sun, and the result is, that in June, July, and August, the highest mean temperature is found in the arid zone of India. Thus Multan has a mean temperature of 77° during what is termed the hot season in other parts of India, and of 92° during June, July, and August; and at Jacobabad, in Sindh, the mean temperature during these months is as high as 96°. Where, however, sufficient water is supplied by irrigation, these high temperatures stimulate vegetation in a remarkable manner. The station of Jacobabad is a striking example of the effect of water supply in that climate. It was founded in 1844 by General Jacob, in the midst of a barren, treeless desert. A canal was led to it from the Indus, and now the plain is a dense forest of babool and other trees, upwards of sixty feet high, sheltering the houses and gardens of the inhabitants. A ride of a few miles takes you into the desert which skirts the hills of Beloochistan, a level plain of splendid, fertile, alluvial soil, but hard, naked, and barren, like a threshing floor, without shrub, herb, or grass, except in the vicinity of the canals, where vegetation is rich and luxuriant.

In the Himalayan hills, vegetation rests in winter as it does in Europe, and in the vast tracts of those mountain ranges the forester finds himself surrounded by forms similar to, and in a few cases identical with, the trees and shrubs of Europe. The climatic conditions are analogous, though not identical. At the higher elevations the year divides itself into the four seasons with which we are familiar in Europe, but the main supply of moisture is in summer, and the summer rains are preceded by a long dry season, which is much warmer than the spring is in Central Europe. In the outer ranges, the rains are heavy, but the whole falls in torrents within a few months, and has not, therefore, the same effect upon vegetation as the uniformly distributed moisture of our own climate. There are other points of difference in the climate of the higher Himalayan ranges and of Central Europe, and this explains that some of the hardiest Himalayan trees, which grow at an elevation of 12,000 feet, within a few thousand feet of the line of perpetual snow, such as the silver fir (*Pinus Webbiana*), refuse to thrive in Great Britain and on the Continent. Even the Deodar (*Cedrus deodara*) and the blue

Himalayan pine (*Pinus excelsa*), which are common in parks and gardens in England, do not thrive in many parts of Europe.

There is a great difference in the total rainfall in the outer and inner belts of the Himalayan forests. At Simla, and in the vicinity, on the outer ranges, the fall is from seventy to eighty inches, and here the Deodar attains a diameter of two feet in from sixty to eighty years. The moist southerly currents which prevail in summer pass over the hot plains of the arid region without depositing their moisture; but as soon as they are brought into contact with the cooler air of the hills and forced upwards into regions of less atmospheric pressure, condensation begins, and their surplus moisture is deposited in the shape of torrents of rain. Thus, there is on the outer ranges of the north-west Himalaya a narrow belt, not more than thirty miles wide, with a rainfall exceeding seventy-five inches. Further inland the fall decreases rapidly—Kotgurh, for instance, distant forty miles from Simla, has thirty-eight inches only. Beyond the first snowy range the rains are scanty. Here, at the same elevation as in the vicinity of Simla, the Deodar takes from 150 to 200 years to obtain a diameter of two feet; higher up the valley, at a distance, as the crow flies, from the plains of 120 miles, spontaneous arborescent vegetation ceases entirely, the last being the tree juniper (*Juniperus excelsa*), fine specimens of which may be seen growing in Kew Gardens.

The moist zone, with a normal annual rainfall, exceeding seventy-five inches, which comprises the outer Himalaya, extends north-west as far as the Dhaoladhar range, which borders the fertile district of Kangra. Beyond this the fall even on the outer hills is less. Thus the station of Abbotabad, between the rivers Jhelum and Indus, has only forty-one inches. South-eastward the moist zone widens. In Lower Bengal the line which indicates its limit passes through Dacca, reaching the coast west of Chittagong, so that Assam, the Khasia hills, Silhet and Cachar, Tipperah, and Eastern Bengal, are all included. This, the north-eastern moist region of India, also comprises Arracan and the coast districts of British Burma. The eastern portion of this extensive moist belt has a much heavier rainfall than the north-western portion, and here again it is heaviest on the mountains. Thus, Darjiling, in British Sikkim, at an elevation of about 7000 feet, has 125 inches; and Cherra, the former Sanatarium on the Khasia hills, at 4000 feet, has an annual fall of 600 inches, or fifty feet. On the Burma coast also the rain is heavy. Thus Akyab, the chief town of Arracan, has 219; Tavoy, further south, on the

Tenasserim coast, has 201 inches; and Rangoon, situated at some distance from the sea in a wide extent of nearly level country, has eighty-five inches.

On the higher mountain ranges of this extensive moist region, forests of pines and other conifers extend from the north-west Himalaya southwards to the mountains of Burma. The Deodar has its eastern limit in Kumaon, but there are other coniferous trees, which extend over the eastern part of the Himalaya range. One of the finest of these is *Pinus Khasiana*, which is found as far south as the high mountains between the Salween and Sitang rivers in British Burma. These mountains are the seat of a numerous Karen population, formerly an idle, drunken, and lawless race, which, through the teaching of Christianity, brought to them by American missionaries, have become an industrious, sober, and peaceful people. Some of their villages are in the midst of these splendid pine forests, and I have often, when coming from the teak forests in the hot valleys of the Salween and Sitang, been refreshed by the delightful fragrance and cool shade of the pine trees on these hills. But, as if to remind the botanist that, though in a pleasant, cool mountain climate, he is within the tropics, and only 19° distant from the equator, there is an underwood of the sago palm (*Cycas*) under the pine trees, and most of the Karen villages are surrounded by the gigantic bamboo, which yields the posts, rafters, walls, and floors of their houses. The joints of this bamboo are so large that they are used as water pails and buckets. There is another pine tree in Burma, nearly related to a Japanese species, which grows at a lower elevation in the midst of the dry and hot tropical deciduous forests.

These tropical and subtropical pines, however, are not yet of much practical importance. The production of teak timber is the main object which the forester has in view in those parts of the country. The export of teak timber from Rangoon is of old date; but, under the Burmese rule, the quantity exported never came to any very large amount. When the province of Tenasserim became British in 1826, the Attaran forests, which are situated south of the town of Moulmein, were worked with great energy, and yielded large quantities of excellent timber. The supply from that source, however, soon diminished, and thus the attention of timber traders was directed to the extensive teak-producing forests beyond the British frontier, on the Salween river and its tributaries, and from that time the importation of foreign timber into Moulmein has steadily increased until within the last few years, when the quantity floated down decreased, mainly because the stock of good timber in the vicinity of the river and its tributaries had gradually become less. Soon after the annexation of Pegu, in 1853, the forests of that province were placed under a regular system of administration, and in 1858 this system was extended to the forests in the province of Martaban and Tenasserim. The result has been, that, without impairing their productiveness, the out-turn of the forests in British territory has gradually been raised from an insignificant figure to a very considerable amount; so that within the last five years they have yielded between one-third and one-half of the total quantity of teak timber brought to the principal sea-ports. The timber trade of the Burma ports is not large as compared with that of Canada, yet it is of considerable importance, the export amounting to about 100,000 tons annually, with a value of about L.700,000. The forests in the king of Burma's territory, in Siam and the Karenee country, are much more extensive and rich in fine timber than those in our own territory; yet, unless placed under a regular system of management, they will surely be exhausted before long, and on that account we must, to a great extent, look to the forests within British territory for the maintenance of the supply in future. It is satisfactory that the efforts to protect and improve the forests in British Burma have also financially been remunerative. Within the last four years the gross revenue from these forests has fluctuated between L.64,700 and L.98,400, and the net annual surplus to the State has been between L.31,900 and L.56,500.

The teak tree in Burma, as elsewhere, is found in the dry deciduous woods, never forming pure forests, but always growing in company with a large number of bamboos and other trees. Its growth is rapid while young, but slow at a more advanced age. In 1862 I sent a few teak poles, thirty feet long, to the great London Exhibition; they had attained that size in two years, in a moist part of the country, on rich soil, and protected from fire. On the other hand, the results of researches made regarding the age of mature trees have led us to the conclusion that more than 100 years are required on an average for the teak tree to attain a diameter of two feet. The fires clear the ground annually of dry leaves and grass, which would otherwise form vegetable mould, enrich the soil, and keep it moist and loose. The bare ground, exposed to the full force of the sun, dries up rapidly with a hard baked surface, the rains of the monsoon rush down the hills and slopes, and the ashes, the remains of the fires, are washed away, without contributing much to the nourishment of the trees. Thus the fires do not only injure the regeneration of the forest, cause the timber to grow up hollow and unsound, but they also impair the productiveness of the soil, and retard the rate of growth of the trees. In Burma the fires are principally caused by the practice of toungya cultivation. The forest, instead of being converted into permanent fields, is cut down in January; and in March or April, when the large mass of stems, branches, and bamboos, which cover the ground, have become sufficiently dry, it is burned. On the first rainfall, rice, cotton, and vegetables are sown, and yield an abundant harvest, no ploughing and digging, only weeding and reaping being necessary. In some cases a second crop is taken; but after that, and more often after the first crop, the field is abandoned, a fresh piece of forest is selected for burning, and in this manner destruction spreads rapidly over large areas. Some of the finest teak forests in British Burma have been destroyed by these clearings; and, with the steady increase of population under British rule, the injury done by this erratic kind of husbandry has become enormous. This mode of wandering cultivation is practised throughout the wilder parts of India; in Mysore, where it is known under the name of kumri, it was possible, about twenty years ago, to protect the forests by stopping this practice throughout the country. This result was mainly due to the exertions of Dr Cleghorn, for many years Conservator of Forests in the Madras Presidency, and afterwards employed by the Government of India in the organisation of forest administration in the provinces of Northern India. In Burma, such a summary course of procedure was not found practicable, and instead of protecting the whole of the forests, all that could be done was to prohibit toungya clearings in a limited extent of the best teak-producing tracts, and in those localities which were set apart for the formation of new teak forests by planting. The selection and demarcation of these tracts, which will eventually be the State forests in that province, has not progressed rapidly, and these reserved forests in Burma do not yet amount to more than about 80,000 acres, 1600 acres of which have been covered with teak plantations.

Besides the dry, deciduous teak-producing tracts, there are in the moister parts of the lower hills of Burma extensive and most luxuriant evergreen forests, composed of a large variety of trees, often 200 feet high and more, and so dense that except on the numerous paths trodden by wild elephants, or on the scanty footpaths which lead from village to village, it is almost impossible to penetrate through them. The forester classifies trees with special reference to the amount of light which they require. The Scotch fir, for instance, demands a great deal of light; its seedlings will not readily spring up and thrive under the shade of its own kind or of other trees. The beech, spruce, and silver fir, on the other hand, can stand a great deal of shade; their seedlings will maintain themselves a long time in the deep shade of the forest, growing very slowly, making very little progress; but when a clearing is made accidentally or intentionally, they will shoot up with great vigour. Where woodlands are managed on a large scale, the peculiarities of each kind of tree are carefully studied, and the treatment of the different classes of forest is adapted to them. In India, teak demands a great deal of light. On the other hand, most of the trees which compose the tropical evergreen forest will stand a great amount of shade; and thus it happens that the underwood of these dense forests does not only consist of shrubs and climbers, but to a great extent of seedlings of the very trees which form the dense shady roof overhead. When one of these old giants falls, the mass of seedlings takes a start, and as they all strive upward to the light they draw each other up to a great height, the weaker plants perishing in the fierce struggle for existence. The trees in these forests cannot, however, either in height or growth, be compared to the Wellingtonia of California or to the Eucalyptus of Australia. The tallest tree which I have seen and measured in India was 250 feet high and 38 feet in girth. This was a species of upas tree (*Antiaris*), in the Thoungyeen forests of British Burma. Such dimensions, however, are never found in the deciduous forests. The tallest teak tree measured by me was 102 feet to the first branch, with, perhaps, an additional 50 feet of crown above. Teak trees with clear stems, 60 to 80 feet to the first branch, are not rare in the moist regions of India. I have found them in Burma, in the Dang forests, north of Bombay, and in those glorious but hot forests of North Canara, which are probably the most extensive and richest teak forests remaining in British India. Teak of such size and length is only found in very favourable localities, where the young trees had grown up close together on rich dry soil, in dells or sheltered valleys, generally in company with tall bamboos, and where they were thus compelled to draw each other up to that height.

Luxuriant vegetation, under the influence of an abundant supply of moisture, has its drawbacks, however, as well as its advantages. Thick masses of tall grass and weeds spring up in the teak plantations of Burma, smother the young trees, and greatly increase the risk of fire. Worst of all are the climbing plants with which the teak, sal, and other forests in all moist tracts abound. Huge creepers, like gigantic ropes, often as thick as a man's thigh, and thicker, stretch from the ground to the top of the trees: they give off numberless branches, and their foliage completely covers and smothers the crown of the tree of which they have taken possession. When a young tree is attacked by one of these gigantic climbers, the stem remains short, gets crooked and deformed, and makes no progress in growth. In Burma several kinds of epiphytic Ficus attack teak and other trees; the seed germinates in a fork or in a hollow of the trunk, sends down its roots, which eventually enclose the stem as with a network. At last the tree dies, and the Ficus spreads its massive but useless limbs in all directions. In the sal forests of Oudh the creepers were particularly heavy and numerous when these tracts came into our hands. Owing to several favourable circumstances, it was possible in that province at once to set apart and demarcate a large area of forest land as State forests, and the work of cutting the creepers was at once taken in hand and completed at a considerable outlay; so that now these forests are almost entirely cleared of large climbers, and the young sal has a chance of growing up straight, and forming valuable timber.

Much smaller in area than the north-eastern moist region is that which extends along the western coast of the Peninsula. It begins north of Bombay, and, guided rather by the character of the vegetation than by meteorological observations, which in those wild tracts we do not possess, I have included in it the northern Dangs, a dense and most feverish forest district at the foot of the Khandeish ghats. The eastern limit of this western moist zone runs nearly parallel with the crest of the ghats, but at a short distance from the ghat line. The moist zone thus includes the edge of the ghats, their western slope, and the hilly country between the ghats and the coast line. Its width varies from 50 to 100 miles. Surat, with 47 inches of rain, is outside; Bombay, which is included, has a fall of 72 inches only, but Tanna, a few miles inland, has 102. Further down the coast, the rainfall is heavier. Rutnagerri has 115 inches, Vingorla 118, and Cananore 123. But the heaviest fall in this zone is on the crest of the ghats. Here, as on the outer ranges of the Himalaya, and the Khasia hills, the moist currents of air coming from the west, which strike against the steep face of the ghats, are forced upwards into a cooler and more rarified air, and the consequence is an extremely heavy downpour during the monsoon. Thus the Sanatarium of Mahableshwur, south of Bombay, 4300 feet above the sea, has a fall of 250 inches; but Panchgunny, at a distance of only 10 miles inland from the crest of the ghats, has 50 inches; and Poona, 30 miles from the ghat line, has a fall of only 27 inches. This rapid decrease of moisture inland explains that the western limit of the southern dry belt runs within a short distance from the crest of the ghats. At the southern extremity of the Peninsula the rain near the coast diminishes, so that Cape Comorin, with 28 inches, and Palamcotta, with 22, fall into the southern dry zone.

Forest vegetation in the western moist region is in places fully as luxuriant as in Burma and Eastern Bengal. There are the same great classes of dry deciduous forest, with the jungle-fires as a regular, annually recurring institution, and the moist evergreen forests, including what are commonly called the Sholas of the Neilgherries, into which the jungle fires do not enter. The rich variety of trees in both descriptions of forest has been carefully studied by Major Beddome, the present head of the Forest Department in the Madras Presidency, and author of the first forest flora published in India, containing a full account of the trees and shrubs of Southern India. In the forcing climate of Malabar, in the heart of this moist region, is the oldest and as yet most extensive teak plantation in India. Commenced in 1844 by Mr Conolly, then Collector of that district, its present extent is upwards of 2500 acres. A hundred acres on an average were planted annually, so that there is a regular succession of thriving plantations, the oldest being now twenty-eight years old, with tall stems 70 to 80 feet high, a splendid instance of the rapid growth of the teak tree in its youth, under good care and in a favourable climate. The northern half of the western moist zone is in the Presidency of Bombay. In this part of India a regular administration of the public forest-lands was attempted as early as 1846, and the result of the early attention paid to this matter may be seen in a large and steady forest revenue, between L.82,000 and L.123,000 annually during the last six years, one-half of which has been a net addition to the general revenues of the Empire. At the same time, the forests in several districts of the Presidency have considerably increased in value; they now contain a larger stock of growing timber than at the time that conservancy was commenced, and plantations have not been neglected.

While thus a good deal has been done to increase the growth of useful indigenous trees, the introduction of foreign trees has not been neglected in India. The splendid table-land of the Neilgherries, which is raised 7000 feet above the hot plains, is in places getting rapidly covered with forests of exotic trees. From Australia several kinds of *Eucalyptus* and *Acacia* were introduced about twenty-five years ago, and they have made such progress that the station of Ootacamund is now almost surrounded by a forest of these trees. Their rate of growth is wonderfully fast, much faster than that of the indigenous trees. At the same time, young forests of the quinine-yielding *Cinchonas* are coming up in many places. The management of these Cinchona woods will probably be similar to the treatment of oak coppice in England; for though oak bark has not one-twentieth the value of Jesuit's bark, it is the bark in both cases for which these woods are mainly cultivated. There will, however, be that difference, that while oak coppice in Europe, after having been cut over, requires from fourteen to twenty years to yield another crop of bark, Cinchonas appear to grow so rapidly that they may probably be cut over every eighth or tenth year. Fever is the great scourge and calamity of India, for natives as well as for Europeans. Cinchona bark, and more so pure quinine, are the only effective remedies, and, if they were less expensive, millions in India would be benefited by them. The natural forests of the more valuable kinds in South America are approaching exhaustion. Experience has sufficiently proved that some of the most valuable species succeed well on the Neilgherries, in Ceylon, and on the lower hills of British Sikkim, and that they yield an abundance of quinine. But the localities where the best kinds can be grown in India are limited, and it would be well if as much of the available area as possible were planted with Cinchonas. It has been said that India owes more to the Portuguese than to any other nation in the matter of plants and trees introduced from abroad, and certainly the papaya, guava, custard-apple, cactus, pine-apple, and agave, all naturalised more or less directly through their agency, bear testimony, in almost all parts of India, to the skill and activity of the early Portuguese settlers. On the other hand, it is due entirely to British enterprise and energy that the Coffee tree, which was introduced about a hundred years ago by a Mussulman saint from Arabia into South India, and first cultivated on the Bababooden hills, in Mysore, is now grown in numerous extensive well-managed plantations; that Tea, the existence of which in India was hardly known forty years ago, has become an important, annually-increasing article of export; and, lastly, that the Cinchona tree was successfully introduced from South America, and promises to be one of the greatest blessings to the people of India.

So much will be clear from these remarks, that in the climate of India the luxuriance of arborescent vegetation is a sure index of moisture. A glance at the map might tempt us to go further, and to say that the limits of distribution of the different species in India seem to depend in a greater degree on moisture than on other climatic conditions. The northern limit of Teak, it is true, seems to be more influenced by the temperature of the cold season than by moisture. Natural Teak forests are not found where the mean temperature of the three cool months is considerably less than 60°, though the tree will stand occasional night frosts, which are not uncommon in some of the valleys of the Satpoora range. But no teak is found on the Aravulli hills about Ajmere, though that place has a mean temperature of 65° during the cold season. In this direction it apparently is the want of sufficient moisture which has limited the further extension of the species by natural means. By cultivation, this, as most other trees, has been extended far beyond its natural limits; numerous fairly-growing teak trees are found in gardens in Bengal, the north-west, and even in the Punjab; a teak plantation has been commenced in Sikkim; and it has been proposed to cultivate this valuable tree on a large scale in Assam. Within certain limits the teak tree does adapt itself to different conditions of soil and climate; but limits there are, and, as far as our present knowledge goes, it thrives best with a rainfall above 30 inches, a mean temperature during the three cool months of between 60° and 80°, and during the rest of the year between 70° and 90°. Teak is spread over a great part of the dry belt of Southern India, but only as poor coppice, yielding a scanty crop of poles and rafters, and never attaining any large size.

The Sal tree is found in two large belts, one extending along the foot of the Himalaya range from Assam to the Sutlej river, with a few outlying patches beyond, and the other occupying the eastern part of Central India. The Sal depends, to a much greater extent than the teak, on certain peculiarities of soil; it is mainly found on sandstone, conglomerate, and gravel, but does not thrive on the heavy clay-soil which overlies the extensive trap-rocks of the Deccan and part of Central India, and this peculiarity may have a considerable influence in limiting the area of its distribution. It stands more cold than teak, but it does not seem to thrive with less than 40 inches of rain.

A far more limited range of distribution has the Caoutchouc tree (*Ficus elastica*), a tree which is frequently grown in conservatories and drawing-rooms in this country and on the Continent; so much so, that in Germany it goes by the name of the Berlin weed. Its milky juice yields a description of India-rubber, not equal to the excellent Para rubber, the product of an altogether different kind of tree in Brazil, but which may be capable of improvement by a more careful method of collection. In India this Caoutchouc tree has only been found in the moist forest skirting the Eastern Himalaya from Sikkim to Assam, and at the foot of the Khasia and Cachar hills. A humid atmosphere, and equable temperature throughout the year, seem to be the principal conditions of its free growth. The mean temperature in the stations nearest to the caoutchouc forests is between 60° and 65° in the cold season, and 80° and 85° in the three hottest months.

The conditions of existence under which the Deodar grows at the north-western end of the Himalayan range are altogether different. To begin with, it demands a certain elevation; as a rule it does not thrive in the north-west Himalaya under 4000 feet, but it ascends to 10,000 and at times to 12,000 feet. As to mean temperature, a range between 35° and 50° in the cold season, and 65° to 75° during the three summer months, seems to suit it best. As regards humidity, the Indian cedar does not go beyond certain limits of drought and moisture. In the Sutlej and other Himalayan valleys it disappears where the arid region commences, although the conditions of soil, temperature, and elevation are not unfavourable. Again, it is wanting in the Eastern Himalaya, where the rainfall exceeds 100 inches. The Deodar is so closely allied to the Cedars of Lebanon, the Taurus, and the Atlas mountains, that botanists find it difficult to keep them distinct as species. A close comparison of the climatic conditions under which these western cedars grow, with the climate of the north-west Himalaya, may lead to interesting results regarding the history of the spread of these beautiful and useful trees. It is not, however, climate, soil, and the action of man in historic times alone, which determine the area over which plants or trees are actually found at the present time; other far more remote causes have been at work, the study of which forms the most interesting part of botanical geography. The forester, however, has to take things as they are, and to him the most important point is to ascertain the conditions most favourable for a vigorous growth of those trees which pay best, and which yield the largest quantity of timber and other forest produce within a certain time on a given area.

The other trees indicated on the map, Babool and Sandalwood, are satisfied with a moderate supply of moisture. The Babool tree is spread over a great part of India, but it is wanting or does not grow well in the moist zones. Without irrigation it seems to grow best under a rainfall between 15 and 60 inches; and where moisture is supplied from below, it thrives well in the driest parts of India. The Sandalwood is at home in India mainly in the southern dry zone: it demands a hot dry climate. In gardens it is grown in many of the more humid districts, but the heartwood is less fragrant and less valuable. The tree is not, however, limited to India; it is also found in the Indian Archipelago, and there are other species of the same genus yielding sandalwood in the Fiji and other islands of the Pacific, from whence it is largely exported to China.

What has here been advanced makes it sufficiently clear that there exists an intimate connection between the climate of India and its forest vegetation. The practical aspect of the subject, however, has not yet been touched upon. Well may the question be asked, why we should trouble ourselves concerning the maintenance and improvement of the forests in a country which has a civilisation many centuries older than our own, which has existed and has maintained an immense population so long, without feeling the want of any systematic care of its forest lands. I must ask the reader at once to dismiss the idea that by preserving and improving the forests of India we may hope materially to change and improve its climate. It is a widely spread notion, entertained by many writers who are competent to judge, that forests increase the rainfall, and that the denudation of a country in a warm climate diminishes its moisture. Much of what is known regarding the history and the present state of the countries round the Mediterranean seems to support this theory, but it has not yet been established by conclusive evidence. In India, where, directly or indirectly, the success or failure of the crops depends on rain at the right time and in suitable quantity, it is natural that the conservancy and improvement of its forests should have been regarded as one of the means to be employed for a better regulation of the rainfall. Many remarkable facts are recorded, which seem to show that in comparatively recent times, the denudation of certain tracts has been accompanied by changes in husbandry, indicating a diminished or less regular rainfall. There is not yet, however, sufficient evidence to prove that a material deterioration of the climate has been the result of denudation in any part of India. Much less has it been established that by preserving and extending the forests we may hope considerably to increase the rainfall. Not that a country covered with forests is not under certain circumstances likely to have more frequent and heavier showers than a hot barren desert, but there is no prospect of our carrying out in India any measures on a sufficiently large scale to effect any appreciable improvement of the climate. In the moist zones, and in a large portion of the intermediate region, the country would not benefit if the total annual rainfall was increased. The land would undoubtedly produce more frequent and heavier crops if we could by any means more equally distribute the moisture over all seasons of the year. The seasons in India, however, are regulated by the dry north-easterly winds which prevail during one half of the year, and the wet south-westerly currents which reign during the other half; and these again are the results of the rotation of our globe, the position of the sun, and the distribution of land and water on our hemisphere, and of other cosmic phenomena which will not be affected by any forest cultivation in India. What might be extremely useful would be to increase the rainfall in the arid and dry regions, where the cultivation of the land to a great extent depends on irrigation, and where a dry season causes famine of the most terrible character. If by any means we could increase the atmospheric moisture in the drier districts of the Deccan, in parts of Mysore, Rajpootana, Sindh, and the Southern Punjab, these countries might maintain a dense population in prosperity. But of such improvements all prospect is denied to us. If it were possible to cover any large proportion of these dry districts with forests, the stratum of air overlying the top of these forests would undoubtedly be cooler and moister, and during the south-west monsoon this would certainly bring down a few additional showers. But it is not possible. Save along the banks of rivers, there is no moisture to raise and to maintain such forests, which I fear will remain a fond hope not to be realised in our time. By preserving and improving the woods along the coast of the western ghats, it has been stated that the rainfall in the dry country beyond might be increased. As far as our knowledge reaches at present, it seems probable that heavy forests along the edge of the ghats, and in their vicinity, have the effect of increasing the local fall of rain along this belt; but if this is the case, the westerly winds will be drained of their moisture, even to a greater extent than if there were fewer forests, and there might possibly be less condensation and less rainfall in the dry country beyond.

Nevertheless, there is no doubt that every grove and every group of trees in the dry and arid regions of India is a blessing, the value of which cannot be estimated too highly; and though we may not be able to raise extensive forests in these districts without irrigation, yet a great deal can be done by improving and extending the wooded tracts along the borders of the dry country. Save in the most arid districts, mere protection from cattle, cutting, and fires is sufficient to produce, not, it is true, dense forests, but brushwood and grass, which certainly, in a small way, serve to keep the ground cooler and moister. There is no country in India where the beneficial effects of mere preservation of brushwood tracts in a dry climate may be better studied than in some of the native states of Rajpootana. Such chiefs as the Rajah of Kishengurh, the Thakoors of Bednore and of Humeergurh, and their ancestors, have set a good example, which the forest officers of the British Government will do well to imitate.

Whatever views may be held regarding such slow, gradual, and limited effects of forest growth upon the climate, there is no doubt that, in a hilly country, forests enable us in many cases better to husband the existing water supply for irrigation. Whether the drainage from the hills is collected in tanks and artificial lakes, as is the case in Rajpootana and Mysore, or whether it is employed to feed canals, to carry water, fertility, and wealth into distant districts, the object is the same, to utilise to the utmost the water supply available during the year. Experience in India and elsewhere has proved that where hills are bare, the rain rushes down in torrents, carrying away loose soil, sand, and stones, silting up rivers and canals, breaching or overflowing dams and embankments; but that where the hills are covered with meadows, fields, or forest, the superficial drainage is gradual, the dry weather discharge of rivers regular, the springs better supplied; in short, all conditions united to ensure the more regular and useful filling of tanks and canals; and in many cases the attainment of these objects is in itself of sufficient importance to justify measures for the preservation and improvement of natural woodlands, and for guarding against the denudation of hilly tracts. The preservation of forests may be made necessary by other objects of a cognate nature; for instance, in order to protect roads and bridges in hilly tracts, to guard against landslips, to prevent the formation of ravines, the silting-up of rivers, and other mischief which may follow the denudation of hilly tracts.

Nor is it at all impossible, that in some cases the preservation and extension of arborescent vegetation may have a beneficial effect upon the sanitary condition of a district. The late unhealthiness of Mauritius has generally been ascribed to the gradual denudation of the island; and public feeling there has been so strong upon the subject that legislative measures have been proposed to facilitate the re-foresting of the waste lands. Too much importance must not, however, be attached to the value of forests in India from a sanitary point of view. The district of Rutnagerri, which is situated south of Bombay, between the coast and the ghats, has been densely inhabited for centuries; and in consequence mainly of the practice prevailing in the Concan, of manuring the fields with ashes of leaves and branches, the whole district has gradually been denuded of trees, save groups of pollards, which are annually lopped for manure, groves of palms, and fruit trees in gardens. Yet this district is proverbially healthy; more so than the adjoining British districts, Tanna and Colaba in the north, and Canara in the south; nor is there any proof that the rainfall of the Rutnagerri district is less than it ought to be with regard to its position on the coast. Nevertheless, even here denudation has done serious mischief. Several of the short tidal streams of this part of the Concan, which were navigable in former times, have gradually silted up, and are now useless, except for very small craft.

Beyond all doubt, however, forest conservancy in India has become necessary in order to meet the growing demands for timber, wood, and other forest produce. Under the influence of peace and security, which all parts of the country are enjoying under British rule, prosperity is increasing rapidly in most provinces. The peasantry of entire districts, who have hitherto been content to live in miserable huts, desire to build good substantial houses and to use better furniture. Hence an increased demand for bamboos, wood, and timber. In certain forest tracts the watershed of the timber trade has entirely changed since the American war has stimulated the export and cultivation of cotton. From the forests of north Canara, the former export of timber was all seawards, and fortunately it was not of great importance, and has not exhausted the forests. The export inland was trifling. Since the American war, however, a considerable demand of timber and bamboos for the cotton producing tracts east of Dharwar has sprung up, and a brisk trade is now carried on in that direction. Similar changes in the lines of export have taken place in the Kandeish Dangs, and elsewhere in many places. The rapid construction, within the last twenty years, of railways, canals, and public buildings of all descriptions, has created large demands for timber and wood. Although a considerable proportion of the railway sleepers laid on the Indian lines were brought from Europe, the demand in India for this item alone has been so heavy, that within the last fifteen years extensive forest tracts have been denuded of nearly all their standing marketable timber, to furnish railway sleepers. In every respect, therefore, the drain upon the resources of our Indian forests is heavier now than it was formerly, and is likely to remain so; and unless the small extent of remaining valuable forest is carefully managed, with a view to its regeneration, there will certainly be difficulties hereafter. For the law that an increased demand will always produce an increased supply does not hold good when the supply requires one hundred years to become available.

It is not, however, timber only the permanent supply of which we must endeavour to secure for the benefit of coming generations. There seems no prospect of finding coal in sufficient quantity in North-Western India. Railways and steamers in the Punjab and Sindh burn wood, and will probably continue to do so. At the same time, the demand for fuel in the towns and villages of Northern India will increase. Hence the necessity of extensive plantations, and of careful management both of the scanty woods on dry ground, and of the more productive forests along the banks of the rivers. These are the future requirements of India in this respect, and they must always hold the first place in the consideration of public measures of this nature. For, after all, if it were not for the benefit of the people of India, there would be no reasonable ground for undertaking the arduous task of preserving and improving its forests. On the other hand, the interests of trade may justly claim to be heard in this matter. Sandalwood, cutch (the produce of *Acacia catechu*), caoutchouc, lac, teak timber, and numerous other kinds of forest produce, are important articles of export from India, and the maintenance of a sufficient supply to satisfy the requirements of trade is a matter of great moment. Nor does the export of these articles benefit the merchant only; it adds largely to the prosperity of the people of India.

These are the principal reasons why forest conservancy in India is necessary. A more difficult question is, how the objects we have in view are to be attained. Forests, like all other landed property, can be either in the hands of the State, of towns, village-communities, or other public bodies or corporations; or, lastly, in the hands of private individuals. There are thus two ways of accomplishing our object. Either the State must, by legislation, subject all forest property to a certain control for the public benefit, reserving to itself the right of compelling the proprietor to manage it in accordance with certain rules and prescriptions laid down from time to time, as circumstances may require. In many European countries this plan has been more or less successfully pursued, and in most is still maintained with regard to forest land which is the property of municipalities, villages, and public corporations. In France, for instance, the management of all these classes of forests is under the control of the State Forest Department; and, upon the whole, the system works well. Similar arrangements exist in Prussia and in other German countries. Private forest property, however, is practically free in most European countries. Nearly all European States hold large forest domains in the hands of Government, and this makes it possible to maintain an efficient body of public forest officers, with practical experience, competent to manage or to control the forests of other proprietors.

Italy has, it is true, of late years pursued a different policy, but its success is doubtful. The greater portion of the State forests and of the ecclesiastical estates, which might have been formed into State forests, have been sold; and the project of a law, placing such tracts of private and other woodlands, as may from time to time appear necessary, under the control of the State forest officers, has repeatedly been discussed, but as yet without any practical result.

In India, everything tends to show that the State must endeavour to retain as many of the more important forest tracts as possible in its own hands. In the first instance, this seems the only way of forming an efficient body of forest officers with practical experience. In the second instance, the control of forests in the hands of other proprietors will, in India, always be a peculiarly difficult matter. Not that the formation of village forests, and their regular management under the control of State forest officers, would not be a most desirable object to aim at. Certainly, the advantages of well-managed communal forests are great. The public property thus created cannot readily be converted into cash, and wasted by an improvident generation. It yields a fixed and certain annual revenue, available for roads and other public improvements. In many parts of continental Europe, long experience has shown that well-managed communal forests increase the prosperity of communities and their inhabitants, facilitating at the same time the development of healthy municipal institutions. And though at present it would be premature to expect the people of India to appreciate the advantages of such institutions, the time will certainly come when the importance of proposals tending in this direction will be recognised. But so much seems certain, that the State ought not to undertake the control of forests of other proprietors until its own forest officers have the needful practical experience, and are competent to manage them to the best advantage.

The general principle, that the more valuable forests should as far as practicable be formed into State forest domains, has, after much opposition, gradually been acknowledged in most provinces of India; and in some provinces the process of demarcating these State forests has made considerable progress. From a late return, I gather that the area of the reserved forests in the provinces under the government of India, outside those of the Madras and Bombay Presidencies, but including the forests leased from native princes, is estimated at 9800 square miles, or 6,200,000 acres. In India, these forests are called "reserved forests," as they are formally reserved from sale, except by the express permission of the Supreme Government. By way of comparison, I may mention that the Crown forests of England cover 112,000 acres, the State forests of France upwards of 2,500,000, and the State forests of the kingdom of Prussia upwards of 6,000,000.

The area here given for India, however, includes a large extent of forests which are not the property of the State, but which are only leased for a definite time from native chiefs and princes. It also includes a large extent of woodlands, which have not yet been finally demarcated, or in which, though the State may be the proprietor, the surrounding agricultural population exercise rights of pasture, of cutting wood and timber, and, in some cases, of clearing ground for cultivation. In a few provinces, such as Sindh and the Central Provinces, circumstances were favourable at the time of demarcation, and the State acquired at once absolute proprietorship of these forest lands free of all prescriptive rights. In other provinces, the gradual adjustment and extinction of these rights, which materially interfere with the protection and systematic management of the forests, will be a work of time, which will require much care, patience, and conciliatory treatment of the people concerned. In this, as in other matters relating to the administration of forests in India, we are guided by the experience gained in this country, and on the Continent of Europe, in dealing with rights of commons and other prescriptive rights in forest land. There has been much thoughtless talk, as if the natives of India, in burning the forests and destroying them by their erratic clearings, were committing some grave offence. If the matter is carefully analysed they will be found to have the same sort of prescription which justifies the commoner in the New Forest to exercise his right of pasture, mast, and turbary. Such rights, when the public benefit requires it, must be extinguished; but the wild tribes of India have the same claim as the holder of prescriptive forest rights in Europe to demand that provision be made for their reasonable wants and requirements. The State forest domains in India are thus in course of formation only; the greater mass of them is in a poor and exhausted state; many are burdened with heavy rights of pasture and other prescriptive demands. For many years to come they must be worked most sparingly; considerable sums must be expended on the demarcation and survey of boundaries, on roads, the clearing of streams, on plantations, and other improvements. At the same time, all these operations and the protection of these extensive tracts require large and expensive establishments. These are the reasons why the administration of the public forests in India has not yet within the short period of its existence yielded any large surplus revenue to the State. The gross income of the Government forests in British territory has within the last three years fluctuated between L.420,000 and L.465,000; but the charges have been high, and the highest net surplus of the year has amounted to L.160,000 only, and in another year fell as low as L.86,000.

Nevertheless, there is no doubt that, financially also, the formation of State forests in India, and their methodical management, will eventually be an important source of revenue and strength to the Government. In this, as in all matters, the first commencement has been difficult. The idea of providing for coming generations may to many appear an unnecessary waste of time; but when the present generation begins to derive substantial benefits from these measures, then their value will doubtless be fully recognised.

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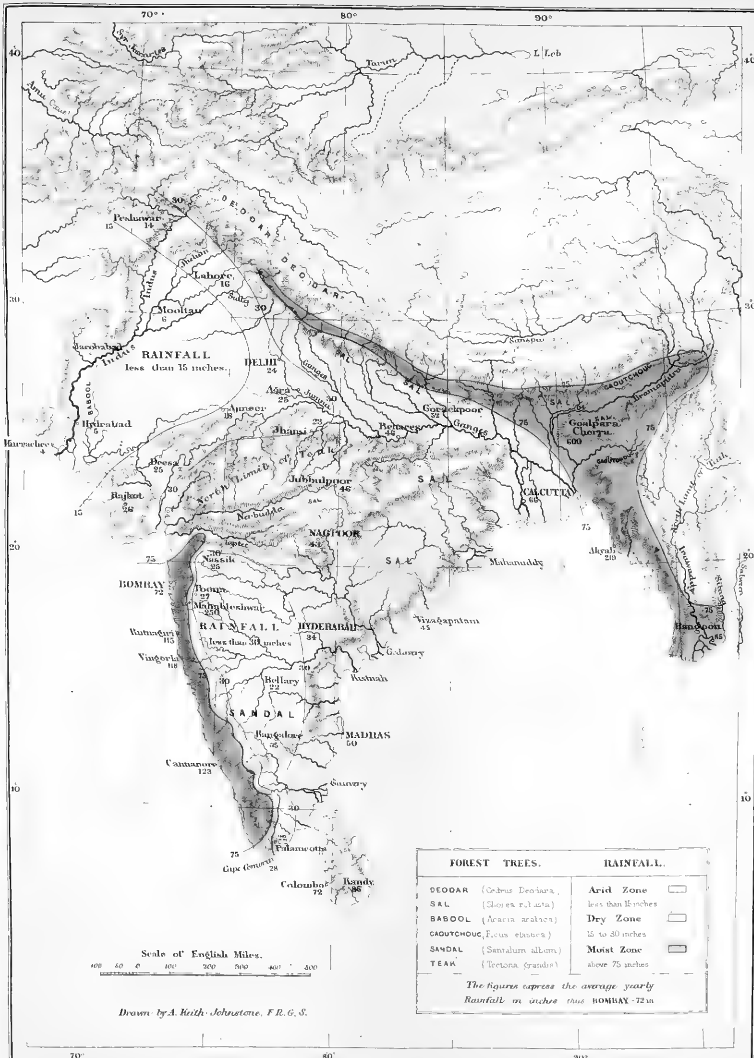
RAINFALL AND FOREST TREES IN INDIA.



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TRANSACTIONS

OF THE

SCOTTISH ARBORICULTURAL SOCIETY

VOL. VII.—PART II.

EDITOR AND SECRETARY.

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EDINBURGH:

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XII. *Address delivered at the Twentieth Annual Meeting.* By HUGH CLEGHORN, M.D., F.R.S.E., late Conservator of Forests, Madras.

GENTLEMEN,—In taking the chair to-day, I have to thank you for calling me again to the office of President of our Society, and to express the pleasure I feel at seeing so many of you. It gratifies me to meet you in this lecture hall, with which I have many pleasing associations; it is by the courtesy and kindness of Professor Balfour, the Regius Keeper of the Garden, we have assembled here, and the very walls speak to us of the science of Botany, some knowledge of which every forester is expected to possess. And much that you will see to-day in this beautiful garden is calculated to stimulate you to extend your knowledge regarding the objects which meet you in daily life.

As a large proportion of those present have recently joined our ranks, it may not be inappropriate to refer briefly to some points in the history of this Society, and to congratulate ourselves on its prosperity and progress since its commencement in 1854.

From the records I learn that the duties of Secretary were performed by Mr J. Alexander (of Messrs Dickson & Co.) from 1855 to 1858, the first volume of "Transactions" being edited by Dr George Lawson, now Professor of Natural History and Chemistry in Dalhousie College, Halifax, Nova Scotia. In 1858 the secretariat devolved on Mr Robert Stark, nurseryman, lately deceased, who continued to act until in 1861 the duties were taken up by our present efficient Secretary, Mr John Sadler.

The first President chosen in 1855-6-7 was Mr James Brown, the well-known author of "The Forester," who, with his two sons, has done much for the advancement of Arboriculture. In 1857 the late Earl of Ducie was President, and contributed a valuable paper, entitled "Remarks on the Effects of Geological Position on certain Coniferæ." His successors were the Earl of Stair, 1858; Sir John Hall of Dunglass in 1859; the late Duke of Athole, 1860; John J. Chalmers of Aldbar, 1861; Earl of Airlie, 1862; Right Hon. T. F. Kennedy of Dunure, 1863; Robert Hutchison of Carlowrie, 1864, who remained in office till 1872, and who has laid us under great obligations by his continued exertions on behalf of the Society.

Financially, the Society has had a very fluctuating experience.

For some years the income was extremely small. The following table, compiled from the records, shows the receipts since 1858:—

1858–59,	L.53	1866–67,	L.140
1859–60,	100	1867–68,	59
1860–61,	50	1868–69,	103
1861–62,	31	1869–70,	163
1862–63,	31	1870–71,	192
1863–64,	57	1871–72,	133
1864–65,	48	1872–73,	187
1865–66,	73		

There is reason to hope that, with growing popularity and an increasing number of members, the income will now steadily rise, as the funds are still inadequate to meet many desirable objects connected with our Society, such as the wider circulation of our Proceedings, the formation of a library, and grants for scientific inquiry.

The examination of our printed Transactions proves that a considerable change is taking place in the subjects to which our attention is directed. During the first four years I find that out of 25 papers and reports the great majority were on purely practical subjects connected with the routine duty of a British forester, such as drainage, pruning, thinning, fencing, and the like; but a wider scope has lately been given to our efforts, and papers have been recorded on the influence of climate and soil, the growth of various introduced trees, improved instruments, continental systems, Indian forestry, and collateral branches of science.

The estimation in which our Transactions are held may be inferred from notices in journals, and from the following letter of Dr Brandis, Inspector-General of Forests to the Government of India, a very high authority on forest science and administration, with whom I was long associated, and from whom I have often derived valuable information:—

"I write to express to you my obligations to the Scottish Arboricultural Society for sending me their Transactions, which contain numerous most interesting and instructive papers. I beg to suggest that copies of these volumes be sent to the leading forest schools and associations of foresters on the Continent. I feel assured they will be received with pleasure, and this may lead to a mutual interchange of publications. I shall be obliged by your conveying to the Council the expression of my cordial wishes for the prosperity of the Society."

I feel assured that it will be mutually beneficial to comply with the request to send our Transactions to the officials and associations named by Dr Brandis, and to cultivate as far as possible a free interchange of experiences. This will tend to fulfil the object of the deputation which it was proposed last year should visit the Continent, and we may hope to receive in Scotland some of the eminent foresters of those countries, to whom we could show much that would be highly interesting and instructive.

Among the materials for an address on the progress and state of forestry in Britain I specially notice a small volume of Reports on Forest Management in Germany, Austria, and Great Britain, lately printed by order of H.M. Secretary of State for India (Duke of Argyll). The table of contents indicates details of the system adopted in various countries. Captain Walker, who spent some time in the Scotch forests of the Duke of Athole and the Earls of Mansfield and Seafield, describes their management, and also fully explains the system of forestry in operation in some States of Germany and Austria, which he studied when in Europe on leave from India. Mr Gustav Mann contributes a paper on the silver fir and spruce forests of the Hartz. Mr G. Ross gives an account of the laws and regulations of the village and ecclesiastical forests in the province of Hanover, and also a paper on plantations of Scotch fir on moor-pan soil in Germany. Mr J. W. Webber writes on the natural oak forests of Sussex, and Dr Brandis concludes the volume with some excellent suggestions on the professional studies of Indian forest officers at home on leave. Selections from this volume might with advantage be reproduced in our Transactions. The following passage relating to Scotch fir forests in Germany I may quote by way of example:—

"In the plains of north-east Germany, Hanover, Brandenburg, Saxony, the extensive Scotch fir forests, which are mainly regenerated by sowing and planting, should be visited. Insects have been the great difficulty in many of these tracts, and in some cases an attempt has on that account been made to revert to natural regeneration. In the eastern provinces of Prussia forest fires have been most destructive. The Scotch fir forests of Franconia (Steigerwald, Hauptsmoor, near Bamberg) are principally maintained by self-sown seedlings. In these forests the successful employment of an underwood of beech to improve the growth of the Scotch fir should be noticed. In the forest tracts round Kloster Ebrach the results of this system are seen in the shape of magnificent stems, with dark red heartwood, which fetches a higher price than oak. A different sort of management may be studied in the sandy alluvial plains of Hesse-Darmstadt. The forest crop (Scotch fir, and sometimes oak) is made to alternate with cereal crops. This remarkable system should be studied in the grand ducal forest district of Viernheim, where it is in force on an area of 5000 acres. The forest crop is cleared and rooted up, and the ground is then planted in lines with Scotch fir, on better soil, mixed with oak (the Scotch firs acting as nurses to the oak), and potatoes are planted between the lines. The second year a crop of rye, and then two more crops of potatoes and rye are taken. In this manner the young plants are sheltered during the first four years of their existence, and the ground is kept clear of grass. Under the peculiar circumstances of the locality, deep but moist sand, much exposed to late frosts in spring, this system answers admirably, the growth of the trees is better than where no crops are taken off the ground (in the vicinity), and in addition there is a surplus from the agricultural part of the operations. Forest officers from Burmah will be glad to see this system, which is analogous to what was introduced in 1864 in the teak plantations near Toungoo."

On the 24th of March 1873, a paper was read by Mr William Brown, at the Institution of Surveyors, London, on "Beech Woods and Larch Plantations," which was followed by an interesting discussion recorded in the Transactions of that Society, vol. v. pt. ix. The remarks of the various speakers (Messrs William Menzies, John Clutton, &c.) contain the testimony of practical men as to what they have seen and practised themselves, but very contradictory statements are recorded. For instance, Mr Clutton, a high authority, averred that "his experience of late years in England and Scotland led him to believe that the larch is a doomed tree;" while Mr Brown and Mr Sedgewick think that the planting of larch in suitable soils should be encouraged, and that it will pay remarkably well. When persons of long experience, entitled to every consideration, enunciate opinions so opposite, surely it should be our endeavour to test the matter and to expiscate the truth, dealing with the question on scientific principles and in a scientific manner.

With regard to the influence of the denudation of trees on the rainfall of North Britain, which has been repeatedly alluded to at our meetings, I may mention that a brief preliminary report of the Committee's proceedings was read at the British

Association at Bradford in September. Two localities were selected after much correspondence, and in one (Carnwath) the recording of systematic observations has commenced. The subject is confessedly a most difficult one to investigate, and I would caution you against forming conclusions from the experience of one or two years, and not to expect much from the observations in one locality.

In regard to this inquiry, "Man and Nature,"* by the Hon, G. P. Marsh, United States Plenipotentiary at Florence, is a most interesting and valuable work, treating the subject broadly and generally, recording many remarkable facts in history and physical geography; but the author does not attack the subject *instrumentally*, or enter upon a rigid inquiry based upon *numerical* data. Indeed, our best meteorologists admit that we are not in a position at present to grapple with the problem directly by instrumental observation. For, from the capricious distribution of the rainfall at all times, many years must be allowed to elapse (at least twenty or thirty years) before the influence of forests on the rainfall can be unmistakably indicated from the data collected by gauges, supposing even that rain gauges are planted over a district in positions suited for the proper investigation of this question.

The only satisfactory means of investigation that can be recommended as likely to lead to successful results is to consider it as part of the more general question, viz., *the influence of forests on climate*, particularly on the two great elements of climate, temperature and humidity. This branch of the question has not been investigated with so much success as has attended Mr Marsh's inquiries into that part of the problem with which he deals. Indeed, the examination of the temperature and humidity can only be said to have commenced. In France, Becquerel has given a good deal of attention to the question, and published the results of his investigation concerning it, but these are unfortunately unaccompanied by the requisite details, and the conditions under which the temperatures were observed are not stated with sufficient exactness. Signor Rivoli in Italy, Paul de la Cour in Denmark, and some others, have done a little in the investigation of the subject. But Mr Buchan, Secretary to the Scottish Meteorological Society, informs me that the most systematic series of observations set on foot in the prosecution of this inquiry are those of Ebermeyer in connection with the forest school at Aschaffenburg in Bavaria, of which the results are regularly published.

* London 1864, and Florence 1870.

The ground already gained is valuable chiefly as being suggestive of what may be expected in future, and the most likely methods to be adopted in prosecuting the inquiry. So far as concerns results already obtained, however, extremely little is positively known.

The rapid rise in the price of coal, to which I alluded last year, has attracted the attention of the Legislature, and a Coal Commission Blue Book has appeared, while scientific opinions on the state and prospects of our mineral fuel supplies have during the past year been communicated from many quarters. In a country where the winter is long and severe, the supply of fuel at a moderate price is as essential to the common welfare as a sufficient supply of food. Indeed, every man who has any regard for the comfort of the poorer classes must be watching with interest all the schemes and discussions for saving fuel. And in what way, it may be asked, is this connected with the work of foresters? When we see samples of peat compressed by various processes exhibited at the Society of Arts, and notice that four companies with large capital have been formed in different parts of Great Britain for the purpose of manufacturing peat-moss into a useful fuel, it seems certain that the branches and fragments of our woods, which are now in many places unsaleable, may be disposed of to advantage. This would, of course, greatly stimulate the planting of rocky hills and waste places not now utilised, where trees might grow with very little attention. I have endeavoured to make calculations to prove the practicability of firewood sales in Scotland, but so much depends on soil, climate, growth, and proximity to a market, that it is not possible to give reliable figures. That the value of firewood will rise much may reasonably be doubted on account of the rapid and cheap means of communication, and because the dearness of fuel would operate as a check to productive industry. In country villages where a supply of firewood is available, wood is still used for firing, and in large towns faggots are in great demand. But from the analysis of manufactured peat by Clayton's process, it seems probable that this article will come into more general use than wood fuel. The estimated cost of this peat at the manufactory is about 8s. per ton. A recent analysis which has been made shows that it gives 8000 cubic feet of gas per ton.

Many insects are most injurious to forest trees, and comparatively little has been recorded concerning them. In this country it is known that our most useful trees have their particular enemies.

Ash is assailed by *Hylesinus fraxini*, elm by *Scolytus destructor*, larch by *Bostrichus laricis*, Scots fir by *Hylobius abietis* and *Hylurgus piniperda*, willow by *Trochilium crabroniforme* (the lunar hornet sphinx), and others. The plane, maple, and walnut suffer less severely. Much interesting and reliable information about insects is given in Selby's "British Forest Trees" and Loudon's "Arboret. Britannicum."

In like manner, incalculable mischief is caused in India by the destructive agency of white ants and other insects. One insect (*Bostrichus*) reduces the bamboo to an impalpable powder; another infests the seeds of tamarinds (*Calandra tamarindi*), which crumble to dust; and the coffee-bug (*Coccus coffeæ*) has been destructive to coffee estates in Ceylon and Coorg. In some parts the carpenter bee (*Xylocopa*) bores through posts, rails, and beams, occasioning serious injury to houses. In visiting wood depots one cannot fail to observe the damage caused by timber-eating beetles, and it is important to trace out the history of these destroying agents and to apply a remedy. Any observations upon the natural history, economy, and proceedings of such insects as are injurious to trees (living or dead), and any detail of experiments made for the destruction of the insects, or for preservation from their attacks, might be of much practical utility. Figures of the insects in their different states, and specimens of the wood showing the effects produced, would enhance the value of such communications. The highest authorities known to me in this country regarding insects which attack forest trees are Mr James Hardy, Penmanshiels, Berwickshire, and Mr Albert Müller, Norwood, London,* who have devoted themselves to this branch of entomology, and whose opinion might be valuable to those whose trees are suffering from the depredation of insects.

This leads me to dwell for a moment on the importance of quickening your power of observation. The forester, like the farmer, has to watch the seasons, the destructive effects of insects, and many incidental circumstances, including the rise and fall of the markets, which hasten or retard his felling operations, the profit or loss being materially affected by his shrewdness and judgment in availing himself of all advantages.

In selecting trees to be felled, the condition and qualities of each individual tree have to be examined as a farmer studies the peculiarities of his cattle. Some trees are of a more rapid growth than others; these should be left as long as this quality shows itself,

* Appointed Director of the Zoological Garden, Basle, Switzerland.

and such as have increased but little should be selected as the first disposable.

I believe it is common to find men engaged in forestry more enthusiastically attached to their profession than in any other calling; they are always surrounded by nature, which ever presents some new aspect to interest and delight those who study her. And here I would suggest that the long evenings of the coming winter would be well spent in acquiring some knowledge of the "*scientia amabilis*," illustrations of which surround us here. By a knowledge of the structure and properties of the plants you see daily in the exercise of your calling, the pleasure enjoyed in your work would be vastly enhanced. The study of the structure of our common woods with the help of an ordinary pocket lens cannot fail to be both interesting and useful.

You must not lose the opportunity to-day of visiting the Museum of Economic Botany, where you will see some objects familiar to you, and many from distant countries fitted to attract your wonder and admiration. The Pinetum formed under the superintendence of Mr M'Nab contains the finest collection of Coniferæ I have ever seen, and they are arranged so skilfully that a careful inspection cannot fail to prove instructive to such as have already some knowledge of the habits and requirements of this family.

In conclusion, I regret to say that the Society has to lament the loss during the year of several distinguished members. Amongst others, Professor Davidson, Veterinary College; Mr Robert M. Stark, nurseryman, formerly our Secretary, the author of a popular "History of British Mosses;" Mr M. Buist, factor at Tyninghame; and Dr J. L. Stewart, an Indian botanist, who, while Conservator of Forests in the Punjab, submitted valuable reports on forest questions in that province. Two years ago Dr Stewart offered a prize for an essay, to be sent to this Society, on the present state of the cultivation of *Cedrus Deodara* in Great Britain and Ireland, which I regret to say has not yet been competed for. Although Dr Stewart has passed away, the prize is still offered, and it is hoped will soon be won.

XIII. *On the Natural History of Beetles and other Insects which infest Coniferæ, and suggested Remedies.* By Robert Hutchison of Carlowrie, F.R.S.E., Vice-President.

The insect world, with its teeming myriads of devouring creatures, varying so infinitely in habits, instincts, forms, and organs, is principally distinguished as to its functions, which may be said to be discharged with a view to great and general benefit and utility to the numerous species themselves, as well as with the object of destroying or removing nuisances which would otherwise deform or possibly infect the earth and its inhabitants. Many insects may, indeed, be said to be the earth's scavengers, the pruners of nature's too luxuriant productions. But while a counterpoise is thus established and maintained for the purpose of checking any tendency to overgrowth in the vegetable kingdom, it not unfrequently happens that by the same agency the projects of man, in regard to the cultivation and use of many staples of vegetable economy, are frequently seriously interfered with, and sometimes altogether marred, by the predacious and destructive attacks of many of the species of this great division of the animal world. The study of entomology, and the consideration of its classification into (1st) insects which are beneficial to the growth of plant-life by destroying others in their larva state, which would prove, if unchecked in population and distribution, most injurious to many trees, shrubs, and plants, and (2dly) insects which are themselves parasitical and inimical to the health and development of vegetable life in many forms, is a subject of the deepest interest to the close observer of nature, and especially so to the student of arboriculture, as well as to every lover of forestry who is practically engaged in that all-engrossing occupation.

It is with the insect world, in the latter of the two subdivisions to which we have referred, that we purpose now to deal, and attention will be mainly confined in this paper to the most prominent and most popularly known species which attack coniferous trees, and ravage no less seriously the newer introductions of this family than they do our common Scots fir and other older and more commonly planted varieties of Coniferæ.

It has been universally observed that trees of the pine tribe, most frequently affected in their young stage by the attacks of insects, are those which are planted in soil previously cropped by the same description of trees. This will also be the case even although the previous crop may not have been affected in the least degree by such ravages, thus clearly showing that the cause of the destruction to the second crop does not lie in any sort of infection or transmission of the disease (if so it may be called) from the former occupants of the soil, but rather from the growth and establishment of larvæ in the ground itself, engendered probably by the dry condition of the soil caused by the previous cropping and absorption of the moisture by the numerous roots left in the ground after felling. This theory is supported by the fact, that frequently after thinning young fir plantations insects are observed to attack a district where they had not been previously known. Probably the dried nature of the substratum of soil, intensified by the continued absorption of moisture by the old roots left in the ground, and also by the sprouting of some of the hardwood stools, may afford congenial habitats for the incubation and increase of these obnoxious enemies to the fir tribe. Some authorities attribute the appearance of insects in such cases to the harbour afforded to the little animals in the decaying stumps, and to the weakened growth in the young wood of the trees left in the plantation from the diminution of moisture in the soil; but it appears more probable that the real cause lies in the drier state of the soil itself (independently of the thinning process), affording a suitable and congenial site for the base of the operations of the insects, rather than in the harbour afforded to them by the decaying stumps of trees thinned out. Thinning tends to produce stronger instead of weaker shoots of young wood upon the survivors, and the roots of trees felled will remain for a year or two in a sound condition, whereas the attack of the insects upon the plantation generally commences almost simultaneously with the process of thinning.

In further support of this proposition, it may be stated that in any wood where the attacks of beetles or other insects are observed after thinning, it will be found that, if there happens to be a "*wet bit*" (*i. e.*, a part less well drained than the rest), the trees there are happily exempt from the inroads of the invaders during the earliest stages of their attack. A careful observer of forest economy has already observed this fact in his own experience.* Another fact worthy of notice here, and to which particular reference will be made hereafter, is that these marauders of coniferous plantations seem greatly enamoured of the cut and drying

* W. Tivendale, Scott. Arbor. Soc. Trans., vol. vii. p. 80.

twigs and branches from early prunings or thinnings. It has been frequently observed that they prefer locating themselves among these cut branches to any other shelter or cover, so long as they find them in a *fresh*, although drying, condition; and they will invariably settle on them rather than on any part of the growing trees themselves. This predilection for shoots in a semi-dry or half-withered state is further attested by the circumstance, that insects which attack the fir tribe invariably commence upon a subject already evincing indications of sickness or decay. This is apparent in woods where no pruning or thinning has afforded them an opportunity of selecting their favourite haunts among felled branches and stools, and in the absence of such they are universally found to select apparently sickly specimens in preference to very robust and healthy plants, the juices of luxuriant and vigorous growths being probably too strong and rank in their vitality for their slower insect development and economy.

One explanation of this generally observed preference of insects of various orders for diseased or sickly specimens of the trees they prey upon, is given by M. Audouin, Professor of Entomology in the Museum d'Histoire Naturelle at Paris, who has closely studied and noted the habits of many insects, and there appears to be good ground for accepting it as authentic and reliable. He thinks that the quasi-incipient decay of the tree is due, not to any inherent failure in the plant-life of the specimen, but to the attacks and boring operations in the bark of the tree caused by the search of the male insects (chiefly) for food, which injures the bark, inducing an unhealthy foliage; into these subcortical borings the female deposits her eggs; and so what we usually ascribe as the primary cause of the tree's sickness is merely the secondary result of the creature's operations, which are really an attack, in the first instance, upon a healthy tree for food. These borings weaken and exhaust the functions of the bark, whereupon the female deposits her eggs in the previously made workings of the male insect, while the act of burrowing and depositing the eggs and of so injuring the tree are commonly supposed to be confined only to trees which previously evinced signs of decay. In the Review Entom. (iv. p. 115), Silbermann also states, upon the authority of Dr Ratzeburg, that the large weevil (*Pissodes notatus*) attacks the bark of young pines with its trunk, and thus renders the trees unhealthy, prior to the female depositing her eggs in them.

The modes of insect attacks upon coniferous trees may be directed towards the root, the bark, or the tender young shoots; but, in any case, their preference for the apparently weaker growths and constitutions holds good, whatever may be the method of attack, and whether their victim be a recently planted seedling or a mature tree. They probably, in the first instance, feed on their prey, and then breed in the cavities which their predacious attacks have made.

The season when insects are most injurious to coniferous woods is generally from the beginning of April to the end of June, and again from about the beginning of August till the middle or end of September, in favourable and mild weather or ordinary seasons. Of course, cold or wet weather may affect their operations, but, as a rule, these are the times of the year during which the greatest havoc is committed. Hot and dry summer weather, especially if succeeded by a cold, dry, frosty winter, favours the dissemination and increase of forest-feeding insects. The warmth of summer fosters their breeding, because by its genial influence their period of transformation from the larva state is shortened, and abundance of time is afforded for several broods to mature in succession; and when the following winter is dry, a superabundant number of insects will be found in the ensuing spring; while, on the other hand, should the summer season prove wet and deficient in sunshine, and the following autumn and winter be damp, intensely cold, or snowy, the numbers of insects, whose increase had been previously checked by the adverse summer, will be materially lessened in the following spring, and the destruction to the woods for the time will be proportionately less severe. These remarks principally apply to insects which affect the bark of pines, especially the silver fir (*Picea pectinata*), and confine their attacks to the tree through that medium, selecting chiefly those old trees the bark of which is not very hard. They direct their attack, in the first instance, to apparently weakly or dying specimens, or settle upon felled timber, feeding upon the stagnated sap of the inner bark, to which they bore, by the aid of their sharply-toothed jaws, in a direction slanting upwards as far as the sap wood, and from thence the female hollows out a perpendicular canal about 3 or 4 inches in length in the inner bark, with small niches close together on each side; in these she deposits her eggs, which are small round white objects, and, having covered them up with a slime of her own secretion, the larvæ are hatched in about fourteen days, and they again cut for themselves ramifying passages in all directions, which widen as they proceed, and resemble alphabetical letters in appearance, whence the insect has sometimes been popularly styled the "*Typographer Beetle*," or *Bostrichus typographus* (Fabricius). Should silver firs be scarce in the plantation, or the insects be so numerous as to overrun all the trees of that species, they will next attack any other fir or pine that may be most convenient.

The full period necessary for the development of this mischievous little creature is about eight weeks from the egg to the full-grown beetle, and there are generally two broods in each season, the last sometimes remaining (owing to cold or wet weather) concealed dormant under the bark of the tree till the following spring, when they are fully developed. The injury to the silver fir by this insect will thus be seen to be effected by the destruction of the sap-wood, which every arborist is aware will insure the speedy death of the tree, even when otherwise perfectly sound and luxuriant. A short description of this most destructive insect may here be interesting. It is, when full grown, a beetle of from 2 to 2½ lines long, and about 1 to 1¼ lines broad, and hairy. On its first development to the perfect state, and while still under the bark, it is of a rusty yellow colour, becoming darker by degrees, and upon its escape to the open air is of a brownish black; jaws sharply toothed; eyes dark brown; wing-cases deeply punctured, broader behind, deeply and obliquely impressed; the impressions with crescent-shaped margins, which have from 4 to 6 irregular teeth. Thorax and sternum always darker than the wing-cases. The female is distinguished by a thicker abdomen, and is less covered by the wing-cases. The larva or maggot is 3 lines long, wrinkled and white when it leaves the egg, soon becoming yellowish at the head; the back reddish striped; jaws sharp; antennæ short; feet six in number and yellowish. The nymphs or pupæ are white and soft at first, becoming harder and yellower by degrees; they are almost the form of the beetle, only with pale indications of the wings, and with the feet drawn up under the body.*

The bark-boring order of insects are not only very numerous, but they are probably, from their mode of attack, the most destructive of all to whose ravages the pine family are liable. Not only is their process of destroying the inner bark and alburnum very detrimental to the tree, but the myriads of little cell-holes which they cut in the bark, even if their further operations be suspended or prevented, interrupt the course of the descending sap, and admit

* Köllar on Insects, Loudon's Translation, p. 358.

the percolation of rain and other ungenial weather, which causes the bark to peel off, causing permanent injury to the tree. These bark-burrowers belong principally to the family of *Scolytidæ*, including the genera *Scolytus, Hylesinus, Hylurgus, Tomicus* (*Bostrichus*), &c. They may be distinguished into two classes, viz., those that bore into the heart and body of the trunk of the wood, and those that confine their inroads to the inner bark with its adjacant sap-wood or alburnum. Probably in the case of coniferous trees, the operations of these internal wood-borers are chiefly of the latter description; while there are many insects which attack hardwood timber, and do not confine their inroads to the inner bark, but chiefly burrow into the heart of the trunk itself, rendering even large willows, poplars, oak, elm, and other timber trees so hollow as to be easily blown down. Of these destructive creatures are the stag-beetle family (Lucanidæ); and the very widely-branched tribe of Capricorn beetles, including *Prionus, Cerambyx, Lamia, Stenocorus, Leptura, Rhagium, Gnoma, Saperda, Callidium*, and *Clytus* (Fab.)

Nor are the ravages of these mischievous creatures apparent and important in the forest and plantation alone, but very frequently the doings of some of them only become known in after years, when trees apparently sound have been felled and converted into timber for construction purposes. This is owing to the length of time sometimes necessary for the full development of the larvæ of many of the species. For example, in the order of Hymenoptera, one genus called *Sirex* is peculiarly destructive to fir timber. In woods in Yorkshire, Stephens reports that whole plantations of firs have been known to be destroyed by the operations of its larvæ under the bark. Two of the most conspicuous and destructive members of this genus are *Sirex gigas* and *juvencus*, both of which have been known to issue from the wood of joists and flooring in houses, after the timber had been wrought up and used for three years.

The other principal bark-boring beetles which affect Coniferæ are *Tomicus pinastri, laricis, micographus, typographus* (already referred to), and *chalcographus*, which are happily, however, less known in Great Britain than in the continental forests. We have, however, more common in this country, the well-known *Hylurgus piniperda*, and the two large weevils, *Pissodes notatus* and *pini*.* Another secondary ailment, which frequently befalls the victim of these bark-

* This insect is said to be common in Rannoch.

destroying insects, arises from the permanent disruption between wood and bark caused by the innumerable earwigs, spiders, flies, wood-lice, &c., which take possession of the cavities, allured by the exuding sap, no less than by the shelter which the loose bark affords. We have in Scotland little conception of the damage done to forests by these insects. Numerous instances are on record of the extent of their prevalence and ravages. In Germany and Austria, for example, it is stated that 80,000 of the *Bostrichus typographus* have been found in one tree; and so great is the vitality of this little pest that nothing short of fire will destroy it. In the beginning of last century it was unusually abundant in the Hartz forests, and continued in immense numbers for several years—first in 1757, when its ravages were very severe; again in 1769 and in 1783, when the total number of its victims in the forests mentioned amounted to 1,500,000; and the indirect result of its destructive agency was that the industrial pursuits of the surrounding country were seriously crippled, and in some localities actually suspended. Cold and wet seasons, however, in 1784 and in 1789, tended greatly to diminish its numbers. In 1790, however, it reappeared, and again in 1796, when serious fears were entertained for the safety of the few remaining fir trees, which the ravages of former years had spared.*

But in addition to the insects which infest pines by burrowing under the bark, there is an equally numerous and destructive host whose ravages are carried on with similar precision in other ways, by attacking the foliage or the roots of the tree. The well-known substance termed "*honeydew*" is said to be the secretion of a species of *Aphis*. The larch in this country is infested with an *aphis* whose wax-like "*cottony*" filaments are well known, and are often so abundant as to whiten the entire tree, and ultimately (if not removed or checked) to cause its destruction. Then again, there are other deposits caused by the *Aphidæ*, which, although in themselves very beautiful, resembling as they do, when their mechanism is closely examined, fruit, blossoms, flowers, &c., are yet, if allowed to spread to undue proportions, full of danger, and sometimes convey total destruction to the tree. These deposits refer to the secretions of the *Aphis abietis*. The larvæ of several moths also attack fir and other trees by destroying their foliage, viz., *Dendrolimus pini*, *Psiluria monacha*, *Achatia piniperda*, *Bupalus piniarius*, *Orthotænia turionana* and *resinella*, &c. The three species of saw-fly (*Lophyrus pini* and *rufus*, and *Pamphilius*

* Latreille, Hist. Nat. ix. 194.

erythrocephala) tend further to swell the number of the enemies of the pine tribe, no less by their annual destruction of the leaves of the year, than by their pertinacity of attack, causing the unfortunate tree to draw upon the undeveloped resources of the next season's supply, to make up the deficiency thus caused in the present. This process, if repeated for a very few years, certainly terminates fatally for the tree. The ravages of the insects we have just referred to are, however, chiefly confined to the continent of Europe, while in Great Britain their attacks, although they have been noticed, are not as yet to any great extent frequent or urgent. They have certainly been known to exist in Great Britain in several localities, but many of them appear not to be indigenous, so it may probably be assumed that their larvæ have sometimes been imported either with seed or upon plants from the Continent. As some of the varieties, such as *Pissodes notatus* (Fab.), already referred to, have of recent years become more common in the United Kingdom, it is probable that it has thus been introduced. This remark applies also to *Acanthocinus ædilis* (Linn.), a little mischief-worker, called in some districts "*the timber man.*"

Thus we see that there are many species of insects whose destructive propensities are confined to the leaves, bark, and shoots of the fir tribe, but there are also others whose operations are directed to the annihilation of the seeds and cones. These are devoured, whether ripe or unripe, with great avidity. To this class belong *Eupithecia togata* (Hb.), whose larvæ are very destructive to the dried seeds of Scots fir, the *Phycis abietella* (Za.), which, in addition to tunnelling into the cones of *Pinus sylvestris, Pinus maritima,* and other firs, and destroying their vitality, lodge themselves in the decaying wood of the tree, and thereby hasten the process of dissolution.

The colour of all these insects at one period of their existence so closely resembles the bark and other portions of the tree, that their detection is exceedingly difficult. Indeed, so well is their presence concealed by this means, that their existence upon the tree attacked is first known by numerous spots of resin being seen oozing from the bark. If examined carefully, each of these spots will be found to cover a small aperture, in which the insidious enemy has securely located himself. In this manner whole trees, and ultimately entire plantations, are overrun and seriously damaged.

The list of those insects which attack roots and subsist upon them is fortunately less numerous and important. Their ravages are chiefly directed against dead and decaying roots of cut trees. The best known of this class is the *Hylobius abietis*, which may be taken as the type of the whole. It is one of the largest of the British *Curculionidæ*, or weevil family.

The destruction caused to pine plantations in this country by the attacks of the *Hylurgus piniperda*, and the wide area over which (both in England and Scotland) it has been observed, demand more than a passing notice in a paper like the present. It is very commonly found upon the Scots fir and Weymouth pine (*P. Strobus*), and many other conifers, detracting oftentimes by its ravages from their deservedly admired, picturesque, and interesting appearance.

This beetle belongs to the same family as one whose attacks upon the common elm (*Ulmus campestris*) are well known in Scotland—namely, the "*Scolytus destructor*," whose ravages upon the elms in St James' and Hyde Parks, London, created some years ago considerable interest and attracted public attention.

The injury done by the *Hylurgus piniperda* consists in its destruction of the leading shoots of the fir or pine which it attacks. It is incessant in its operations when these are fairly commenced, and the following narrative of the mode and progress of its attack, by Mr John Lindley, will give an accurate idea of the rapidity and devastating effects of this insect's operations:—

"For the purpose of observing its proceedings more narrowly" (says Mr Lindley), "I placed a shoot of the Scots fir under a glass with the insect. In about three hours after, it had just begun to pierce the bark at the base of one of the leaves; its mandibles seemed chiefly employed, its legs being merely used as a means of fixing itself more firmly. Four hours after, its head and thorax were completely buried in the shoot, and it had thrown out a quantity of wood, which it had reduced to a powder, and which nearly covered the bottom of the glass. In sixteen hours more it was entirely concealed, and was beginning to form its perpendicular excavation, and was busily employed in throwing back the wood as it proceeded in destroying it. There were evidently two kinds of this sawdust, part consisting of shapeless lumps, but the greater portion of very thin semi-transparent *lamellæ*, or rather shavings, which presented an invariably regular spiral appearance. I now examined it every day till the fifth, when I found it had emerged through the central bud at about an inch from where it had first commenced."

Of this most destructive pest there are several varieties well known throughout the United Kingdom, which may be specified as follows :—

Hylurgus piniperda, Linn.	*Hylurgus angustatus*, Gyll. = *ater*, Mars.
„ *rufus*, Mars.	„ *rhododactylus*, Mars.
„ *obscurus*, Mars.	„ *ater*, Fab. = *niger*, Mars.
„ *picens*, Mars.	„ *Boleti*, Mars.

They are found principally in June, July, and August, under the bark of the trees they have attacked. Hitherto it seems to have been the general opinion that they molested only diseased or decaying and feeble trees. Some authors even assert (Selby amongst others) that in no single instance have they ever been known to attack a tree in perfect health; but this point we have already referred to in this paper, and we think it is conclusively shown, from recent observations of their habits, that, in their incipient stages of attack, so insidious are their movements, that it is only after a time their presence is detected, and then the vigour of the tree has already begun to decline, and thus the insect is assumed to be *the result* rather than *the cause* of the tree's failure.

As it would be impossible within our prescribed limits to describe and specify *all* the insects which are injurious to the pine family, or whose ravages tend to retard the progress of that interesting class in our gardens and *arboreta*, we can only name a few others whose predatory habits are well known in certain localities, before passing on to notice some of the means of prevention which appear at least feasible, if not thoroughly effectual, for the prevention of the progress of the mischief which these animals occasion.

In some situations the *Ernobius mollis* (Linn.) is frequently found upon both Scots fir (*P. sylvestris*) and *Pinus maritima*. Like the *Hylurgus piniperda*, it lives at the expense of the tree; but Perris (a French naturalist) asserts that it only attacks sickly or ailing plants. To this, as has already been stated, we object, and need not recapitulate the reasons. *Blastophagus piniperda* (Linn.), *Hylastes ater* (Payk.), and *Hylastes palliatus* (Gyll.), which in some places is very abundant, are all extremely destructive.

One of the most fatal enemies of the silver fir (*Picea pectinata*), and which it is to be feared is increasing in many parts of the country, especially in low-lying situations and in deep or heavy soils, is the *Bostrichus typographus* (Fabr.) This insect confines its attacks to the leading shoots of the tree. These it disfigures by settling upon their bark, and sucking the juices of the plant till the young wood is literally killed. It spreads with marvellous rapidity over whole trees, and frequently causes total destruction to every young silver fir in a plantation. Young thriving trees of about eight to twenty feet in height appear to be most vulnerable to its attacks. The first appearance of the tree being infested with this plague is to be noticed upon the main stem and under side of the branches and young shoots, where it presents the appearance of a pure white minute substance in small patches close together, which, when microscopically examined, are found to consist of an adhesive cotton-like substance or covering, within which numberless clusters of the eggs of the creature are deposited, and occasionally the insect itself may be found. Gradually the whitened appearance spreads, and with wonderful rapidity the entire bole and branches seem to be dusted over with this downy matter, containing myriads of animals, each busily engaged with its sharp though minute proboscis in tapping the juices of the tree. Their settlement upon any tree will continue for two or three years, till, from first presenting a dwining and unhealthy look, the unfortunate victim falls into a decline from which Nature cannot recover it. The spectacle presented as the progress of decay proceeds is indeed melancholy; the top branches and terminal shoots die first, and gradually, tier by tier, the handsome branches wither off, and in a very few seasons the tree is killed to the ground-line. This insect never attacks the leaves, but confines its ravages entirely to the bark of the young shoots and bole.

A nearly-allied species of *Bostrichus* (*B. laricis*) is very common upon the larch. It does not, however, prove so fatal in its attacks. This insect is commonly and appropriately called "*the larch blight*," from the appearance which it gives the tree when first attacked. The eggs may easily be detected concealed in the crevices of the young bark, and in the hollows around the buds, where they abound in winter time, and are easily discernible by the naked eye, like minute round black grains. They propagate in spring with marvellous rapidity, covering leaves, branchlets, and stem with a small black covering, which gradually whitens as those creatures weave for a covering and protection from rain, a thick, white, viscid, woolly-like substance from their numerous pores, and which is the cause of that sticky and clammy feeling so well known in connection with the larch tree. Happily, as has already been stated, the ravages of this little creature are seldom fatal, although it lives upon the juices of the plant, sucked out by means of its sharp proboscis, and according to the moisture and temperature of the season are its attacks more or less severe. For instance, if, by reason of unpropitious frosty winds in spring the opening foliage of the larch should suffer a check, the trees so affected are more likely to be overtaken by the subtle and interminable exertions of its army of little enemies; and after such a season the larch trees present a sicklier hue, and have a more viscid feeling, than in a season when their vitality has flowed in an unchecked tide into a rapidly-developed foliage and blossom.

But while thus presenting the dark side of this picture of Nature in her forest economy, it should also be borne in mind that although a long catalogue of most destructive little insects has been named, there is also a very numerous class of insects which are not only not detrimental to the coniferous or even hardwood trees, but are directly beneficial to them, and especially to the pine tribe, in destroying, and thus keeping in check, other insects which are in themselves destructive, and many of which have been named in the foregoing pages. For example, in the United States of America there exists a small black ladybird, with two red spots on its wing-covers, named *Chilocorus bivulnerus*, which is remarkably useful in destroying bark lice and pine-tree scale. Another small ladybird, *Exochomus gnexi*, which is of a *red colour*, with two *black* spots on its wing-covers, and of similar habits, is also frequent, and deserves protective attention. Many of the ichneumon flies destroy whole acres of caterpillars infesting fir trees; and without the aid of such small predacious and parasitic allies, destructive insects would increase to such an extent as to render all forest labour unavailing. It is well known that while there are multitudes of noxious insects devastating whole forests, there are also many useful little animals which by their operations may be said to act as the good genii of all trees, and chiefly of the coniferous tribe. By diminishing the numbers of the injurious, they check their otherwise too rapid increase; and it is the more necessary to state this fact prominently, because, while the planter sees only the damage which is done by the obnoxious creatures, he seldom observes those little insects and their operations which, unappreciated because unseen, are silently, but not the less surely, engaged in counteracting the pernicious operations of the destructive myriads. To encourage and foster the increase of the innocuous classes of insects should be the aim of every one connected with woodland management or plantations. This may, indeed, to a considerable extent, be achieved by preventing the too frequent and indiscriminate slaughter of many species of small birds and other forest denizens; for it is a remarkable fact that the smaller birds feed much more generally (by a wise provision of Providence) upon such insects as happen to be injurious to tree life than upon the harmless varieties.

One of the most useful insects in attacking and destroying many of those allied species which are injurious to the pine tribe is the *Thanasinus formicarius* (Linn.), and the destructive abilities of this small creature are truly marvellous, depositing its eggs not unfrequently in the wood-boring larvæ themselves, as well as in the bodies of many other descriptions of very destructive insects, and also in the larvæ of numerous kinds of destructive beetles which live between the bark and wood of decaying trees.

While it will thus be seen, from the foregoing cursory sketch of some of the numerous enemies of Coniferæ, that their name is truly "Legion," it yet remains that some remedial measures should be pointed out to check the ravages of these incursive hosts, and so preserve the healthful amenity of our beautiful coniferous favourites.

The first suggestion that naturally falls to be offered, with the view of preventing, or at all events of retarding, the attacks of predacious insects, is the entire removal, after felling or thinning any plantation or strip, of all brushwood, refuse, or root stumps, which may be left. Indeed, the instant transport of these outside the wood, and their immediate consumption on the spot, is the first safeguard which can be suggested for healthy plantations. In the case of woods where insect attacks have become apparent upon silver firs, Scots firs, or other common nurses, the immediate felling and removal for burning of the infected victims may tend to stay or lessen the plague. Paring off the grass all round infected trees, to the distance of a yard on each side, and burning the turf along with the diseased plant, is also a good and frequently an effectual remedy.

Where it is practicable, and can be economically done, it is well, before planting any strip or ornamental belt of wood, to plough the ground deeply. This not only turns over the sod and affords less cover for insect life therein, but also affords a deep soft bed for the young roots of the new plantation, and thereby induces a rapid and healthy start, which is always beneficial to a newly-formed wood. Early thinning, *boldly and fearlessly accomplished*, so as to admit of a free circulation of air among the young plants, and to prevent overcrowding and other obstructions to the radiation from the earth's surface, and evaporation from the trees themselves in their young state, has likewise a salutary effect in preventing the inroads of insect vermin. This is especially the case with larch plantations, for moss-covered bark, engendered by damp, close, and confined situations and habits of the tree, are fruitful of disease, and harbour innumerable parasitical foes of the pine tribe. When plantations have been once thinned, and are fairly established in growth, it suits very well to allow the *second* thinnings and prunings to lie in the wood for a year after being cut, and then to remove them suddenly in midsummer and burn them up. By this plan a vast number of those insects which prefer settling upon fresh cut and drying shoots and branches are destroyed; but as, generally speaking, in a *first* thinning of any wood, their presence would be rather in the way than otherwise, the plan suggested may be found effectual with a second or third thinning—say when the trees are sufficiently apart, and are probably from 12 to 18 feet high or thereby, so that a free circulation of air can play through them without being interrupted to any extent by the felled branches and other prunings during the first season after the thinning process has been effected. To prevent harbours for insects in hard-wooded plantations, the stools should be cut as *low* as possible, so as to prevent sprouting, and the formation of cluster heads and bush-like forms.

NOTE.—*Coloured illustrations of several of the insects mentioned in the foregoing paper are being executed, and will be given to the Society, by Mr Hutchison, in the next part of the Transactions.*—ED.

XIV. *On the Present State and Future Prospects of Arboriculture in Yorkshire.* By David Tait, Forester, Owston Park.

Arboriculture is daily becoming of more importance, not only to landed proprietors, but to the commercial interests of the nation. Foreign timber has lately risen in price about 50 per cent., the result of which has been to raise the price of that grown at home to an equal, and in some cases even a greater amount. It is, notwithstanding, astonishing to find so much ignorance existing in regard to arboricultural matters, both in a practical and a scientific light. Plantations are too commonly looked upon simply as game preserves, not existing for any benefit to the country, or even to the owner, except as affording sport to a limited section of the community. It, however, only requires a slight acquaintance with the subject to show that, while they conduce to a certain amount of sport, they are of infinitely greater importance as a source of revenue to the proprietor, and also to the agricultural and commercial interests of the country.

In the following remarks I will deal with the subject from a practical point of view, and shall endeavour to give a description of the prominent features of arboriculture in Yorkshire.

In this country we must expect to find the proprietor of woodlands consulting his own taste in their management,—that is, whether he will have them kept merely as game preserves, or managed so as to increase the revenue of his estates. If proprietors can be shown that it is their interest to lay out and manage their plantations in a scientific manner and on sound principles, we may expect them to look at the subject more from an arboricultural point of view, and make the consideration of shooting or hunting a secondary matter, so far as their plantations are concerned.

In laying out plantations in this county, as elsewhere, proprietors have been influenced by various motives. Love of sport, ornament, shelter, and profit have all contributed to the increase of woodland property. The result is, that plantations have not always been laid out to the best advantage, or the most suitable trees planted in different soils and situations.

Fences.—The thorn hedge is the most common, the management at a certain period of its growth being peculiar to the county—viz., when the hedge becomes overgrown, which it is sometimes allowed to do to form shelter, it is laid over, and a fence about the common height formed without cutting down. This is done by cutting the stem two-thirds through about six inches above the ground, and laying it over at an angle of about forty-five degrees. Small stakes are driven into the line of fence about two feet apart to keep the layer in its place. The cut which has been made is sloped neatly to prevent water from lodging, and left open, so as to give young shoots plenty of air. If a strong fence is required, small rods are twisted in along the tops of the stakes to bind it. Where an old hedge is thin, this sometimes makes a good fence, as the layers fill up the thin places, but the necessity for such treatment is the result of mismanagement at an earlier period. The laying of hedges is not nearly so common now as it was. The bills used for switching or trimming are heavy, and the handles long; sometimes the blade inclines backward at an angle from the handle. When at work, the hedger uses both hands to hold his bill, and works with his face towards the hedge. Sometimes the work done is very neat; often, however, it is of an inferior description. There are matches throughout the county for hedgers trying their skill, but unfortunately in some districts these are being discontinued. Dry-stone dykes are also common in the hilly districts of the county. Iron fencing, too, in all the different styles, is being extensively used.

Draining.—This is an important adjunct of arboriculture; and a large extent of this county being flat, were no artificial means employed to convey the water off the land, a large tract would be marshy ground and stagnant water, instead of fertile fields and luxuriant crops. Even with an extensive system of drainage, the low-lying districts are periodically visited by floods more or less disastrous. Last year (1872), in the month of July, we had in one district 11,000 acres under water, and it was calculated that damage was done to crops to the extent of L.50,000. Had the damage done to plantations been included, the estimate must have been much higher. Many trees of large size were killed, and many acres of young plantations destroyed. What were thriving young trees from 12 to 20 feet high, as well as full-grown specimens, may this year be seen standing leafless. The varieties which have suffered most are ash, wych, elm, and larch. These are the trees we would have expected to suffer most by long exposure to water stagnant on their roots. Oak on the same ground was uninjured, which may be from its roots drawing nourishment deeper in the ground. The drainage of ground before planting, and the most careful attention to drains afterwards, are of the greatest importance to the profitable rearing of timber in a district such as above described.

Planting.—It is difficult to say what amount of care has been bestowed on the selection of trees to form existing plantations, without knowing what the primary object of planting may have been. It is a common fault to find existing plantations formed exclusively of oak, which when small fetches a comparatively small price. This may be accounted for by the high price obtained for oak at the time of the plantations being formed, but the object would have been better attained by planting oak at suitable distances for the permanent crop, and filling up between with larch and other kinds. Much of the land, however, is very suitable for growing oak, a wood which, when matured, commands a good price. Although larch will not grow to a large size on clay lands, it thrives well until it is suitable for coal-pit purposes, when a remunerative price can be obtained for it. Young trees for planting are generally obtained at public nurseries, of which there are several in the county, some of large extent. Many proprietors prefer getting trees from Scotland, being of opinion that trees grown under the influence of a northern climate are more hardy, and succeed better after removal. There is a good deal to be said in favour of this view. It is a great shock for trees to be planted out in a bleak situation after being crowded in a nursery; and it appears a sound view, that if reared in a colder and more ungenial climate, they will be less susceptible to the change than if planted out in the locality in which they have been nursed. This, however, only holds good as regards trees of small size, as when plants are large the shorter distance they are removed the better. The operation of planting is generally done by digging pits 4 feet apart, which, in the low clay lands, is the only suitable method. The same difficulty of protecting young trees from the ravages of hares and rabbits exists as in other parts of the country, the only effectual cure being either to have them all killed, or to put wire-netting round the whole of the plantation. For several years after being planted, the young trees are liable to suffer from late spring frosts, the ash and larch being the varieties most affected.

Pruning.—This is a branch of forestry that one does not see practised so often in this county as it ought to be, and in many instances where attempts are made to prune, the trees acted upon (which are generally those grown in hedge-rows) are more disfigured than benefited by the operation.

Thinning of Plantations.—Besides all other arguments in favour of early thinning, we have the advantage of a ready market for even the earliest thinnings, which are used by farmers, gardeners, crate-makers, &c., for various purposes, the price obtained repaying the cost of labour. Yet I fear there is a tendency rather to neglect thinning at this stage, and afterwards to do it too severely. On many estates even of considerable size no qualified forester is kept to whom this duty can be intrusted. In such cases a professional timber valuator is called in whenever it is thought desirable to have a sale of timber. To him is intrusted the duty of thinning the plantations, and putting a value on the trees to be cut down. This state of things is very objectionable, and is rendered more so in some cases by a percentage being allowed the valuator on the money drawn at the sale. That is certainly an inducement to get in the largest possible amount of cash, but it may be to the ruin of the plantation, by thinning too severely or removing trees which should have been left. On small estates, where there is not sufficient employment for a forester, some disadvantage of this kind must be submitted to. It is obvious, however, that where a qualified person is in charge, whose professional character depends on the manner in which he discharges his duties, he will take more interest in his work than a person only called in for the time being. It must be understood that the class of persons here spoken of is very different from the landscape gardener, being simply valuators, and not professing to understand the thinning or general management of plantations. Thinning requires much attention in all cases, but particularly in a picturesque or hilly district. There is not only the welfare of the plantation to be considered, but also the shelter of adjoining land and the beauty of the landscape. An important part of thinning here is clearing out the underwood, which can always be profitably disposed of, and, if of hazel or ash, is much sought after. It can be cut with most advantage at from six to ten years' growth. When a quantity of wood is marked for sale, the common method adopted is, in the first place, to have all the underwood cut and sorted, the different classes tied up into bundles, and carried to the roadside. Any plants likely to make good timber trees are left in open spaces, or to take the place of trees to be felled. In some cases the underwood is sold, standing, by auction, the purchaser doing all the labour. I do not, however, approve of this method.

Cutting Down and Disposing of Timber.—Felling is generally done by contract by timber merchants' men, or when it is cut down previous to sale by the proprietors' own men. Contracts are objectionable in this work, as the men are less careful in preserving standard trees; but where it is difficult to obtain competent men for estate work, it is the only way of solving the labour difficulty. The methods of disposing of timber may be classed under two heads, viz., selling it standing, and cutting it down previous to its being sold. The first method is much more common throughout the county, and sales of two or three thousand pounds value are effected in this way. There are many objections to this method, but I merely give the system of management practised in the county. Cutting down timber previous to sale is becoming more common year by year, and were proprietors or their managers giving the subject the attention it deserves, it would soon be general. There are various methods adopted for arranging a sale of timber, but selling by auction is the most common. When the timber is felled, sometimes the number of feet, in other cases no particulars, are given, and it is generally more satisfactory to allow purchasers to satisfy themselves on different points. As I have before stated, much of the timber grown is oak, and it would strike a traveller through the county in summer to see a number of trees standing minus the bark and branches. The practice is to strip the trees of their bark, and let them remain a month or two before being felled, to prevent their splitting from the heat of the sun. When there are no branches for the men to stand on when taking the bark off, iron spikes are driven into the tree for that purpose, and those who are used to it can get the bark off very quickly, but I have not found the price obtained repay the extra labour. Trees of large dimensions are certainly much benefited by the operation, and when required for estate use it well repays the extra expense incurred. This work is invariably done by contract, the price paid at the present time being from L.1, 15s. to L.2 per ton, and the price paid for cutting down is from 6s. to 10s. per hundred feet.

On Measuring Timber.—In many districts of the country, when trees are felled, the trunk or bole is sawn through where it becomes knotty, but the general custom in Yorkshire is different, the tree being dressed out as far as it will girth six inches on the side.

When quoting prices per foot, the two methods make a considerable difference; in the one case there is only the best of the timber, in the other the rough top is included. Owing to felling being done by contract, the timber is measured out very exact, and the contents marked on every tree with a timber scribe. A quarter of a foot is always included in the measurement, and it is no uncommon thing to see a tree containing 80 or 100 feet have an odd quarter or half foot marked on it. This exactness of measurement has arisen from timber merchants buying the trees standing; and bringing their customers to the plantation to select wood to suit their purposes, the measure marked on the tree forming the basis on which the bargain is completed. There is much to be said in favour of exactness in measurement, as it forms a reliable guide for reference at any future time, but it is a duty often very loosely performed. Another feature in timber measuring here is, that no allowance is made for bark except when oak timber is sold standing; the measurement is then calculated under the bark. There is no good reason why an allowance should be made for bark—an allowance which varies in different districts of the country, and which can never be exact. It would be very desirable to attain uniformity in this respect throughout the country. Of course, where an allowance is made for bark, the price per foot will be higher. The class of wood used for pit purposes, in many districts sold by lineal measure, is here sold by cubic measure, so that small trees containing only half a foot of wood are measured in that way. When sold by lineal measure much time is saved in measuring, but the cubic measurement is the most exact.

The Demand for Timber in the County.—Perhaps in no other part of the United Kingdom can higher prices be realised for timber than in the south and west of Yorkshire, to which district this paper chiefly applies. The following list of prices received for timber on an estate in the south of Yorkshire this year (1873) will form the best criterion for judging as to the demand. When comparing prices with those in other parts of the country, the peculiarities in measuring before mentioned require to be kept in view. The prices here quoted were received for the timber lying in lots in the plantation, two or three miles distant from a railway station. Cartage to station cost the purchaser from twopence to threepence per foot, according as the access to the wood was easy or otherwise, after which it was carried on the railway an average of 25 miles before arriving at its destination :—

Description of Wood.	First Class.		Second Class.		Third Class.		Fourth Class. (Handle-wood & pit-prop size).	
	Years old.	Price per ft. s. d.	Years old.	Price per ft. s. d.	Years old.	Price per ft. s. d.	Years old.	Price per ft. s. d.
Ash	60	2 5	50 to 60	1 9	50	0 10	30	1 9
Alder . . .	—	—	36	1 1	—	—	—	—
Beech . . .	80	1 6	60 to 80	1 3	—	—	—	—
Birch . . .	—	—	36	1 1	—	—	—	—
Elm (Wych) .	60	1 3	—	—	—	—	30	1 0
Elm (English)	120	1 6	60	1 3	50 to 60	0 10	—	—
Larch . . .	—	—	—	—	—	—	36	1 1
Oak	90	3 0	—	—	45	1 1	30 to 36	1 1
Sycamore . .	—	—	60	2 7	40 to 50	1 6	—	—
Spruce fir . .	—	—	—	—	36 to 50	1 0	—	—

The Class of Labourers employed in Plantations.—Assistant foresters as a class are unknown in the county. The working woodmen as mere labourers will compare favourably with those in other parts of the country, but they are deficient in knowledge as arboriculturists. Their highest ambition is to be good axemen, and this undoubtedly many of them are. The work is looked upon too much from a money point of view; consequently, there is a want of interest in the work itself. The evil has grown up under a loose system of management, and the remedy must be a work of time. In Scotland young men enter the profession with a view to push themselves forward to fill head foresters' situations; so that, without looking so much to present wages, they have a stimulus to improvement which would otherwise be wanting. In present circumstances, to obtain such a class of workmen in Yorkshire is impossible, as young men prefer going into public works, where wages are higher. This, no doubt, is partly owing to the low estimation in which our profession is held in the county, caused by ignorance of its principles. We have here intelligent young men being trained as gardeners, and it is from that class—as in Scotland—we should be able to obtain our assistant foresters, who would then, instead of looking solely to the amount of money they could earn, look forward to advancing their social position, and be an example for others to follow in the same steps.

Ornamental Arboriculture.—That there has been, and still is, a considerable taste for planting ornamental trees and shrubs is proved by the extensive and varied collections in the county. It would prove interesting to report on the deciduous and evergreen trees and shrubs on different estates—their variety, height, age, nature of soil, &c.; but a complete list would much exceed the limits of this paper.

I have now noticed the prominent features of arboriculture in Yorkshire, and it will be seen that much requires to be done even to place it on the footing it has attained in Scotland. I shall now offer a few remarks on the *future prospects of arboriculture in Yorkshire*, which must necessarily be to a large extent speculative. I may, however, observe that there is plenty of room for extending the acreage and improving the management of woodland property. There are large tracts of land, especially in the hilly districts, yielding a very small rental to the proprietor, on part of which, were plantations judiciously formed, not only would they yield a better return for the ground occupied, but by affording shelter to adjacent land would much increase its fertility and productiveness. There are instances in the county of plantations growing at a high altitude, the trees having attained moderate dimensions, the small extent planted alone preventing them from affording much shelter, or giving any appreciable return for the ground occupied. The fact that such plantations do exist is a proof that on a larger scale they would succeed in a greater degree, as it is well known that the greater the extent of a plantation the better trees will succeed in it. Narrow belts and small patches planted on exposed situations are comparatively worthless for shelter.

On some of the inferior low-lying lands, which are liable to frequent flooding, and which produce little but rushes or other inferior herbage, plantations of birch, alder, and willow would prove much more remunerative, especially when such a class of wood realises, as at present, above a shilling per foot for trees of thirty years' growth.

In some circles of agriculturists there is a tendency to talk of land occupied by plantations as so much land lying waste. This, no doubt, is from want of an unbiassed consideration of facts. The great benefit plantations confer on the agriculturist by the amelioration of climate is lost sight of. Before planting a large proportion of his land, a proprietor will always consider the return he is to get for money expended and land occupied. Arguments in favour of reclaiming comparatively waste land by planting have been pressed on the attention of landed proprietors in this country for many years, and although much has been done, much more remains to be done.

The length of time that must necessarily elapse before any return is received for the money laid out in planting forms the chief objection to its being more generally practised. This objection, however, had more force thirty years ago, so far as this county is concerned, than it has now. At that time it was only mature timber that brought any considerable price—that is to say, trees that had occupied the ground for eighty or a hundred years; so that a proprietor had no chance of planting and reaping the benefit in his own lifetime—the work done was for the future benefit of the estate. Now, however, the case is different; there is a great demand for pit prop-wood in the country, for which trees are suitable at from twenty to thirty-six years' growth, and larch even at an earlier age. So that on the class of land we have specified, after trees had grown for thirty years, if they were cut down, the price obtained for them would well repay the cost of rearing them, and the rent for the ground occupied,—a fact which may be gathered from the prices quoted at page 143. The advancement made in arboriculture would probably have been much greater, but for the very men who pretended to promote it. So many extravagant expectations were held out which could never be realised; so many calculations based on unsound foundations; so many enthusiastic dreamers, who buoyed up proprietors for a short time by leading them to expect a speedy fortune by planting land which formerly gave little or no return. A short time, however, unfolded the deception, and no doubt caused many planters to abandon the operation in disgust.

As illustrating such writers, I cannot do better than quote from "Cobbett's Woodlands," published in 1825:—"The time will come, and it will not be very distant, when the locust tree (*Robinia Pseud-Acacia*) will be more common in England than the oak; when a man would be thought mad if he used anything but locust in the making of sills, posts, gates, joists, feet for rick-stands, stocks, and axle-trees for wheels, hop-poles, pales, or anything where there is liability to rot. This time will not be distant, seeing the locust-tree grows so fast. The next race of children but one, that is to say, those who will be born sixty years hence, will think that locust-trees have always been the most numerous trees in England; and some curious writer of a century or two hence will tell his readers that, wonderful as it may seem, the locust was hardly known in England till about the year 1823, when the nation was introduced to a knowledge of it by William Cobbett."

It is nearly half a century since these words were written; how far they have been accomplished the reader may judge for himself. They serve to show how little dependence is to be placed in speculative writing, dealing with future events, unless there is a sure basis on which to rest one's calculations.

XV.—*On the Different Modes of Profitably Disposing of Home-Grown Timber.* By WM. GILCHRIST, Forester, Cluny Castle.

The best mode of profitably disposing of home-grown timber depends much on local circumstances, but there are general rules which ought to regulate all timber sales. Wherever timber is cultivated for profit, the chief consideration is how to produce the greatest amount of timber at the least expense; and, after having produced it, how to dispose of it to the best advantage. The first of these propositions scarcely comes within the scope of this paper; still it is impossible to disregard it altogether, as the age at which a crop of timber is disposed of has a great influence on its profitable disposal. Suppose a plantation where a third or perhaps a half of the trees have arrived at maturity, the question arises, Is it most profitable to dispose of the whole, or only such as seem to be at maturity? Leaving out of view amenity and shelter, and looking at this case on strict commercial principles, it would be consistent with good estate management to cut down and dispose of the whole whenever a good price is to be had. By doing this two important objects are gained, viz., the money is realised and the ground can be replanted, so that the second crop will be a number of years further on than if the whole were not cut until all were at maturity. And where there is only one-half or two-thirds of a crop of trees left on the ground, the increased value of the wood will not equal the value of the money received for them if sold at the proper time and the amount realised judiciously invested. Again, suppose a fir plantation from 40 to 50 years old, worth say L.30 or L.40 per acre, will such a plantation continue to increase at a ratio equal to the cumulative interest of L.30 or L.40, and the value of a succeeding crop? In other words, is it most profitable during a period of 80 or 100 years to grow two crops of wood or one? Or take the medium,—two crops at 45 years old and one crop at 90 years; suppose the first to be worth L.50 per acre, the cumulative interest of that during 45 years would be about L.400; deduct L.40 as the cumulative interest of cost of replanting, leaves L.360 as against the price of the wood at 90 years old. Supposing it to have increased at 5 per cent, which is a high rate, the value at 90 years would be L.162, 10s., being a balance of L.197, 10s., and the value of the second crop in favour of cutting at 45 years. At 45 *versus* 75 the balance in favour of the former would be L.55, besides the value of the second crop. At 45 *versus* 60 the balance in favour of early cutting would be L.12, 10s. per acre, and the second crop 15 years in advance. These statements are worth consideration, although contrary to ordinary practice. The general opinion is that timber ought not to be cut until it is full grown; but, as a rule, wood merchants put little value on trees being matured or ripe, their chief object is to get them of a useful size and free from disease. At present quick production and quick returns are the ruling axioms of all profitable enterprises, and there is no reason why the same rule should not be applied to the production and disposal of timber. In fact, before the growth of timber occupies the position which as a branch of rural economy it ought to do, it must be clearly shown that the profits can be realised within a reasonable period. This can only be attained by disposing of timber when of sufficient size to suit the markets. Probably the highest revenue will also be procured by the same method. There are exceptions to this proposition, as all slow-growing varieties that reach the maximum price when they are of large size must be allowed to grow to maturity.

The expenses connected with the disposal of timber depend upon the mode of sale adopted. Occasionally these expenses are very considerable, and materially reduce the value of the wood. This is not so observable in small as in large lots, although, other things being equal, the proportion is the same. To reduce these expenses to the minimum, the exposer should arrange that as much as possible of the work of cutting and transport should be done by the purchaser. In general, wood merchants can do this more cheaply and advantageously than proprietors, as they have special plant for the purpose. If done by the proprietors, it should be as much as practicable by piece-work. Good roads are an important consideration for a wood merchant; and exposers of wood are often penny wise and pound foolish with regard to roads. In general, when a lot of wood is to be sold, the roads ought to be put into good repair previous to the day of sale. The amount of traffic expected must in all cases decide as to the quality and make of a road. Good roads are seldom made for the especial transit of wood, although in many cases they add from 5 to 15 per cent. to the price of the wood,—bad roads often detract as much. In large plantations it will ultimately increase the revenue to have the main roads good and substantial.

Where water power is available for floating, driving saw-mills, or such work, every facility should be given to have it applied either by the exposer or purchaser. If by the latter, it is generally satisfactory to have the dams, weirs, sluices, lades, &c., put in good repair, and given over to the purchaser on the condition that they be left in the same state,—damage done by heavy floods being excepted.

On estates producing an annual timber revenue, it is important to consider how much can be profitably disposed of at one time; in the case of large lots, care must be taken that the market is not glutted or competition suppressed. Wood merchants are not proverbial for playing into each other's hands, but the reverse. Still cases of the kind have happened, and the exposer should guard against such occurrences. This can be done by arranging the lots in such quantities and disposing of it in such ways as to meet the wants of the district. For small quantities, ranging from L.10 to L.50, the mode adopted must be either tender or private bargain, as it rarely pays to call a roup even for L.50. Lots of timber worth from L.500 to L.5000, principally of one class, may be sold profitably in one lot, especially where it is necessary to manufacture the timber on the ground. It may be said that selling in such large quantities tends to suppress competition, and play into the hands of extensive timber dealers and capitalists; but by making the terms of payment easy, and holding a proper security over the wood, the small capitalist is not only encouraged, but accommodated. Instances could be given where lots sold above L.5000 have been bought and wrought most satisfactorily by individuals of small capital.

Entailed Estates.—Difficulties sometimes arise in disposing of wood in large lots on entailed estates, especially if the heirs of entail signify disapproval of the proceeding. Under these circumstances, it is not judicious to dispose of large quantities at one time, unless with the full consent of all interested parties. Lots worth from L.500 to L.1000 are sufficient to bring out the best wood merchants in the district and induce competition. For the removal of lots of this size the time is necessarily more limited; the purchaser's risk in the event of a change of proprietors is not so great, and therefore it is not so requisite that they should take instruments for their own security.

As regards competition for large lots, it is well known that extensive dealers only attend sales where the quantities are such as to be remunerative, and in general it is only such dealers who have the appliances and machinery for manufacturing wood to advantage. Every encouragement ought therefore to be given to the capitalist, as a part of whatever profits he may derive from the simplifying or reducing of labour is sure to revert to the producer in the increased value of the rough wood. Exceptions to this statement may be taken in favour of local traders, but such exceptions do not alter the general principle. No doubt where there is a local demand a saw-mill on a small scale, or even a pair of sawyers, may carry on a profitable trade, and be able to give large prices for the wood they manufacture. That is no criterion. The hand-spinner and the hand-loom weaver can do the same in their calling; but it is the extensive manufacturers and capitalists in all departments of industry that by their several appliances have raised the price of the raw material. Such being the ascertained fact regarding ordinary manufactures, the same naturally follows in regard to wood. The large wood-merchants are at present paying for rough wood more than double what it was when portable machinery was first introduced and capital employed in its manufacture and transport.

Mixed kinds of wood suitable for different classes of work are most profitably disposed of in small lots, provided the site is within easy distance of where the wood is to be used, and the quantity not more than sufficient for local demands. On the other hand, where the quantity is large, it should be sold in one or more large lots, even although it is not to be manufactured on the ground, as contracts for the transport of large quantities are readily entered into at greatly reduced rates, while the transport of small quantities cannot be so advantageously arranged, whether by road, sea, or rail. The cost of transport being one of the principal items to be considered in estimating the value of a lot of wood, it follows that the lower the rate of transport the higher is the price of the wood; therefore such reductions, although made directly in favour of the purchaser, are, by the increased price given for the wood, indirectly for the benefit of the seller.

How to regulate the payments of large lots, so that while accommodating the purchaser to a reasonable extent, the exposer's interest shall be secured, is a question on which much difference of opinion exists. It is doubtful how far in the interests of legitimate trade the wood merchant with insufficient capital ought to be encouraged to compete for lots that are beyond his means. The length of time that must elapse before money can be realised from wood bought in a rough state, makes it imperative that the wood merchant should have large capital or good accommodation, and a reasonable accommodation given by the exposer will invariably enhance the price. So long as such accommodation does not encourage speculation it may be given to a reasonable extent; at the same time the interests of the exposer must be secured. For this purpose the simplest method is to make the payments within a given period by fixed instalments—the purchaser only obtaining right to such a quantity of the wood as the exposer shall consider to be covered by the instalment paid. To counterbalance this, so as to give a fair chance to the capitalist, a rate of discount commensurate to the time at which the instalments are payable should be offered for ready money. This method is common, and although at first sight it may seem a little one-sided, it has been found to work well for all parties. The capitalists may occasionally object if the percentage allowed for ready money is considered insufficient, but there is seldom much difficulty in regard to this matter. In my experience the system has been found to work well, and it has neither been abused nor seriously objected to.

In the sale of small lots by tender or private bargain, ready money, or what is considered equivalent, payment within the month of purchase, is the most common and the most satisfactory mode of settlement.

In sales by public auction, the conditions usually declared are, that the lots are at the purchaser's risk after they are disposed of by the auctioneer. However, settlement should invariably take place before their removal. Bills for wood sales by public roup are not recommended; and where it is necessary to have them, the auctioneer should guarantee the sale. This he will readily do for a small percentage, and the exposer has neither risk nor trouble in the matter. These are the general rules to be considered before any definite mode for the disposal of timber is adopted, and they may be modified to suit local circumstances and the custom of the district.

To particularise all the ways by which timber can be profitably disposed of would extend this paper unnecessarily. In my opinion the whole may be summarised under tender, public or private; public auction; private bargain, by weight or measurement; and in a manufactured state. Each of these systems is suitable for the profitable disposal of timber under certain circumstances, but they differ widely in their application. This will be best illustrated by considering the merits of each system, and the circumstances under which each should be adopted.

I. *Tender, Public or Private*, is the most flexible and economical of the modes indicated. It may be adopted for disposing of home-grown timber or coppice wood under all circumstances, whether standing, cut, or wind-blown, in quantities varying in value from L.10

to L.1000. It is unquestionably the mode by which large quantities of growing wood can be most profitably disposed of, whether in one or more lots, and especially when it requires to be manufactured before removal.

For lots of wind-blown or standing trees, where the whole are to be cut, the felling should be done by the purchaser. Before the sale it is only necessary to have the trees counted and classified (they are sometimes numbered, but this is not essential). As soon as the tender is accepted and the payments arranged, the wood settled for should be at the purchaser's risk. Two years ago the writer sold a lot of Scots fir and larch for upwards of L.800, and the expense of counting and classifying only amounted to 10s. for the whole. In the case of thinnings, the work requires care, so that the most thriving trees may be left to grow, and the expenses of preparing for sale are therefore rather more, as it is necessary that the trees should be numbered as well as classified. In classifying, three classes are generally adopted, viz., timbers, spars, and props. In some districts a given size for each of the classes is recognised, a plan which should be universally adopted. It often occurs that the exposer, or those acting for him, makes three classes, independent of recognised sizes. In such a case, it is best to put beside the number on the intermediate class a × or other distinctive mark. This is a simple and effective method, and by adopting it the classes are easily ascertained. Thinnings, though sold standing, should be cut off the roots at the expense of the seller, the purchaser cross-cutting and snedding.* Snedding is often done along with the cutting, but the purchaser sometimes objects that it is not rightly done. There is often good cause for this objection, as it is almost impossible to get a tree properly sned until it is turned, and this can be most easily done after the tree is cross-cut; indeed, some heavy trees can scarcely be turned until they are cross-cut. The cutting off the roots should be done by the exposer, to insure its being done carefully; but it is not necessary, as some allege, that it should be done by day's wages. On the contrary, it can be done as carefully and more economically by contract. My practice is to let all the cutting by contract to some of the workmen employed on the estate. This is generally done at from 5s. 6d. to 10s. per 100 trees, or at about 10d. per 100 cubic feet. Of course there are exceptions to this, as when the thinnings are growing amongst hardwood trees, and special care is required in the cutting. In such

* This Scotch expression corresponds to the German *schneiden*, to prune or amputate.—Ed.

cases the work is invariably done by day's wages, under supervision. Objections to this mode of selling timber and allowing it to be taken out of the woods by the purchaser are sometimes made, it being alleged that wood merchants' people are more careless with the horses in dragging than the proprietor's, and also that men cutting by contract are more careless than when cutting by the day. Such may be the experience of some who have had unscrupulous parties to deal with, but it is unfair to make a general allegation. Wood merchants and other people are usually anxious to leave a place in good condition so that they may return to it again. For this reason alone —if for no higher—it is their interest to take good care of the standing trees. However, to prevent any risk in the matter, it is best to provide in the conditions of sale that all damaged trees are to be taken by the purchaser and paid for at double or such other prohibitive price as may be agreed upon.

As regards the cutting of trees by contract, there are few practical foresters who have not done a little in their time, and their opinion of others will almost invariably be a counterpart of their own practice under similar circumstances. A writer in our Transactions (vol. vii. p. 74), states that he has "never found any practical forester or wood manager declare that it was the most satisfactory way of doing the work;" but many foresters follow this system, for the reason forcibly stated by the same writer—"the cheapness whereby sales conducted in this way can be effected." The argument with which he answers this statement is, that timber merchants generally pay a higher rate of wages for felling, &c., than proprietors do, and that the expense of such work must be made up in some way. If the writer carefully considers the whole matter, he will probably come to the conclusion that wood merchants do not pay a higher rate of wages than they can avoid, and also that it is their interest, as well as that of proprietors, to have the work done as cheaply as possible. On the other hand, it is seldom that work is cheapest or most satisfactorily done at the lowest rate of wages: the contrary is generally the case; and the reason that wood merchants pay higher wages than proprietors is that they have a better class of men—or at least men who work hard and thoroughly understand their craft.

Sales by tender, if private, are generally made known by circular; if public, by advertisement or sometimes by schedule, containing, besides the number and class of trees, a printed copy of the conditions of sale and blank form of tender. This latter is a commendable method, whether the sale be public or private, and will become more general. The mode of tender should be stated in the conditions, but it is usually given by offering a slump sum for each lot, or in the case of coppice woods a rate per acre. If desirable, it can be given at a rate per tree, or any number of trees, or per foot. It is always understood that neither the number nor classing is guaranteed, and the offerers are always held as having satisfied themselves on these points before offering; and no claim on the grounds of any shortcomings or inferiority can afterwards be entertained. The party whose offer is accepted is held bound to subscribe a formal agreement of sale embracing the general conditions. The cost of sales by tender seldom amounts to one per cent. of the sum realised. The only objectionable form of sale by tender is where an agreement is entered into, or an offer accepted for a given number of trees, at a fixed rate before the trees are actually marked or counted. In the case of thinnings and prop-wood this has often been done, but the results have generally been so unfavourable to the seller that the mode has seldom been tried a second time. Such forms of sale are unsound in principle, and the failures resulting therefrom are owing to the defective agreement, and not to the sale by tender.

II. *Sales by Public Auction.*—This mode is specially adapted for disposing of timber grown within easy reach of a good market, or adjacent to manufacturing towns; and also for all mixed lots of wood suitable for country purposes. In fact, firewood and wood suitable for fencing are often sold by auction at rates above market prices. However, in the preliminary arrangements a good deal of expense is incurred, as previous to the sale the wood has to be cut and lotted as near good roads as possible, and the several lots distinctly numbered. The relative value should also be ascertained, so that a reserve price may be put in if required.

In preparing the lots great care is needful to separate the trees suited for different purposes, and to arrange those adapted for the same purpose in lots to suit purchasers. The reasons are obvious, as parties who may wish one class of wood for one purpose may not want another, and would be prevented from offering; or if they did offer, it would only be by putting a small value upon the class they did not want—a value, in fact, at which they could dispose of it readily to another party. In the neighbourhood of Edinburgh sales by public auction are common yearly, or in some cases half-yearly sales being an institution on some estates. They are also generally adopted throughout Scotland for selling mixed lots. Even some of those who sell their large lots by tender, adopt this mode for mixed lots that are cut within or adjacent to the policies. For this class of sales, so long as the supply does not exceed the local demand, public auction is without doubt the best mode of disposing of mixed lots of home-grown timber.

The expenses connected with the preparation of wood for sale by auction are considerable; but so long as the competition is kept up, prices sufficient to pay for the extra outlay are generally obtained. Instances to the contrary have occurred, and cases are known where the purchasers have agreed not to bid against each other. This only occurs where the competition is limited, and under such circumstances sales by public auction should not be adopted. Instances are also known where the sum realised for the wood did not pay the expenses of cutting and preparing for the sale. These instances occurred in a district where only a small local trade exists, and therefore unsuitable for selling wood by auction except in very small quantities. It will thus be seen that although public auction is a desirable mode of selling timber, its success depends upon the district, local demand, and quantity to be disposed of. In my experience neither wood-merchants nor consumers are in the habit of going far to attend auction sales, except for some particular trees, or class of wood that is difficult to procure.

The conditions relative to this mode of sale have been indicated, and all lots are understood as being at the purchaser's risk immediately after being disposed of by the auctioneer. Still it is generally considered requisite to have a reliable man in attendance to watch the proprietor's interest during the time the wood is being removed. In this way many difficulties that might arise regarding roads, gates, &c., are prevented.

The cost of preparing wood for sale by auction generally ranges from 15 to 25 per cent. of the total sum realised, according to the quality and kind of wood. The expense depends upon the situation, particularly as regards the roads and access to the plantations.

III. *Sales by Private Bargain.*—This mode is more or less adopted in all woodland properties; but it is not to be recommended except under special circumstances, such as—*First*, For disposing of wood from plantations in the immediate neighbourhood or centre of a mining district, where the consumers are willing to give the full market price for whatever wood they require. *Second*, Local saw-mills, boat-building yards, and other tradesmen may be supplied on the same terms, viz., market price. *Third*, Telegraph poles, pit props, or any other class of rough wood for which, at a stated depot, a fixed rate can be obtained for a given size and quality of wood. In any of these cases the wood should be sold by measurement,—in the case of turners' wood and firewood by weight. On delivery of the wood a note of the measurement or weight, or what is better, a regular invoice, should be forwarded to the purchaser. The strict adoption of this mode prevents difficulties, facilitates business, and is beneficial to all parties.

All classes of wood should be charged at recognised market rates; and if any change of price takes place, formal intimation of such change should be made to the purchaser before any wood is charged at the increased rate. Wood sold in this way is generally delivered at the premises of the purchaser, or put on rails at the expense of the exposer. The market price is sometimes considerably curtailed by the expense of delivery and transport. For instance, a wood-manager on a large estate lately sold a lot of heavy Scots firs at 11d. per cubic foot put on rails. He had everything done in the most economical way, and on comparing notes it was found that the actual price got for the wood in the rough state was rather below 6d. per foot; while for wood of a smaller size and inferior quality sold by tender, an average of 6½d. per foot was readily obtained in the same district under similar circumstances as to situation, distance from railway station, &c. This result is mentioned to show that although apparently high prices are got for wood when sold in this way, these are often not so in reality. Therefore, before adopting this mode, it is well to count the cost carefully. Where large quantities of firewood or other rough wood are sold by weight and to be delivered, the cartage should be by contract at a fixed rate per ton. Railway weights, when taken advantage of, should be binding on all parties. For small lots of fuel or fencing wood, it is not generally considered requisite either to weigh or measure. Fencing wood is generally sold at a rate per dozen, and parties accustomed to sell such lots can easily fix their relative value. In all strictly local transactions, delivery should be given in the plantation for the purchaser to remove at his own expense. Some parties consider private bargain the best mode for disposing of all sorts of forest produce; but the writer does not recommend it save in exceptional cases, as those indicated. The expenses connected with it are seldom less than 30 per cent., and sometimes as high as 50 per cent., on the gross receipts.

IV. *Manufacture of Wood by the Producer.*—The writer cannot report from personal experience, not having had the management of *sale* saw-mills. Still he has had considerable experience in manufacturing wood for estate and building purposes, the result of which has led him to form the opinion that it is not profitable for the producer to be the manufacturer. If it is desirable that such a mode be adopted, portable machinery must be introduced and used; and the whole of the work in connection therewith should be done by the piece, as in that way only can a profit be realised. Fixed saw-mills for manufacturing wood for sale may pay well for a few years, or so long as wood is within easy reach; but the expense of horse work soon comes to be so great that the saw-mill, instead of being a profit, entails considerable loss. Many wood-managers having adopted this method, or finding it in operation when entering their situations, utilise the mill as well as they can, without making any comparative calculation as to whether it is profitable or otherwise. This is not surprising, as it is always difficult to make radical changes and to move expensive plant and machinery. No doubt there are instances where wood has been profitably manufactured by the producer, but these cases are rare, and the successes have invariably been dependent to a great extent upon local circumstances.

A wood manager who has manufactured wood extensively for sale for upwards of twenty years, unhesitatingly states that it is the most profitable mode of disposing of home-grown timber. However, this case is exceptional, as a good road runs almost parallel with the woods, and he has command of sufficient water power. Besides these advantages, there is a special local trade, and he has never had occasion to compete much with wood-merchants in the open market. It is worthy of notice that, with all these advantages, he has been obliged to keep a stock of *foreign* wood, to accommodate and keep on his customers. This fact speaks for itself.

On the other hand, the opinion of one of the most extensive wood managers in the north of Scotland is so decided on the subject, that he sells all the wood in a rough state, and contracts with merchants to supply the manufactured wood required for estate purposes. Where the manufacture of wood is practised, the mode of sale is usually by private bargain, already noticed. It may be added, that all experience goes to prove that wood sales should be made as open and public as possible, especially by foresters or those who are acting for other parties. The expense of manufacturing timber under favourable circumstances and with good appliances generally adds about 75 per cent. to the price of the rough wood.

Many facts drawn from experience and observation could be given in support of the foregoing statements, but the following summary will serve to indicate the writer's general conclusions :—

1. It is most profitable to dispose of wood when it is of a size and in a state to command the best price.

2. Whatever mode of sale is adopted, the wood should be sold in such quantities and at such periods as will insure good competition.

3. Where an annual income is derived from wood, the periods of sale should be yearly or half-yearly, that purchasers may make arrangements accordingly.

4. It is more profitable to dispose of wood by a clean cut than by thinning or selecting mature trees; but the amenity of the property having to be considered, often militates against this mode of procedure.

5. When timber is to be manufactured on the ground, it can be most profitably disposed of in large lots, provided they are not spread over too wide an area.

6. Detached lots should be tendered for separately.

7. When practicable the wood should be sold standing; and, except in the case of thinnings, the work of cutting, &c., in connection therewith done by the purchaser.

8. As much of the work as possible should be done by contract.

9. Good roads are a great advantage, and add considerably to the value of wood.

10. Water power, where available, should be taken advantage of, and handed over to or shared with the purchaser, especially if the wood is to be floated or manufactured before removal.

11. Sale by tender, public or private, is the mode most applicable under various circumstances for profitably disposing of home-grown timber.

12. Sale by public auction in small lots is the most profitable mode of disposing of mixed timber suitable for country purposes, or within easy reach of manufacturing centres.

13. At sales by public auction the lots should be arranged and classed to suit the purchasers.

14. Sale by private bargain, save in exceptional and special circumstances, such as those indicated, is not adapted for the profitable disposal of home-grown timber.

15. Timber can seldom be profitably manufactured for sale by the producer, except where great natural facilities exist.

16. The mode of payment should be such as to encourage the

capitalist, and give reasonable accommodation to the purchaser, and if possible prevent speculation.

17. The conditions of sale should be distinct and simple, containing no vague expressions which can be misunderstood by either party; and however small the sale, or by whatever mode it may be effected, the whole business should be done in a legal and formal manner.

XVI. *On the different Modes of disposing of the Produce of Woods and Plantations.* By ANDREW PEEBLES, Highclere Castle, Hampshire.

Great diversity of opinion exists amongst arboriculturists in regard to the best means of disposing of the produce of woods and plantations. This is apparent, if we observe the sales of timber advertised in the various county papers. There we see timber to be sold by the cubic foot, by the load, by the lineal yard, by the number of sleepers and pit-props, by the tree or hundred trees, by the lot, by the ton, by the acre, &c. In one district the timber is cut and arranged in convenient lots adjacent to good roads, while in the adjoining county the whole of the produce is sold standing. There are public sales, private sales, and sales by tender, all more or less practised by experienced foresters in different localities. If we inquire into the cause of this great diversity of procedure, we find it dependent on local circumstances; and yet how often is it attributed to apathy, or inexperience on the part of the forester. Many of our practical men are accused of having no fixed principles in regard to this branch of forestry, simply because they find it expedient to deviate from the old beaten track, and adopt various modes of selling the produce of the plantations under their charge. I give a *resumé* of my own experience of the different modes of selling home-grown timber and underwood, and may mention that I have seen a public sale of pit-props realise less money than if they had been sold privately, simply because the purchasers were not connected with any collieries, and consequently left a large margin for intermediate profits. In the same district, I have seen oak for which the forester was offered 1s. 2d. per foot privately, sold by auction for 1s. 9d. per foot. Again, if the plantations are within easy distance of a powder factory, where a fixed price prevails for charwood, that circumstance will be taken advantage of when there is any powder wood for sale. It would serve no good purpose to sell small alder, birch, limetree, &c., otherwise than by private sale, although, on the same estate, the most profitable way to dispose of oak, ash, and other hard woods may be by public auction. I have myself sold alder in the Lothians at L.1 per ton; in Lancashire at 1s. per foot, and in Hampshire at L.22 per acre. Here we have three distinct modes of disposing of the same sort of produce, and each equally appropriate for the locality where the crop was grown. It is clear that no fixed principle is applicable to all cases, and therefore the intelligent forester wisely adapts his *modus operandi* to the various circumstances of the neighbourhood in which he is situated.

Private Sales are best adapted for disposing of any produce which, owing to local circumstance, has a fixed market value in the district. A large rake manufactory regulates the price of rake-ware, a powder-mill determines the price of charwood, and collieries control the price of pit-props, sleepers, or any timber required for mining purposes. When local causes such as these determine the price of any plantation produce, no auction sales will realise more money than can be obtained privately; but if the competition is indifferent, the timber may sell considerably under its market value. Private sales are also adapted for small estates, where the quantity of timber sold is too limited to defray the expenses of sales by auction. If the quantity of timber to be disposed of at one cutting is under L.50, it is not advisable to incur the expense of advertising, printing, and auctioneer's fee; but if the quantity to be sold exceeds L.60, the extra money realised by public competition will more than compensate for all additional expenses. My first experience of private sales was acquired in the mining districts of the north of England. There the proprietor's work-people invariably cut the timber, and arrange it in convenient lots, where free access can be had for its removal. In arranging the lots for sale, the various sorts of timber are kept separate from each other—ash from oak, oak from beech, large timber from timber suitable for sleepers, sleepers from pit-props, pit-props from piles and rails, and piles and rails from firewood. Firewood is sold by the lot, piles and rails by the score, pit-props by the lineal yard, sleepers by the pair, poles and small thinnings by the tree or hundred trees, and large timber by the foot cube. It is considered of importance to arrange the lots neatly and systematically, and to pile one tree above another in such a manner that only the best of the timber will be exposed to the purchaser's view. This is effected by placing the blemished trees in the centre of the lots, and covering them with timber of a superior quality. The intention, obviously, is to induce the purchaser to pay a price beyond the real value of the timber, and, consequently, the practice is fraudulent and deceptive. It is much better to complete the lots with timber of the same quality, and instead of piling one tree on another, have them spread out so that all can be seen and measured with facility. This avoids misunderstanding between the purchaser and vendor, and in almost every case the timber will realise more money than if valuable trees are used to decorate trees of inferior quality. It is often asserted that the good timber aids the disposal of the bad, but this is a fallacy I need hardly refute. Every practical forester is aware that timber will realise more money when arranged according to size and quality, than if clean grown trees are mixed with rough blemished timber. Having arranged the lots adjacent to good roads, the next thing to be done is to have them numbered and measured. In regard to measuring timber, I may remark that the system generally adopted is often fallacious. If a tree tapers gradually it is considered sufficient to girth it in the centre, but the true contents cannot be ascertained with less than three girths. In order to measure correctly with a centre girth, the tree ought to be cut in two where the small end is half the circumference of the butt end. This, however, entails extra labour, and depreciates the value of the timber, and consequently the trees are invariably kept their full length. A forester who measures with one girth will often increase the contents of his trees by allowing the purchaser eight or ten feet off the small end. The more a tree tapers beyond half the circumference of the butt, the more will the vendor loose by measuring with a centre girth. One girth is invariably in favour of the buyer, who *naturally* adheres as much as possible to that system of measuring. If he pretends not to understand any other system, the best plan is to measure the timber in two or three lengths, which is the most correct way. The other day I measured a larch tree which tapered gradually, with a centre girth, and at 20 feet long the tree contained $1\frac{1}{2}$ foot more than when measured to its full length of 30 feet. I measured the same tree with three girths, and the contents were increased 4 feet. I then measured it in two lengths of 15 feet each, and this gave me 1 foot more than with three girths, and 5 feet more than with one girth. These hints are sufficient to show the necessity of measuring carefully when selling timber at so much per foot.

In selling timber privately it is difficult to meet with a purchaser who will give full value for the whole of the lots. He will regulate his price by the local demand for the sort of timber offered for sale. In one district a certain description of produce may be comparatively worthless, while in another it is the most profitable crop that can be grown. If there is no demand for any certain class of timber, it is a wise provision to make inquiries in regard to a profitable market previous to cutting the crop. When this is not attended to, the vendor must necessarily sell at a sacrifice to a purchaser who probably knows not how to dispose of the produce he is buying. He may have a good market for pit-props, or railway sleepers, and no demand for hard-wood; or he may be able to dispose freely of all sorts of hard-woods, and yet have no market for railway sleepers or pit-props. It matters not whether the produce is hard-wood, fir, pit-props, rake-ware, or hop-poles, if the purchaser has not a ready market he will either decline to buy, or will do so at a price which will allow a large margin for contingencies. This is one of the greatest obstacles in disposing of timber by private sale. But another objection often urged against private sales is the difficulty of inducing purchasers to give full value for any of the lots. This is owing to the want of competition, and may be provided against, in a great measure, by offering the timber to several purchasers, and accepting the highest offer. That this, however, has not always the desired effect is evident from the following facts:—I once had a quantity of mixed hard-wood for sale, which I arranged in convenient lots, and offered to Mr B. at a price varying according to the quality and description of the timber. He would not purchase unless I reduced the upset price twenty per cent. This I would not consent to do, so the matter ended without effecting a sale. A few days afterwards I offered it to Mr C., but this time the reduction claimed had increased to thirty per cent. I afterwards advertised the lot to be sold by auction, and realised five per cent. more than the price originally fixed. It subsequently transpired that Mr B. had arranged with Mr C. to offer less than he had done, on the understanding that they should share alike in the purchase. These facts show the necessity for discretion in treating with timber merchants, but must not be understood to imply that the system of taking offers from several purchasers serves no good purpose. When a forester has a quantity of mixed timber to sell, he will often realise more money by receiving offers, than by confining himself to one purchaser.

Sales by Tender.—It may seem at first sight that the same object is gained by offering the timber to several purchasers, as by receiving tenders. In practice, however, the two systems differ materially. Sales by tender are generally conducted in the following manner:—The vendor sends circulars containing particulars of the number of trees to be sold, accompanied by the conditions of sale, to as wide a circle of timber merchants as possible. The circular requests them to send in their offers by a certain date, and to tender for the whole, whether it consists of one class of timber, or a mixed lot of various sorts. If the lot contains only one class of timber, the purchaser will probably be able to give a fair price for the whole; but if several sorts are sold together, he may have to offer for timber of little value to him. A better plan is this :—The timber is arranged and classified as for private sales, and catalogues prepared, containing the number of lots and conditions of sale. These are sent to the timber merchants, who offer for each lot separately, or only for such lots as they really require. This they do by marking the sum they are prepared to give opposite the different lots in the catalogue. The catalogues are returned under seal by a certain date, and the highest offers are accepted for the lots separately, without regard to the aggregate of the whole. Thus a purchaser whose offer is highest for oak may be lowest for beech, and one whose offer is highest for beech may be lowest for larch, and so on through all the lots. This system has many advantages over private sales, or the plan generally adopted of selling timber by sealed tender. Theoretically considered, the same object may be attained by accepting offers from several purchasers for each lot separately, and selling in the same manner as if the offers were sent in under seal. Practically, however, the result will be unsatisfactory; and this is accounted for by each purchaser being under the impression that there is no competition, and, consequently, will offer the lowest price which he thinks is likely to be accepted.

Auction Sales are best adapted for all estates where the quantity of timber or other produce to be disposed of is sufficiently large to defray the necessary expenses. It matters not whether the timber is sold standing, or prepared for sale by the proprietor's workpeople—the result, so far as selling the timber is concerned, will be the same. I may remark, however, that I once attended an auction sale of felled timber, which realised considerably less than the timber might have been sold for privately. The number of purchasers did not exceed eight or nine, and before the sale began they arranged which lot each would offer for, and consequently avoided competition. The same thing also occurred at Highclere with a sale of growing timber, which I conducted there. After dinner the whole of the purchasers left the table, and were observed in the stableyard in earnest conversation. I perfectly understood what the result would be, and arranged with the auctioneer accordingly. The first two lots were bought in at L.15 under my valuation, and in each case the auctioneer gave his clerk a fictitious name. This so completely disconcerted the stableyard arrangements, that the purchasers began to offer for each other's lots, and we had an excellent sale. At the close of the sale the first and second lots were again put up, and sold for L.13 more than was previously offered.

My first experience of auction sales was acquired at Arniston, near Edinburgh. There the work was performed by the proprietor's workpeople, and all the timber, except oak, was cut and arranged in convenient lots during winter. The oak was cut in spring, as soon as it could be stripped of its bark, and the sale generally took place soon after stripping was completed. In arranging the lots for sale we were particular to separate the varieties of timber, and to classify each according to its quality. It was not considered sufficient to keep oak separate from ash, and ash from beech; but we kept small trees separate from large ones, and rough timber of little value from what was clean grown and valuable. This was considered essential to enable parties attending the sale to purchase the class of timber they required, without being compelled to include timber which might be comparatively worthless to them. A country carpenter, who required a lot of small ash for agricultural implement handles, might have no use for ash of large dimensions; a wheel-wright, who required oak, might have no use for beech; and a cabinet-maker, who was ready to buy birch, sycamore, or wild-cherry, might not feel disposed to speculate in larch. It is scarcely necessary to describe the manner of lotting the timber, numbering the lots, conducting the sale, &c. These things are well understood by every forester; and neither need I advert to advertising, as it is customary that all auction sales should have at least two or three insertions in the best county newspapers. In addition, the forester should forward catalogues to as many timber merchants as possible. I have always found that a liberal distribution of catalogues secured a larger attendance of buyers than any other system of advertising. When this is neglected, the vendor will seldom realise the full value of the timber he has for sale.

Many people maintain that auction sales never realise more money than sales by tender, and occasionally less. In support of this view, they argue that if purchasers send in sealed tenders of the full amount they can afford to give for each lot of timber, no competition will induce them to go beyond these figures. If, on the contrary, competition is languid, they are not unlikely to purchase the lots under what they consider their fair market value, and what they would naturally have offered for them by tender. From these apparently logical deductions, we might infer that sales by tender had many advantages over auction sales; but, in practice, I have invariably found the reverse to be the case. Let us suppose that A. B. and C. attend an auction. They have each contracts on hand for which the timber advertised for sale is admirably adapted. Previous to the day of sale, they go round the lots, and measure and value them very carefully. We will further suppose that lot 3 consists of thirty fine large oaks, which A. and B. respectively require for a special purpose. When the lot is put in, these gentlemen refer to their sale-books, and find it valued at L.80. The "bidding" is general until it reaches L.75, after which it is continued exclusively by A. and B. Eventually the hammer falls to B.'s "bidding" at L.15 over his valuation, and A. remarks, "You have paid very dear for that lot, sir." The next lot again goes beyond its value, and this time B. continues the "bidding," to retaliate on A. for making him pay so dear for the previous lot. In this manner several lots are disposed of, which C. required to complete a contract in hand, and he is now prepared to exceed his own valuation, rather than lose any of the remaining lots which are suited for his purpose. In this way the competition becomes lively, and a purchaser, disappointed in several of the first lots, usually makes an effort to secure some of the remaining lots. This is no imaginary picture, but what often occurs at sales, and it is this competition and rivalry amongst purchasers which constitutes one of the principal advantages of auction sales over private sales, or sales by tender.

Underwood Sales.—In the southern counties of England, underwood constitutes a very important crop. It consists principally of oak, Spanish chestnut, ash, birch, and hazel, and is sold periodically at 11, 12, and 13 years of age respectively. In fertile plantations, comparatively sheltered, the underwood is as large at 11 years old as it is in the upland districts at 13 years, and hence the age of the underwood varies accordingly. It is worthy of remark, however, that the underwood which has been grown in the upland plantations is worth considerably more than what has been grown in sheltered localities. The value of the crop, however, is controlled in a great measure by the condition of the plantation in regard to timber trees. If the plantation is overcrowded with trees, the underwood will be comparatively worthless; if it is fairly thinned, the underwood may be worth L.4 per acre; and if thinned severely, it may realise from L.8 to 10 per acre at 11 years old. In the upland districts, where it is considered superior for making crates, sheep-cages, hurdles, and hurdle-stakes, it sells readily at L.11 per acre at 13 years' growth.

In calculating the value of this crop, the periodical thinnings, as well as the continual increase in value of the permanent crop, must be added to the sum received for underwood. I find by taking a period of 60 years, and adding the whole receipts, the two crops combined will realise about L.2 per acre for the land after deducting expenses. In fertile districts the receipts are more, but seldom less, even in an exposed situation and thin gravelly soil resting on chalk.

Underwood is divided into convenient lots, and invariably sold growing, either by auction or private sale. If the shoots are distributed regularly over the ground, the crop is sold by the acre; but if the underwood is patchy, with large vacant spaces, it is generally sold at so much per lot. The reason for selling by the lot in such cases is to avoid the inconvenience of measuring and deducting the vacant spaces, which it would be unfair to include when computing the area. The rule in this neighbourhood is to have the lots accurately measured, and the contents entered in the catalogues previous to the day of sale. This must be done with great care, as it is difficult to get straight lines where they are required in a full crop of underwood. In some districts it is sold at so much per acre, without stating the quantity; and when this is the case, the ground is measured after the crop is cleared. The advantages of this system are, that the ground can be measured with less trouble and more correctly; and the disadvantages, that the purchaser cannot ascertain the quantity of underwood he is buying, and the auctioneer has no data for demanding the usual deposit. On the whole, it is best to measure the underwood previous to sale, and when this is carefully done, errors seldom occur.

Another description of woodland prevalent in the south of England is termed "Gullies." Large tracts of low-lying marsh lands are planted with alder, willow, poplar, and ash, and when judiciously managed are highly remunerative. A good "gully" will pay a rent of upwards of L.2 per acre after deducting expenses, and that too for land almost worthless for agricultural purposes. Occasionally wet plantations are thinned severely and converted into "gullies;" but gullies, par excellence, have no timber in them to exclude the light and injure the valuable undergrowth. The produce is divided into lots, and sold in the same manner as coppice underwood. If the gully is free from timber and stagnant water, the usual price is from L.21 to L.22 per acre for nine years' growth. As the underwood is sold growing, and must be cut and cleared by the purchaser, the expenses to be deducted are merely nominal. It is often maintained that the proprietor's own workpeople ought to cut and convert the whole of the underwood before it is sold. This would be something like converting timber for sale, and would have to be done very judiciously to be remunerative. It is well known that proprietors who convert their own timber seldom realise so much money, after deducting expenses, as those who sell it unconverted. The reasons assigned are many and various, but I think the principal cause is that the forester has neither time nor experience to compete with those who devote their whole energies to this branch of business. A saw-mill is a great acquisition, and very desirable on every estate; but it ought only to be used to convert timber for estate purposes, or for the benefit of tenants, who are often allowed rough timber for their repairs. Theoretically considered, a proprietor who converts his own timber and sells it afterwards, ought to secure all the intermediate profits; but in practice, his profits vanish, and the whole thing works unsatisfactorily. The same thing would occur were proprietors to attempt to convert their underwood. Hurdle-stakes would be made into fagots, hurdle-rods into "withs," rake-ware into hoops, and hop-poles into sheep-cages. Those who buy our underwood are hard-working men, whose lives of experience enable them to convert expeditiously, applying each piece of wood to the purpose for which it is best adapted. If a staff of inexperienced workmen were to convert a piece of underwood, it would probably be of less value after they had finished than before they began. The more valuable the underwood, the less chance there would be of its being converted judiciously, and for these reasons I recommend underwood to be sold growing in the manner described. Every description of underwood is sold as soon after the fall of the leaf as circumstances will permit. The following "conditions of sale" are printed and distributed with the catalogues:—

Reservations and Conditions of Sale.

1. The highest bidder to be the purchaser; and if any dispute arise, the lot in dispute shall be put up again and resold.

2. No person shall advance less at each bidding than 2s. 6d. per statute acre.

3. The purchasers to take their respective lots with all faults, and at the close of the sale pay to the auctioneer a deposit of 20 per cent. upon and in part payment of the purchase-money; the remainder of the purchase-money to be paid on the 29th September 1874, or

security must be given to the satisfaction of the vendor, for such payment before any part of the underwood will be allowed to be cut or carried away.

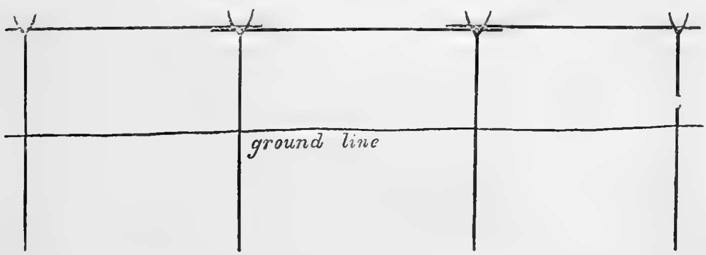
4. The underwood shall be cut in a workman-like manner, the stems not to be cut lower than is usual for future growth, nor to be split or broken off. All samplers or timber-like trees which are marked, shall be carefully preserved; and if any be cut or injured, or any other damage be committed by the purchaser of the lot, his workmen, or customers, such purchaser shall pay treble in value for each sampler or timber-like tree cut or injured, and shall also pay full compensation for any damage done.

5. The whole of the underwood shall be cut before the 25th day of March next; and the underwood cut to be cleared off by the 10th day of April next. Any wood which may remain on the ground after the day above named shall be forfeited to the vendor.

6. The purchaser is to make use only of the usual roads, and to make good all damage done or committed in cutting or taking the wood away; and no dogs to be taken into the woods either by the purchasers or their workmen; and where the boundaries are *required*, the purchaser must make the hedge in a workman-like manner.

7. If the purchaser neglect or fail to comply with these conditions, the deposit-money shall be forfeited to the vendor, who shall be at liberty to resell by public or private sale the lot or lots bought by such purchaser; and any deficiency, and all expenses which may be caused by such resale, shall be made good by the purchaser in default or his sureties.

Sales of Growing Timber.—I will now consider the system of selling growing timber by auction as practised on many estates in the south of England. Growing timber is generally sold in the months of January and February; but if the sale consists exclusively of oak, it may be deferred until March or even April. Ash, firs, and all sorts of timber except oak, are sold as early in the winter as possible, to afford the purchasers sufficient time to cut their trees before the sap begins to circulate in spring. With oak the case is different, as oak bark, though much cheaper now than formerly, is still a consideration with timber merchants, who leave their oak until the middle of April, when stripping begins. In regard to stripping, I may mention that it is done more economically and efficiently in the south than in many parts of Scotland. The whole process is briefly this:—At the proper time to begin (which is ascertained by a perceptible enlargement of the oak buds), the woodmen commence operations by testing the state of each tree with the stripping iron. If the bark moves easily, the tree is cut; but if not, it is left, and earlier trees selected first. This is a much better way than felling every tree indiscriminately, whether it will strip freely or not, leaving a party of women and boys to hammer the bark off as best they can. When a tree is felled, the trunk and head are stripped as expeditiously as possible, and no lopping of branches is performed except such as cannot be conveniently reached by the strippers. The whole of the work is performed by men, who engage to cut the timber, strip and dry the bark, and tie it in bundles ready to load, at 28s. per ton. Instead of erecting bark ranges, capable of supporting a thick layer of bark, they merely select a number of straight pieces of stripped oak which are supported in forked stakes, about 2 feet high. These straight pieces of oak are arranged in one continuous horizontal line, and the bark is erected on either side of them in the form of the letter A. This secures a continuous and effectual current of air from end to end, which thoroughly dries the bark in eight or ten days if the weather is favourable. In wet weather the bark must be reversed occasionally; but even if the weather is unfavourable, it is never damaged so much as when deposited in a thick layer on the top of a bark-range. Being placed on end, the water passes quickly off it without washing out any of the tannin, and when the weather clears up, it is soon dry and ready to send to the tanyard. The following represents the bark-range referred to, which is the only form of range used in this neighbourhood:—



When the timber to be sold consists of various sorts of hard-wood, including oak, it is best to sell the whole together as early in the winter as possible. Occasionally it is considered expedient to sell the mixed hard-woods in November, and the oaks early in the following spring. I cannot see, however, that much advantage is gained by this system, as the same object may be attained by selling the whole together, and allowing the purchaser to leave the oak lots until spring. Our practice here is to thin the woods where the underwood has been previously sold; and we always begin to prepare for timber sales as soon as sufficient underwood has been cleared to enable us to proceed with marking the trees. This is done by myself and two assistants in the following manner:—I first mark the trees with a racing-iron, and one assistant follows with a bill-hook with which he shaves off part of the bark, in readiness for the second assistant, who numbers the trees with white paint. When there are more than one lot in the same plantation, we distinguish them by means of capital letters. For instance, we begin by marking the letter A on several of the first trees in the first lot, and then proceed to number from 1 to 50, or any other number fixed upon for lot 1. Towards the end of the lot a few more trees are marked with the letter A, to indicate where A finishes and B begins. Lot 2 is numbered on the opposite side of the trees, and several of the first and last trees of the lot are marked B—the numbers again running from 1 to any number fixed upon. Lot 3 is marked C on the same side of the trees as lot 1, and lot 4 is marked D on the same side of the tree as lot 2, and so on with all the lots to the end of the plantation. Sometimes the timber varies considerably in size and quality, and when such is the case, it is necessary to have one or more lots of small inferior timber in each place. As these lots run through all the other lots of good timber, the distinguishing letter ought to be marked on every tree, so as to avoid confusion when the trees are being cut. We distinguish the lots in the catalogues in the following manner:—

Lot.	Great Penwood.	Marked.	Numbered.
1.	Fifty fine oaks, . . .	A,	1 to 50
2.	Sixty navy oaks, . . .	B,	1 ,, 60
3.	Ninety small oaks, . . .	C,	1 ,, 90

Another system of marking often adopted in the south is to carry on consecutive numbers to the end of each plantation. Thus, lot 1 would be numbered 1 to 50; lot 2, numbered on the opposite side of the tree, would begin with 51 and end with 110, and so on through all the lots. The system of distinguishing the lots by figures instead of letters is not understood in the south, and is seldom adopted. It is, however, a convenient method of marking trees, especially if there are many lots in one plantation. It is done thus—Lot 1 is numbered $\frac{1}{1}$, $\frac{2}{1}$, $\frac{3}{1}$, and so on up to $\frac{60}{1}$. Lot 2 is numbered $\frac{1}{2}$, $\frac{2}{2}$, $\frac{3}{2}$, and so on up to $\frac{60}{2}$; and lot 3 is numbered $\frac{1}{3}$, $\frac{2}{3}$, $\frac{3}{3}$, and so on to the end of the third lot. In each case the upper figure represents the number of trees, and the lower figure the number of the lot in the catalogue.

Having marked all the trees by one of the preceding systems, the next thing is to advertise the sale, and get the catalogue printed and widely circulated. Previous to the day of sale I measure and value the whole of the lots, inserting particulars in a sale book kept for the purpose. The sale book is divided into columns, with the following headings:—1st, Date of sale; 2d, No. of lot; 3d, Name of plantation; 4th, No. of trees; 5th, Description of timber; 6th, No. of loads; 7th, Average measure per tree; 8th, Rate per load; 9th, Forester's valuation; 10th, Price realised at sale; 11th, Remarks; and, 12th, Purchasers' name and address. The first nine of these columns are filled in previous to the day of sale. Of course the three last can only be filled in after the timber is sold. A book of this description is absolutely necessary in order to see that the timber sells at its full value, and it is also an excellent reference book in after years.

To those unaccustomed to measure growing timber, it will appear a laborious undertaking to measure and value two or three thousand growing trees. It is not so difficult, however, as many people imagine, and an expert hand will easily measure from 800 to 1000 trees in a day. We keep a staff of six or eight labourers to show the lots and assist in measuring the timber, and a few days before the sale the whole of them are employed with different parties. Each timber merchant requires two assistants; one carries a long pole marked in feet, and the other a leather strap which indicates the side of the square. In going to work, the man with the pole declares the height of the tree in feet; the man with the strap the side of the square in inches; and the timber merchant refers to his sliding rule for the contents. The measurer has to allow an inch and sometimes more, for the taper of the tree from where the girth is taken, to the centre of the portion he is measuring. Of course this is measuring with a centre girth, but an experienced measurer never goes higher than half the circumference of the butt, and adds the number of feet he considers the tree contains above that point. All these things are puzzling to a beginner, but it is astonishing how accurate an old practitioner's work is. Some people contend that it is impossible to give an approximation of the contents of growing timber by means of a pole and strap. They argue that an experienced judgment and practised eye are more to be depended upon than a deceptive pole and strap. If those using the pole and strap were to discard the eye and judgment, there might be some force in this reasoning, but as they do not, the whole argument falls to the ground. I speak from experience when I assert that there is seldom a difference of 5 per cent. in the measurements of the various purchasers, and when the lots are afterwards tested most of them are actually within 5 per cent. of the truth. In my opinion no amount of experience will qualify a forester to calculate the contents of growing timber as accurately when trusting to the eye alone as when assisted by a pole and strap. I admit that there is a great waste of time in the most expeditious way of measuring growing timber, but if the trees are sold growing they must be valued in some way, and no better plan seems hitherto to have been adopted than that practised in the south. If a sufficient staff of men are employed on the estate, I would strongly recommend the timber to be cut and prepared for sale by the proprietor's own workpeople. This obviates the necessity for measuring growing timber, which can be done more expeditiously and correctly after the trees are felled. On many large estates, however, this is not practicable, as the quantity of timber annually sold is out of proportion to the number of woodmen employed. When such is the case, the usual way of getting over the difficulty is to sell the timber growing, under such conditions and reservations as will protect the vendor against wilful damage, and ensure the timber being cut and cleared away within a specified time. The following are our conditions of sale for disposing of growing timber :—

Conditions of Sale.

1. The timber to be sold by the lot, the highest bidder to be the purchaser; and if any dispute arise between two or more bidders, the lot in dispute to be put up again and resold.

2. No less a sum than 10s. shall be advanced at each bidding under L.20, and 20s. above that sum at each bidding, nor shall any bidding be retracted.

3. The purchaser of each lot shall, immediately after the sale, sign a contract, and pay into the hands of the auctioneer a deposit of 20 per cent. on the amount of the purchase money, giving sufficient and approved security within ten days from the day of sale, for the payment of a moiety of the remainder on the 29th day of

September next, and the other moiety on the 26th day of December following; and if the amount, or respective amounts, shall not be paid on the said days, or either of them, or if the purchaser or his surety shall fail, and any timber shall remain on the estate, the vendor shall be at liberty to prevent the removal thereof without discharging the purchaser or his surety from liability on such security till the amount be paid.

4. That the timber shall be carried away at the purchaser's expense on or before the 1st day of October next, and that he and the persons to be employed by him shall not grub nor take away any of the stools or roots, nor do any wilful damage to the crops or lands where the timber is now standing, nor to the timber which may remain on the premises, nor dig any saw-pit upon any part of the said land and premises.

5. That the purchaser shall have liberty for his workmen, horses, and carriages to pass and repass by all usual and proper ways for removing the timber, from the time of his giving the aforesaid security to the said 1st day of October next, but no part thereof shall be felled or removed before such security be given.

6. The lots to be fagotted within one month from the felling of each tree, otherwise to be forfeited to the vendor. No dogs to be taken into the woods, either by the purchasers or their workmen.

Lastly, If the purchaser or purchasers shall refuse or neglect to comply with the foregoing conditions, the deposit money shall be forfeited, and the vendor shall be at liberty to resell the lot or lots bought by such purchaser, either by public or private sale, and if any deficiency shall happen by such resale, the same shall be made good by the purchaser or defaulter.

These are our conditions, and before closing this paper I will state a few of the disadvantages of selling growing timber. If the purchaser resides at a distance from the place of sale, he is put to considerable inconvenience in getting woodmen to cut the timber. He has also to arrange with some one to cart the bark, and must make several visits to the plantations while his men are stripping oak and drying it. All this leads to expense and loss of time, and, in my opinion, the whole thing could be more satisfactorily done by the forester on the estate. If a sufficient number of woodmen are not permanently employed on the estate, he could engage men temporarily to cut the oak and cure the bark by piece-work, and on the same terms as agreed upon by the wood merchants. The forester on the spot would be able to superintend the whole of the woodmen, and see that no damage was carelessly or wilfully committed. When woodmen are employed by timber merchants, they require to be as diligently supervised by the forester as if he employed them himself, and he labours under the disadvantage of not having them so thoroughly under control as if he were their paymaster. A staff of negligent or inefficient workmen may soon do much damage to the permanent crop, and when they are not engaged by the forester, it has a tendency to make them more careless than they otherwise would be. I have heard of careless woodmen cutting down every tree they injured, in order to obliterate all traces of the damage they had committed. If damaged trees are dealt with in this summary manner, it would clearly be to the timber merchant's advantage to employ as careless a staff of workmen as he could find. I have also heard of unprincipled purchasers cutting large numbers of trees which were not marked, and sometimes actually agreeing with their workmen to pay so much per tree for all *extras* cut. When *extras* are being cut, the clearing of the timber goes on as the work proceeds. This is done with the view of preventing the forester detecting the fraud by counting the number of felled trees, which would be in excess of the number stated in the catalogues. Another way of detecting the fraud would be to count the number of stools, but the stolen trees are always cut very low, and the stools covered with leaves and rubbish. These precautions may deceive an inexperienced forester, but a practical man can tell by the state of the permanent crop if more trees than necessary have been cut in the usual course of thinning. I must say, however, that I have never had to deal with cases of this sort, and I believe very few timber merchants would connive at anything so dishonourable. The timber merchants that I have come in contact with are highly respectable gentlemen, incapable of taking a single tree that was not justly their own. But apart from the question of honesty, I advocate the timber being cut and arranged in lots previous to sale, as alike advantageous to buyer and seller, and more satisfactory in every way than the present system of selling growing timber.

XVII. *The different Ages at which various Timber Trees may be most profitably felled in different soils and situations.* By Lewis Bayne, Forester, Kinmel Park, North Wales.

Timber trees are planted with the view of profits being derived, either directly from the sale of the timber, or indirectly by giving shelter to stock and crops, and increasing the value of an estate by adding to its amenity. But in this short paper I shall confine my remarks to trees yielding profit from the sale of their timber, as trees grown for shelter or ornament, or partly for both, are generally allowed to grow beyond maturity before being filled.

At the outset it may be observed, that much depends on management whether the planting of trees will turn out a profitable or a losing investment; and whatever may be the kind of trees, or the soil in which they grow, their general management in judicious pruning and thinning on the one hand, or total or partial neglect on the other, will have much to do with the age at which they can be most profitably cut down. When trees neglected in their youth are drawn up, and branchless except within a few feet of the top, in consequence of over-crowding and want of judicious thinning, they become prematurely ripe before reaching half the normal age and size. In such cases, the most profitable system would be to fell the whole at once and replant the land, as after trees pass a certain stage thinning is of little avail, and a loss and waste of time results from any attempt to improve them by changing the management. But even with careful treatment and thinning from the first, the results are different as regards the age at which trees should be felled, the quantity and quality of the timber, and the revenue to be derived by the proprietor therefrom.

Thus, it occasionally happens that trees in the same plantation, and in the same soil, do not arrive at maturity simultaneously—one tree becoming mature, it may be, when eighty years planted, while another close by may not reach the same stage before one hundred years; but such is the exception and not the rule, as in well managed plantations trees in the same kind of soil generally attain maturity about the same time, although they may vary much in size.

It is stated by some that Scots fir, larch, and spruce can be most profitably cut at from twenty to thirty years of age, when growing in a locality where they can be disposed of for mining purposes;

but I have not found this to be the case in my experience in the management of plantations within fifteen miles of large coal mines. In such a locality, when the price of prop-wood is high, it will almost invariably be found that proportionally high prices will be obtained for larger timber. While, if the plantations be far from a market, or a railway station or seaport, the crop at that age would not be worth the planting, cutting, and removing, and would therefore be a dead loss to the grower of from twenty to thirty years' rent of the land. Further, it would not pay to cut down trees of the above description for fencing and estate purposes, because these can easily be supplied from the thinnings of well managed plantations.

It has already been remarked that, as a rule, timber trees should be allowed to grow to large dimensions before being cut; but the situation in which they grow often necessitates a different course. For instance, in glens and mountainous districts, and in places inaccessible to horses, the most profitable management would be to cut them down before they arrive at a size too large to be removed in entire lengths by manual labour. At that early stage fir trees would be valuable for prop-wood, fencing, and other estate purposes; ash for handle-wood, and birch or alder for charcoal or bobbin-wood, &c.; whereas, if allowed to grow to a large size, they would have to be cross-cut in lengths to admit of their removal by men, and this would, in the first place, make the timber useless for many purposes for which it might otherwise have been valuable; and secondly, the expense of removal by manual labour might equal, or even exceed, the value of the timber itself. When Scots fir, larch, or spruce have been planted as nurses for hard-wood trees, they should be thinned out as soon as they begin to encroach on the trees intended for the main crop, as this is necessary for the welfare of the plantation, irrespective of the value of the thinnings. But when such trees are planted as the future crop, on suitable ground, it will almost always be found most profitable to allow them to attain timber size.

The larch being of fast growth, and useful for various purposes at an early age, can be cut down profitably much sooner than the Scots fir.

Oak is extensively used for ship and boat building purposes, furniture, agricultural implements, &c., and is longer than any of our forest trees in arriving at maturity. It can never be cut down so profitably when small, as when well matured and having plenty of heart-wood. When young and with little heart-wood, and a large proportion of sapwood, the timber is of comparatively little value per cubic foot, so that it can seldom be cut down profitably, especially if thriving on soil suitable to its growth, until it reaches one hundred years old. Of course, when grown as copse-wood, it ought to be cut young; but even under the most favourable circumstances in Scotland copse-wood is less profitable to the proprietor than a crop of timber, and larch can be grown more profitably in most situations. The oak is of slow growth when young, but on suitable ground it increases rapidly after about thirty years. It sometimes happens that oak, planted in good soil and in a sheltered position, attains a large size, but has little matured heart-wood at sixty or seventy years old, and in such a case it would be better to allow it to remain till fully matured, when the value of the timber per cubic foot would be materially enhanced.

The ash, although capable of growing to large dimensions, can be cut down more profitably in its young state than other hard-wood trees. When clean grown, and from thirty to forty years of age, it is in great demand for handle-wood, and for agricultural implements; but in a rich loam, with dry subsoil, it would be more profitable to allow it to grow to double that age.

The alder is generally in good demand at all stages of its growth, after arriving at sizes suitable for the clogger, and for turnery, or charcoal, and is seldom grown to very large dimensions. Thriving best in damp soil, it can be profitably cut down at forty years' growth, making way for a second crop, which springs up rapidly from the stools.

The beech is of little value in its young state, and is seldom cut till well grown.

Birch, like the alder, can be cut down profitably at about forty years old, being then in good demand for cloggers, charring, and turnery purposes; and, when of large size and good quality, it is extensively used for furniture.

Horse chestnut is seldom planted for profit, but is valuable as an ornamental park tree. When grown on good soil and in a sheltered situation, however, it can be profitably cut down when it attains large dimensions.

Spanish chestnut is of most value when of large size, and is in many cases used for the same purposes as oak. It is most profitably cut down when about one hundred years old.

Elms (Scotch and English), are of little value until they have arrived at timber size, and should therefore never be cut as a crop until they are from eighty to one hundred years old. When on good soil, the English elm will, when matured, be of large dimensions. The Scotch elm seldom attains so large a size as the English elm, but its timber is of more value when matured, and forms heart-wood sooner.

The lime tree, like the horse chestnut, is seldom planted for profit; but when of large size is in great demand for brake blocks for railway purposes, &c. It is, however, of little value before it is sixty years old.

Poplars can generally be most profitably sold when about fifty years old. Being very fast growers, they arrive at timber size sooner than most of our timber trees, and the wood is then much used for brake blocks, boarding, &c. When of small dimensions, the wood of this tree is of little value.

Sycamore and Norway maple, although in demand for turnery purposes when of small size, can seldom be cut down to full profit, until they have arrived at maturity, and attained large dimensions, when high prices are obtained for them for printing blocks, &c., and larger timber becomes proportionally more valuable. When the sycamore is planted in a good soil, well drained and sheltered, it may be profitably cut down at about one hundred years old.

The willow, like the poplar, is a fast grower on suitable soil, and can be cut down profitably about sixty years old, and for its timber there is a good demand.

Gean tree or wild cherry, holly, and laburnum are more grown for ornament than for profit, though, in some instances, good prices can be obtained for their timber. The two latter seldom attain a large size, and may be felled any time when in demand, after attaining a size suitable for turnery. In consequence of its hardness and susceptibility to receive a fine polish, the wood of these trees is much sought after.

The walnut, when matured, is much esteemed for furniture, &c.; but is of little value in its young state, and is generally planted for its fruit or as an ornamental tree.

The annexed table shows the different ages at which, in accordance with my experience, timber trees growing in different soils and situations can be most profitably felled.

[Table

TABLE—*Showing the different Ages at which Timber Trees can be profitably Felled.*

NAMES.	Clay Soil or Heavy Loam.	Strong Loam and Gravel Subsoil.	Light Loam resting on Gravelly Subsoil.	Light Loam resting on Sandy Clay Subsoil.	Strong Sandy Loam and dry bottom.	Light Loam and moist Subsoil.	Poor thin Sandy Soil and dry bottom.	Dry Sandy Loam and dry bottom.	Rich Alluvial Loam and dampish Subsoil.	Dampish Clay or Loam along the margin of rivers, &c.	Stony Loam and dampish Subsoil.	Gravelly Loam or Slate on Granite formation.	Gravelly Loam on Limestone formation.	Loam resting on Gravel and Slate formation on sloping ground.	REMARKS.
	Sheltered.	Exposed.	Moderately sheltered.	Moderately sheltered.	Sheltered.	Sheltered.	Exposed.	Exposed.	Sheltered.	Moderately sheltered.	Moderately sheltered.	Moderately sheltered.	Exposed.	Sheltered.	
Ash, . . .	60	90	70	80	80	70	...	70	80	60	70	60	60	60	Loses its toughness when old.
Alder, . .	50	50	...	...	...	40	...	...	50	40	40	...	...	...	Succeeds well in damp soils.
Beech, . .	70	80	90	80	100	80	120	100	70	70	80	90	80	90	
Birch, . .	60	60	50	60	50	60	70	60	40	40	40	50	50	60	
Chestnut, Horse	80	...	80	90	90	100	...	...	100	90	80	...	...	...	Apt to get damaged by wind.
,, Spanish	100	80	100	120	100	100	...	70	120	80	100	...	...	100	
Elm, English,	70	80	100	90	110	80	...	90	70	...	70	...	...	90	Grows to a large size in good soils.
,, Scotch,	80	80	100	100	120	90	80	100	80	...	80	...	...	100	
Lime, . .	90	80	...	80	80	100	...	...	120	90	100	...	...	80	
Oak, . . .	120	100	80	100	110	90	...	80	120	...	100	...	...	80	Requires good soil to grow well.
Pine, Scots, .	70	80	80	70	70	60	80	80	60	...	60	90	50	70	
,, Spruce,	60	50	40	50	40	60	...	...	60	50	60	40	40	50	
,, Silver,	70	60	50	60	50	60	...	...	60	50	60	50	50	60	
,, Larch,	50	70	80	60	70	50	40	50	50	...	40	70	40	90	
Poplars, . .	60	60	60	50	50	60	...	40	70	50	60	40	40	50	Fast growers in moist soil.
Sycamore, .	80	100	110	80	100	80	90	120	80	...	...	100	110	110	
Willow, . .	60	60	45	50	50	60	...	40	70	50	50	...	...	50	Thrives best in damp soil.

XVIII. *On the Natural Production or Self-Sowing of the Common Silver Fir* (Picea pectinata). By WILLIAM GILCHRIST, Forester, Cluny Castle.

In a plantation on the estate of S——, in the county of Aberdeen, my attention was arrested by detached plants and scattered groups of young silver firs. The person accompanying me, who had been connected with the plantation for upwards of forty years, assured me that there had been no plants of any description planted there since he knew the plantation. On closer examination I found seedlings ranging from two to fifteen years old, and came to the conclusion, that here was an ascertained fact which ought to be communicated to the Scottish Arboricultural Society.

The part of the plantation in which the seedling silver firs are found is said to have been formed about the end of last century, but the date cannot now be accurately ascertained. At present it appears to be from eighty to eighty-five years old. The larch forms rather more than half of the crop, the remainder being Scots fir and spruce, with a few silver firs, beech, lime, plane, and birch. No regular mode of thinning appears to have been adopted, my companion informing me that during his time nothing had been done beyond supplying the tenants with wood for fencing and fuel, except when a hurricane blew down a lot, which had to be cleared out and sold. The trees are therefore tall and much drawn, except some near the outside of the plantation, which have had more space. The larches are of fine quality (when sound), tall, clean in the boll, and the bark free from blister, but many are "royed" at the root. Six years ago a large quantity of the smallest larches were cut for fencing, and almost all were "royed" at the root; a number of the larger spars were cut during the present year, and it was ascertained that fully four-fifths were more or less affected with the disease. The spruces are also inclined to be "royed," and show signs of being at maturity. The Scots firs are quite sound, but, like the spruce, are evidently mature; their timber is good but rough, the branches being strong and coarse; the bark is also, with slight exceptions, very rough, and most of them have lost their leading tops. Some of the silver firs still have main leaders, but others have lost them, and gone off into numerous lateral shoots. The original silver firs are models of beauty and symmetry, some, notwithstanding their close confinement, being clothed with branches almost to the ground. These branches are small, and do not give the trees the rough appearance they generally have when so closely furnished with branches. The timber is quite sound, and of good quality. They also appear to be in perfect health, and will probably increase in value for some years to come; long after the spruce, larch, and Scots fir are decayed or cut down, the silver firs may remain with their progeny at all ages springing up around them. The cubic contents of the silver firs are considerably greater than that of any of the other trees. The measurements of the largest trees will demonstrate this:—(See p. 182).

These measurements present a striking contrast in favour of the silver fir, and it is even greater in reality, as the latter are not nearly so much tapered as the others. This is not owing to their having been grown under more favourable circumstances, as in one instance two silver firs, which are bracketed in the table, are growing at 24 feet apart, and most of the others have been so closely mixed up with the other varieties, that the larch and Scots fir were growing under the drip of the silvers, and even amongst their branches. These particulars are mentioned to show that the situation appears to be well adapted for the growth of the silver fir.

The soil is a light brown loam, containing a large percentage of granitic and vegetable matter, with large granite boulders cropping out on the surface. The subsoil is gravelly clay, resting upon granitic gravel, much used for blinding metal on roads, but which on exposure turns rather clayey and soft, especially after frost.

Where the silver firs are growing, the exposure is north-east by north. The ground is steep, rising at a gradient of about 1 in $2\frac{1}{2}$. The altitude, as per Ordnance Survey, ranges from 580 to 750 feet above sea-level. The general configuration of the ground is conical, steeper towards the north and east. The extreme altitude of the hill is 974 feet; the average height of the surrounding cultivated land being 740 feet from south-east to north-west by west, and 450 feet from north-west to south-east by east.

Seedling silver firs are found growing close to all the large trees, but are more numerous in some places than in others, and particularly in spaces that have been partially opened up by hurricanes. In these open spaces the seedlings are chiefly from eight to twelve years old, a few being about fifteen years. A number are from two to five years old. In fact, they are to be found at all ages from two to fifteen, but from eight to twelve and from two to five are most numerously represented. The theory that I would advance is, that the presence of these seedlings is due to the hurricanes of October 1860 and February 1868. On both these occasions many trees were

TABLE—*Showing Measurement of Largest Trees.*

		Silver Fir.							Spruce.							Scots Fir.							Larch.						
		Girth from Surface at						Height.	Girth from Surface at						Height.	Girth from Surface at						Height.	Girth from Surface at						Height.
		1 Foot.		3 Feet.		6 Feet.			1 Foot.		3 Feet.		6 Feet.			1 Foot.		3 Feet.		6 Feet.			1 Foot.		3 Feet.		6 Feet.		
		Ft.	In.	Ft.	In.	Ft.	In.	Feet.	Ft.	In.	Ft.	In.	Ft.	In.	Feet.	Ft.	In.	Ft.	In.	Ft.	In.	Feet.	Ft.	In.	Ft.	In.	Ft.	In.	Feet.
No	1.	8	2	6	10	6	6	90	5	9	4	9	4	5	78	5	11	5	4	5	0	67	5	9	4	8	4	5	75
,,	2.	7	9	6	5	6	2	85	5	7	4	8	4	6	70	5	6	4	9	4	6	70	5	5	4	5	4	0	73
,,	3.	7	7	6	4	6	0	95	5	4	4	7	4	4	65	5	5	4	10	4	8	55	5	2	4	6	4	0	75
,,	4.	7	7	6	8	6	4	87	5	3	4	6	4	4	70	5	5	4	9	4	5	50	4	11	4	1	3	8	68
,,	5.	7	5	6	4	5	10	83	5	3	4	3	4	0	67	5	5	4	11	4	7	60	4	9	4	0	3	9	75
,,	6.	9	6	8	6	4 6	9 0	95	5	2	4	5	4	0	75	5	3	4	11	4	5	53	4	8	4	1	3	9	70
,,	7.	7	3	6	2	5	10	70	5	0	4	4	3	11	73	4	9	4	2	3	11	55	4	8	3	10	3	7	74
,,	8.	6	7	5	7	5	5	64	5	0	4	1	3	10	65	4	8	4	2	3	11	50	4	8	3	10	3	4	75
,,	9.	5	10	5	0	4	10	45	4	10	3	8	3	6	68	4	8	4	1	3	9	57	4	9	4	3	3	10	70
,,	10.	6	9	5	10	5	6	92	4	8	4	1	3	11	75	4	6	4	1	4	0	54	4	7	3	10	3	7	73
,,	11.	6	2	5	5	5	2	87	4	4	3	8	3	6	60	4	5	4	3	4	0	55	4	5	4	0	3	9	65
,,	12.	5	9	4	10	4	7	85	4	4	3	6	3	4	65	4	3	3	11	3	8	63	4	4	3	9	3	4	65

uprooted; and after the trees were cut and cleared off, the roots were taken out for fuel. Portions of the surface were thus opened up, and the seeds germinated and grew readily.

Seedlings being most numerous between the ages of eight and twelve, and between two and five, would seem to confirm this theory; but apart from this, seedlings of all ages are most numerous in a partially opened space near the outside of the plantation, where roots for fuel have been periodically grubbed out. It has also been observed that larch and Scots fir seeds germinate most readily in plantations where roots have been holed, and after wind-blown trees have been cleared off. All this is only theory, and I will not pursue it further, but the fact remains that seedlings of the common silver fir are growing in K—— plantation. That fact having been ascertained, the circumstances most favourable for their further development or reproduction can be observed and noted.

Seedlings are not to be found beyond a radius of 60 yards from the old trees, and this extreme distance is invariably up the hill. Throughout the plantation within this radius of the old trees there are several silver firs from thirty-five to forty years old, about 38 feet high, and from 2 to 2½ feet in circumference at 3 feet from the ground; these may also be natural reproductions. In some parts of the plantation there are a few self-sown plants of the common spruce, as also a few larches, but the almost total absence of Scots fir seedlings is curious. Indigenous birch, rowan, raspberry, and holly grow freely from seed, and broom in some of the more open spaces, along with *Vaccinium Myrtillus* and *Calluna vulgaris*. The natural herbage in the plantation where the silver firs are growing consists principally of the following:—

Flowering plants.—*Cardamine hirsuta*, *Digitalis purpurea*,* *Galium saxatile*,* *Goodyera repens*, *Hypericum pulchrum*, *Luzula pilosa*, *Oxalis Acetosella*, *Ranunculus acris* and *repens*, *Rumex Acetosa* and *Acetosella*, *Stellaria Holostea*, *Tormentilla officinalis*, *Trientalis europæa*, *Scabiosa succisa*, *Viola canina*, *Veronica Chamædrys* and *officinalis*; as also the beautiful and rare *Linnæa borealis*.

Grasses.—*Agrostis vulgaris* and *canina*,* *Aira flexuosa*,* *Anthoxanthum odoratum*, *Festuca ovina*, *Holcus mollis* and *lanatus*.

Ferns.—*Pteris aquilina*, *Blechnum boreale*, *Asplenium Filix-fœmina*, *Aspidium Filix-mas* and *dilatata*, *Polypodium Dryopteris*.

Mosses.—*Dicranum scoparium*; *Hypnum loreum*, *purum*, *proliferum*, *splendens*,* *triquetrum*, and *undulatum*; *Polytrichum commune*.

* Those marked * are most plentiful.

XIX. *Note on a Wood damaged by Gases from Calcining of Ironstone.* By Andrew Slater, Forester, Loftus, Yorkshire.

The wood is within five hundred yards of the calcining hearths, and is twenty acres in extent; it consists of oak, ash, elm, plane, black Italian poplar, horse chestnut, Spanish chestnut, holly, lime, alder, common spruce, Weymouth pine, larch, Scotch fir, and silver fir. The calcining hearths were in operation in the spring of 1870, and as soon as the oak and holly were in foliage the leaves became white round the edges, and soon after white spots appeared all over the leaf. The other hardwood trees were little affected that year, but all the pine tribe were much damaged the first season, and although part of the foliage remained green, wood was not made that season nor since, and last autumn (1872) they were all dead except the Scotch fir, which retained a few green leaves till it was felled this spring. The elm, ash, plane, alder, and lime were not much damaged the first two years, but since then they have made no wood. The Spanish chestnut had the same appearance the first season as the oak, and the horse chestnut was sheltered by other trees from the effects of the fumes, so that I cannot say what the effects would have been upon them had they been exposed.

The black Italian poplar is the only tree that is not affected in any way; it is as healthy as can be, and made good shoots this season (1873), although exposed more than the other kinds, being at least 40 feet higher than the other trees.

There are two acres of wood, ten years old, consisting chiefly of black Italian poplar, with larch and Scotch fir as nurses. The poplars are all in robust health, without the least sign of blemish on their leaves, but the nurses are nearly all dead or dying. The wood was very healthy previous to 1870, but now it has the appearance of being burned with fire, and that part of the estate looks very desolate.

The twenty acres were sold and a portion cut down and barked, part of which had the bark as adherent to the wood as at midwinter; it is still standing.

We cut and barked four acres of oak adjoining the above plantation, and the bark came off well; it is the same distance from the calcining floors as the other, but is screened from them by a rise in the ground, and I believe that if screens were erected round the hearths the gas could be prevented from spreading to the injury of any crops around them, whether of grain or wood. There is a large percentage of sulphur in the ironstone, and while the stone is undergoing the process of calcining, sulphurous acid gas is generated, which is very destructive to vegetation; but being more than twice as heavy as common air, it does not rise much higher than the top of the heaps, and might be confined within proper screens. The gas has an offensive smell, which is never felt far from the works, unless when carried along by the wind.

NOTE.—The effects of different gases on trees and vegetation generally is an important subject, and demands the attention of proprietors and foresters at the present time, in order that more information may be obtained. Some valuable papers have been published of late years treating of the subject. Reference may be made to the following:—Gladstone "On the Growth of Plants in various Gases," "Philosophical Magazine," 4th series, vol. ii. p. 215; Turner and Christison "On the Effects of Poisonous Gases on Vegetation," "Edinburgh Medical and Surgical Journal," vol. xxviii. p. 356; Livingston "On the Effects of Narcotic and Irritant Gases on Plants," "Transactions of the Edinburgh Botanical Society," vol. vi. p. 380.—ED.

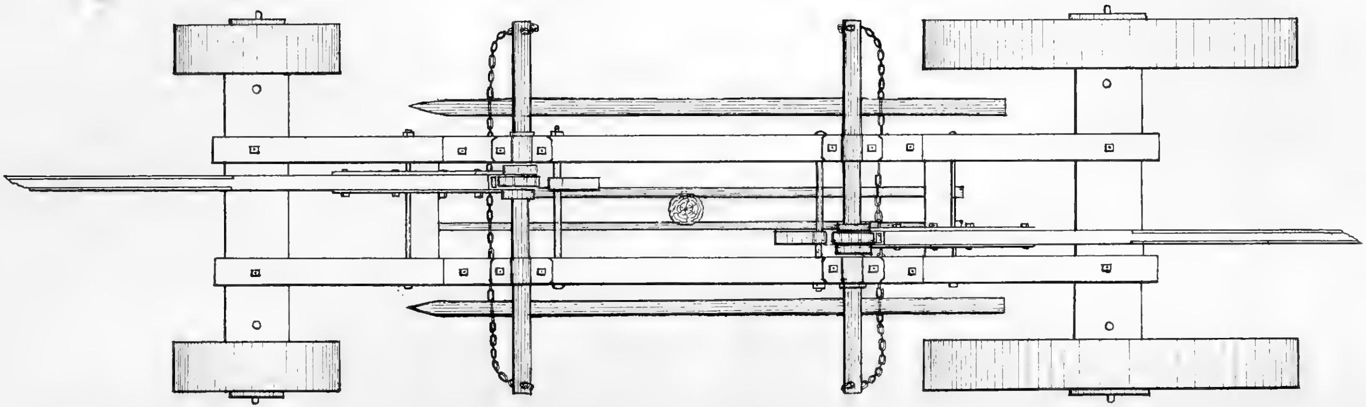
XX. *On a new Transplanting Machine.* By JAMES KAY, Forester, Bute Estate, Rothesay. (Plates I. and II.)

Having a number of trees to transplant in spring (1873), and there being nothing more suitable for the purpose than a common janker used for transporting logs, I carefully considered the construction of those machines that have been in use for some time, such as M'Glashan's and M'Kay's (referred to in Brown's "Forester"), as well as the old-fashioned janker; it appeared to me that none of them possessed the simplicity and power necessary for carefully lifting, removing, and transplanting trees. The old-fashioned janker undoubtedly possesses sufficient power, but the tree is put to a severe test at the outset by being torn from the ground by physical force, and the roots and branches rudely dragged along the ground, and the earth jostled from the upturned root at every movement. Certainly a more barbarous way of pulling a tree out of the ground could not be devised. The construction and mode of lifting the tree by M'Kay's machine is certainly more satisfactory than with the janker. Still the means of getting the wooden bars placed under the root are somewhat imperfect, and cannot bear up the weight of the tree so effectually as if placed immediately under the root—the planks being placed along the outer edge of the ball, thereby straining the roots. The raising of the tree is also performed in a slow and cumbrous manner, being effected by common hand screws, and the chain made to pass round the planks on which the tree rests.

In regard to M'Glashan's machine, however effective it may be in raising shrubs or moderate-sized plants, it seems to me to be unsuited for removing trees of large size; for though it may be possible to lift a large plant, it is evident that if part of the "ball" should be detached, the plant would fall to the ground, not having sufficient support between the spades.

Having considered all these matters, I set about contriving how to obviate the difficulties. It occurred to me that a common hay-compressing machine possessed the elements of what was wanted. I may state that this is simply a square frame, with a movable bottom, which is compressed against the hay by chains wound round two strong iron axles by means of two strong ratchets and levers—one ratchet and lever being fixed on each axle. Still, though the levers and chains possessed the power wanted to raise any given weight, the difficulty was, how a solid platform could to be got underneath the tree without running the risk of tilting it over. It ap-

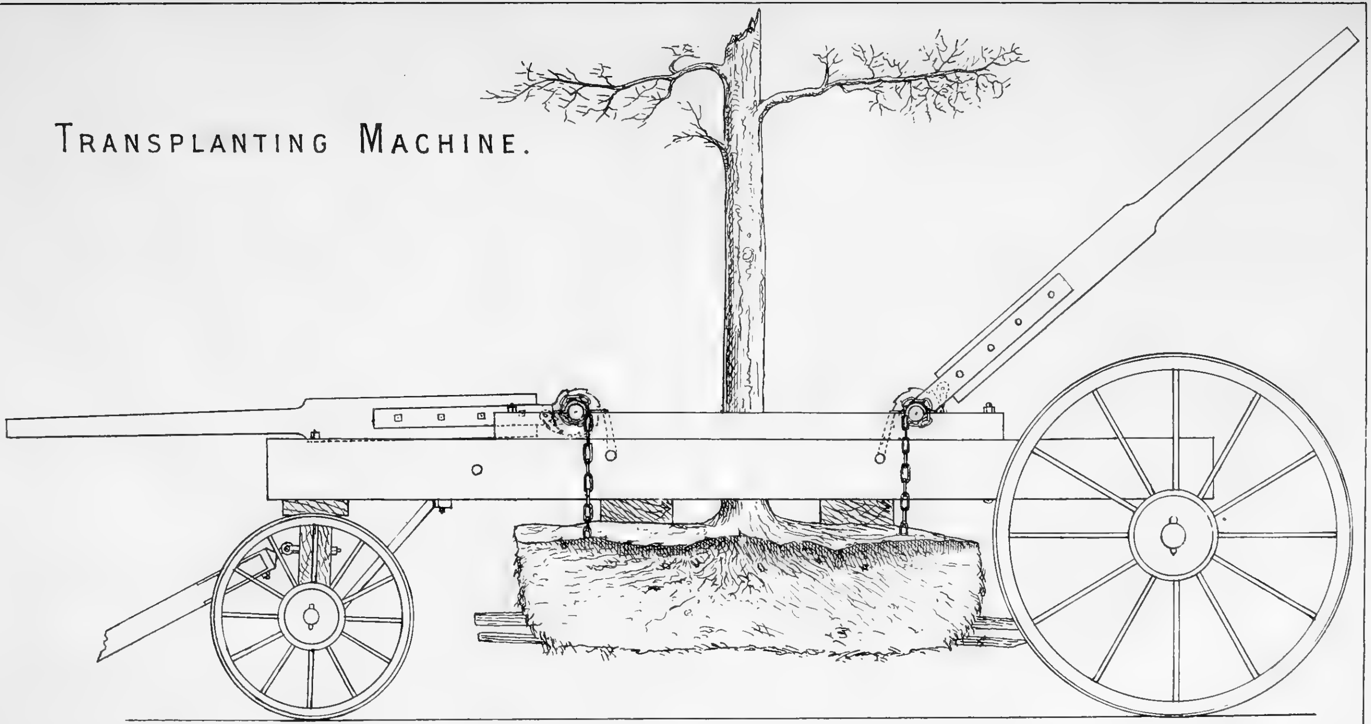
TRANSPLANTING MACHINE.



GROUND PLAN.

SCALE.

Transplanting Machine.



Side Elevation.

peared to me that an effectual way of overcoming this difficulty was to have strong iron bars driven under the " ball," and to have the chains for raising the tree made with large rings at the same distance apart as the bars are from each other, and placed over the ends of the bars, the ends of the chain being wound round the axles, as in the case of the hay machine. Difficulties being so far overcome, the next thing was to have a suitable frame placed on wheels for transporting the trees to their new site. Nicety being useless, and not having time to construct all the necessary appliances, I got a pair of common broad waggon-wheels and axle, with the axle and wheels of a buggy used for transporting timber, and with these we performed satisfactory work. I will now give the details of the machine used.

The machine (see Plates I. and II.) is simply a frame formed of two strong beams placed on two axles with broad wheels. The beams are 13 feet long, 10 inches broad, by 4 inches thick; and, in order that the frame may be solid and strong when in use, and at the same time easily disconnected when placed in position for the removal of a tree, the side-beams are bolted to two cross planks, which lie immediately above the axles, the frame being kept solid and at the required distance apart in the middle by the blocks of wood placed between the beams, and in immediate contact with the jamb-bolts, which keep the machine knit together when in use. A bar of beechwood, 7 feet long and 4 inches square, is placed on the top of each of the beams, a part being hollowed out for the axles to turn in; and to keep the axles from canting over in lifting or removing a tree, they are kept in their place by iron covers bolted down to the beech bar referred to. The axles are 5 feet long and $2\frac{1}{2}$ inches in diameter, and are placed about 4 feet 9 inches apart, a strong ratchet and lever being fixed on each of the axles, and a keeper placed under each of the ratches. To facilitate the turning of the machine, the front wheels are made to turn half round under the frame by means of a locker-bolt, which passes down through the end of the frame and the axle of the fore wheels. For the portability of the machine, shafts are attached to the front of the frame, either double or single, as necessity requires. (See Plates.)

In proceeding to lift a tree, a trench is dug round at a distance, proportioned to its size, and of such a depth as to be completely under the roots. In order to lighten the " ball " the *extremities of the roots* are cleaned of superfluous soil with a common fork or grape. Before placing the machine in position, a sloping trench is made on opposite sides of the tree, so that the tree may be easily drawn on the level ground. After having the trench cleared out, and the roots well undermined, the iron bars are driven under the "ball." In driving the bars they must be held so as to come out parallel to each other, and on the same level on the opposite side of the "ball," and at the distance apart the large rings in the chain are from each other, so that the chain may be easily placed over the ends of the bars. Next, one end of the frame is disconnected from the connecting bar and axle on which it rests, and the machine run into the trench till the tree stands nearly in the centre of the frame. The connecting bar is again bolted and placed on the axle as before. The winding axle and lever, which have been removed to admit the tree, are also placed in position, and the chains fixed to the hooks at the end of the axles. All being now ready for lifting the tree, the levers are raised and lowered alternately, which causes the ratchets and axles on which the chains are wound to advance one tooth at a time. This is continued till the root is clear of the ground. When raising the tree, if it is found to be lower at one end of the machine than the other, raise the lower side a tooth or two while the opposite lever remains stationary. In order to keep the tree from canting over, two pieces of plank are placed between the root and the bottom edge of the frame—one on each side of the tree. These, and four ropes which are fastened about 15 feet up, and attached to the four corners of the machine, are an effectual means of keeping the tree in position during its removal.

The machine may be drawn out of the trench in various ways, according to circumstances; by men, by block and tackle, or by yoking horses, and taking it to the new site at once. When coming to a part of the road with considerable incline, in order to prevent the possibility of an accident, should the machine get "under-way," the horses should be unyoked and the machine drawn cautiously by men only; and to counteract the jolting of the machine when being drawn along a rough road, four pieces of vulcanised india-rubber should be placed between the axles and frame. The outer edge of the wheels should also be covered with several plies of matting or old sacks, or should the rough part of the road be of limited extent, the line of wheels may be covered with straw.

After the tree is drawn to the new site, and the pit ready for its reception, the machine is run into the centre of the pit, the trench being kept sufficiently wide and deep to admit of a quantity of fresh soil being placed under and around the roots. The machine being brought to the proper position, the levers are pulled down, and the keepers thrown out of gear, and a tooth allowed to escape each time till the ball rests on the ground.

If the tree should lean to one side, have that side raised and soil placed under the root and well firmed up (so that it may not subside afterwards, a point of particular importance), till the tree stands in a vertical position. The next process is to have the frame disconnected as before and run clear of the tree. The iron bars are next pulled from under the roots by means of a horse and tail-chain. All the apparatus being now clear, the soil is filled in and the work completed.

We transplanted thirty oaks, several of them upwards of 30 feet high, and from 5 to 7 inches in diameter, besides a number of large yews and other shrubs; and, although the most of them were carried upwards of half a mile, we have not had a single failure—in fact, any person that did not know that the oaks were newly planted would never detect it from their appearance.

It may be stated that the trees were in no way *prepared* previous to transplanting, and the operations were carried on in all suitable weather from the end of February till the end of April. In fact, one large lime was in full leaf before being transplanted. The oaks are fine healthy trees, clean in the bark, and had they not been turned to account in the above way, would have been thinned out and probably made into stobs; but by transporting them as described, we have filled up the lines of the old vistas, and produced an effect in a few weeks which would have taken thirty years to accomplish by planting small saplings.

NOTE.—A number of trees were moored in the usual way with strand wire, to prevent the possibility of them being "wind-waved;" but the balls and roots being so solid and perfect, all such appliances proved superfluous.

The chains for raising the tree are formed of $\frac{5}{8}$ inch iron, 11 feet 3 inches long, with six rings in each, each ring being $4\frac{1}{2}$ inches in diameter. Lengthening hook-chains, 18 inches long, are kept in reserve should the chains prove too short for any particular specimen. In practice I found six rings were unnecessary, four rings and bars in the middle of the chain immediately under the root being sufficient. When six bars were used the outer ones tended to compress the edges of the root. The bars are formed of round iron, about 8 feet long. The outside bars are 2 inches in diameter, and the two centre bars $1\frac{1}{2}$ inch in diameter. Any measurements not given here may be obtained from the plans. The cost of the appliances, irrespective of wheels and axles, was L.16.

XXI. *On the Altitude and Appearance of the* Wellingtonia gigantea. By Robert Hutchison of Carlowrie, F.R.S.E., &c. (Plate III.)

Travellers from the Sierra Nevada, and other high altitudes of California, have told us, and enthusiastic writers have pictured in words of glowing interest, and enriched with varied anecdote, delineations of this mighty giant of the woods in its own native habitats. But much as we may value such descriptions, and interesting as they undoubtedly are in themselves, they but convey to the mind's eye of the arborist in this country an imperfect vision and idea of what a personal inspection with the eye of sense alone, of the form, appearance, and proportions of the actual tree itself, could thoroughly and conclusively realise. To what height and dimensions the Wellingtonia may ultimately attain in Great Britain, where it has now been fairly acclimatised, it is of course impossible to foretell; the rapidity of annual growth with which it has inaugurated its career in all sorts of situations, augurs well for its attaining, in no distant decade of years, to majestic proportions, equal at least to the dimensions of any of our well-known and established timber trees of the coniferous family, if not (as is more probable) superior to all of them in this respect.

In the meantime, forecasting what the appearance of the landscape of our native hill sides may be in future generations, from the numerous acquisitions of rare beauty of foliage, hue, and form, which have been made of recent years to our arboricultural flora, and indulging in the fancy that these newer coniferæ may attain, in this the land of their adoption, their usual dimensions in their native homes, the accompanying interesting illustration (Plate III.) will do more to convey to the members of this Society a vivid picture of how most of our tallest monuments and noblest edifices will appear relatively to the dimensions of a full-grown Wellingtonia, and how they will be dwarfed by its towering proportions.

This illustration of a most interesting subject I have been able to present to the members of this Society by the kindness of my friend, John Ord M'Kenzie, Esq. of Dolphinton, in whose possession is the original oil painting from which it has been taken.

The picture is understood to have been painted many years ago, for and under the directions of the late Colonel James Fergusson, H.E.I.C.S., a brother of Sir Adam Fergusson, and a great friend (as

Sir Adam also was) of Sir Walter Scott, and from whose intercourse, probably, his love of trees was derived, or, at all events, fostered. The picture is drawn on a scale with Lord Melville's Column in St Andrew Square, Edinburgh (150 feet in height.)

The picture accurately represents one of the *giant firs*, seen and measured by the celebrated travellers Lewis and Clarke, in their journey across the American continent. It was measured "with great care," we are told by Humboldt in his "Aspects of Nature," and was found to girth round the stem, "at 6¼ feet from the ground, 42 feet; its stem was 300 feet in height, and totally destitute of branches for the first 192 feet." This specimen, it will thus be seen, is by no means one of the largest of these mammoth trees, many others of those in the Mariposa, Frezno, and Calaveros groves in California being both loftier and more gigantic in circumference. For example, Mr Hutchings, in his "Scenes of Wonder in California," records the girths of no fewer than 132 of these trees, being about one-half the number of the entire grove. Looking over these measurements as given by Mr Hutchings, we find that three of the Wellingtonias exceeded 100 feet in circumference, two of them were between 90 and 100 feet, and the others varied from about 30 feet to 90 feet in girth. Many of the trees in the Mariposa grove had attained 250 feet in height; several even 300 feet; while one fallen giant, with bark gone, and its sides long since charred by fire, measured over 100 feet in circumference, and had probably attained not less than 350 feet in height. The largest of all these famous trees, however, measured in its fallen grandeur and decay, 33 feet in diameter across the butt of the stump; and as it was destitute of bark, there is little doubt that in full vigour it had girthed 120 feet in circumference, or 40 feet diameter. "Only about 150 feet of the trunk remained entire, yet the cavity where it fell is still a large hollow beyond the portion burned off; and upon pacing it, measuring from the root 120 paces, and estimating the branches, this tree must have been 400 feet high. We believe it to be the largest tree yet discovered."*

Such are a few facts regarding the altitude and dimensions of the *Wellingtonia gigantea* in its native habitats. The sites in which it appears to thrive most luxuriantly, and to attain its largest dimensions, are in sheltered valleys or gorges in the Nevada range, where the soil is deepest and subsoil moist. This quite accords

* Hutchings' "Scenes of Wonder in California." London: Chapman and Hall, 1865, p. 148.

with what we have ascertained regarding the progress of the tree in this country. Although it will thrive in almost any soil and exposure, and will withstand severe frosts like that of 1860–61 with little and only temporary damage, yet the progress made by specimens placed in favourable circumstances as to soil, subsoil, and shelter, are most apparent. In deep loamy soil, with a subsoil tending to stiff clay, unlike many of the coniferous family, the Wellingtonia thrives best; and in any soil, if only the subsoil be damp and retentive of moisture, it will succeed admirably even in an exposed situation in Scotland. The spring winds of March and April singe and brown its foliage occasionally, and the warm sunshine during the day and chilly frosty nights of May retard and blight its development of young shoots; but all these impediments it overcomes, and plants of 20 to 30 feet in height, which in many places in April and May in any ordinary year present a very brown and withered aspect, will be found by the month of July quite vigorous and healthy in appearance, and to have entirely shaken off their sickly aspect of the spring time.

We are perhaps too apt, in considering the merits of such an acquisition as the Wellingtonia, as regards ultimate utility, to be carried away by our admiration of its handsome pyramidal form, hardiness, and beautiful foliage and habit, and to overlook its prospective value as a *timber-producing tree.* As yet few individual specimens have been cut down in this country, and these only from accidental circumstances, and hence there have been few opportunities hitherto of judging of its likelihood of becoming a valuable timber tree. If, however, we judge so far by appearances, and compare the characteristics of the Wellingtonia in habit and growth with our ideal of what a first-rate timber tree should be, we shall find that it possesses these points in singular eminence. We have hardihood, large development of trunk and stem, rapidity of growth, straightness of habit, smallness of branch shoots starting from the stem, all combined; and, it may be added, in so far as experience has hitherto found from a few examples which have been tried from home-grown trees, apparent durability of timber. The wood is light, tough, rather coarse in the grain, but very easily wrought, and not unlike the wood of the poplar, or saugh, or white cedar. In its older and more matured stages of growth, the value and texture of the wood will be found to be much improved, and to present a closer and finer grain.

The soil and climate of Ireland seem to be peculiarly well adapted for the Wellingtonia, and many instances might be recorded of very handsome and thriving specimens occurring in various districts. One in particular is perhaps deserving of special notice here, as being probably at the present time the tallest specimen in the United Kingdom; we refer to the tree at Cecil, county Tyrone, which, although only planted fourteen years ago, is already about 45 feet in height, and growing luxuriantly.

In looking at the illustration, one cannot fail to be struck by the bare and scant appearance of branches forming the head of the tree, a peculiarity very unlike the habit of the young specimens of the Wellingtonia as known to us in this country; but the representation, as the writer has learned from an eye-witness of the *big trees*, is quite accurate. The peculiarity of the trees in their native habitats is not their umbrageous heads or wide sweep of branches, but their immense massive trunks. A traveller in California in 1873 gives the writer the following account of his visit to the giants:—"On my way to the Losamite valley I took the Mariposa 'trail,' and there with two friends, one the travelling artist of the 'London Illustrated News,' went seven miles out of the way through the pine forest on horseback to see the *big trees*, as they are called. This was on the 9th May last (1873). With regard to the altitude at which the trees are grown I cannot inform you exactly, but it could not be less than from 5000 to 6000 feet above the level of the sea. The highest of the trees, the guide told us, were over 300 feet high; but in a forest, with other trees intervening to obstruct the sight, it is difficult, on getting to a proper distance, to get a full view of any tree in particular so as to form a judgment of its actual height. The big trees all had the appearance of being withered or withering at the top, and their height did not at all correspond with their circumference. As my object in going to see the trees was more for pleasure than with any scientific purpose, I was not provided with a measuring line to take the dimensions of any of them, but for curiosity, the three of us and the guide *with our horses*, got as close as we could to the root of one of the largest, and we did not half encircle it."

It is a curious fact that two cones of the genus *Sequoia* (Wellingtonia) have been found in a fossil state in this country. May we not, therefore, in introducing this tree be only restoring to the flora of Great Britain one of its former treasures, now long extinct, and unknown for countless ages?

XXII. *The Self-Sown Oak Woods of Sussex.**
By Ralph W. Clutton.

In this paper I propose to inquire into the following matters connected with the growth and management of self-sown oak woods. Oak will grow in almost any description of clay, from the poorest and stiffest to a good deep loam. As the oak, in its earliest stages of growth, has a long tap-root, a deep soil, free to a certain depth from rock, is necessary to its rapid development. Oak will grow with considerable luxuriance in a gravelly soil, but, on arriving at a size fit to be called timber, it becomes what is termed shaky, and it will be found on felling to be little more than a bundle of laths, utterly unsuitable for the uses to which oak timber is generally put.

The Position of Oak Woods as affecting their Growth.—There is no tree grown in England more sensitive of exposure to wind than the oak, and the best and fastest growing woods are those in sheltered positions, well inland. There is a tract of country in the south-east of Sussex, lying between Battle and Hailsham, the soil of which is well adapted to the growth of oak, but which, from its nearness to the sea—about ten miles as the crow flies—fails to produce, except in very deep narrow gills, other than short stumpy trees with bushy boughs, evidently thrown out as a protection against the south-west wind. These trees produce knotty and unsaleable timber. About thirty or thirty-five years ago, the planting in St Leonard's Forest was begun with larch and oak, the proportion being about five of larch to one of oak. Since the larches were seven or eight years old, they have been gradually thinned out, and, though in no case have they thoroughly disappeared, the land is fairly planted with straight-grown silver-rinded tellars, which bid fair in due time to become a fine oak forest. This land is ordinary forest land.

Effect of the Periodical Cutting of Underwood.—The periodical cutting of underwood affects the growth of trees, as it affords the only opportunity of thinning woods; thus the thinnings are at longer intervals than, perhaps, is best for the growth of oak timber. The custom in the Wealds of Surrey, Sussex, and Kent is to cut the underwood at intervals of from eight to twelve years. Underwood is usually sold by auction in November, and in the following

* An abstract of a paper read at an ordinary general meeting of the Institution of Surveyors, February 16, 1874.

spring the oak trees are inspected, and such thinning as is required is then done. If the timber only was considered, a shorter interval of, say, five or six years, would be better; but as the underwood is an important portion of the profits, it is impossible to make the most of it until it becomes large enough for conversion into hop-poles, hoops, &c. As to the age at which the timber causes injury to underwood, supposing there is a full plant of tellars at any given fall, for the next two cuttings (say, for twenty years) there will be little difference found in the value of the underwood, which averages from L.8 to L.10 per acre. The next three cuttings will be reduced, on an average, about one-half, and afterwards the periodical cutting will be sold for a very small sum, viz., L.1 to L.1, 10s. per acre, which will not pay for rates, fencing, and ditching.

Pruning Oak Woods.—Not only is pruning unnecessary—for, if thinning is done gradually, allowing the oak trees to draw each other up to such height as may be required, the lower branches will of themselves drop off—but it is actually injurious, as every timber merchant or village carpenter knows. And the boughing of oak trees materially affects the value of the timber when felled, though the tree, when pruned, may be only 20 or 30 years, and, when cut, 150 years old. When the boughs are thrown off by nature, as they are most perfectly under careful management, the bark gradually closes over the part from which the bough dropped, and it becomes impossible to define the former position of the bough, nor would any sign of it be found when the tree is cut; but, should the tree be pruned, an unsound knot, or a sore in the tree, is at once formed, allowing the water to penetrate the trunk where the branch was cut off. This will rot, and a black dead piece of wood will be found in the centre of the tree when it is cut. The bark will, no doubt, usually close over the wound made; but this will take some years, and, before it is closed, the mischief will be done; and, in old trees, it not unfrequently happens that the perfect closing over the wound by young wood causes a species of dry rot.

Thinning and Clearing.—As I stated above, the time for thinning woods is when the underwood is cut. The greater part of the timber of the weald in question is grown with underwood. The underwood is cut, on an average, once in ten years. At each cutting, trees which have attained a good size, and show symptoms of diminished growth, are felled, and open spaces are thus obtained for a fresh crop. The same opportunity is taken for thinning the young tellars, and of saving such further young plants as have come up since the last cutting of the underwood, that is, ten years previously. In thinning tellars and young trees, it is of the utmost importance that the leading trees should be left, and the inferior ones cut. For the ultimate crop the trees should stand from 20 to 30 feet apart. The great aim of every forester should be to keep the trees thick enough to draw each other up to the height required, so as to have a clear stem of from 20 to 40 feet, as the case may be, and so to gradually thin them as not to abruptly admit the wind, and thus cause them to be checked in growth. Any checking of growth is speedily detected by the throwing out of a quantity of "rushy" boughs, as they are called. We have now carried our wood up to the age of from seventy to eighty years. If the trees have been properly managed, little further thinning will be required until their clearing, unless the timber is left for a longer period than 100 years for large shipbuildings. After a wood has been cleared of a natural crop of oak, and the underwood has grown for a period of ten years, it will generally be found, at the next cutting, that a good crop of self-sown oak tellars is fairly scattered over the ground. The tellars are usually marked with paint, and are excepted from sale. At this first cutting the young oak trees will be about the same height as the underwood; and, if the underwood is fairly good, the chances are that it will be unnecessary to thin the tellars at all, more than by a woodman going round and chopping down with a hatchet any inferior trees. During the next five or six cuttings the real work of thinning must be executed.

Profits.—I now come to the question of profit, whether timber or underwood pays best, taking a certain period of time, say 100 years. Assume an acre of underwood of a fair average description in Kent, Surrey, or Sussex, no oak trees being allowed to be grown upon it, but kept entirely for underwood. I will suppose that it has a good set of stems upon it. This underwood is worth, to sell, upon an average of L.10 per acre at ten years' growth; and it may be assumed, for the purpose of rental value, that underwood selling for L.10 or L.12 per acre, is worth the same number of shillings rent; this will be found a close approximation if worked out. This acre of woodland will therefore produce a rent of 10s. per annum, and go on producing the same description of underwood for the 100 years with occasional filling up. Take, secondly, an acre of woodland under similar conditions with regard to underwood, but allow tellars to grow upon it; there will be found little or no difference in the value of the underwood for the first twenty years. During the next forty years the underwood will have diminished in value; but we may fairly calculate that the trees which have been cut in the course of thinning, after twenty years, will have made up any loss in the value of the underwood in this period. In fact, the produce is much more than enough to make up the loss of profit from underwood. For the remainder of the 100 years the underwood will pay very little, and the thinnings will not produce more than enough to pay expenses. In the foregoing observations I have assumed that underwood sold at L.10 per acre is worth a rental of 10s., and that for sixty years the underwood and tellar thinnings together will produce fully 10s. per acre. From the latter period, and up to 100 years, when I assume the timber will be fit for felling, little or no revenue will be derived. The rental of 10s. per annum accumulated for forty years at 4 per cent., gives, in round figures, L.50 per acre. The following is an instance of a wood of 4 acres near Reigate, which was planted in 1830 with oak and other trees. I have no record of any thinnings prior to 1866. In April 1866, twenty-eight oak trees, containing 111 feet, and 208 tellars, were cut and sold for L.42. In April 1872, thirty-nine oak trees, containing 216 feet, were cut and sold for L.21. In 1873, seventy oak trees were cut which were valued at L.40. This wood was sold, and the timber on it valued very accurately, in 1872. There were 375 oak trees, containing 2600 feet of timber, and a few other trees, valued together at L.247, being at the rate of L.60 per acre. The above sum of L.60 per acre gives a rental of 11s. per acre at 4 per cent., and beyond that, of course, is the sum of money received for the thinnings. The trees in this wood will not require much more thinning. It is, I think, apparent that the oak-growing districts, in which underwood and timber are grown together, produce a much larger profit on an average of 100 years, than it is possible for oak plantations alone to produce, as, during the earlier periods of growth, underwood pays an income when the land planted with oak pays nothing.

TRANSACTIONS

OF THE

SCOTTISH ARBORICULTURAL SOCIETY

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EDITOR AND SECRETARY.

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XXIII.—*Address delivered at the Twenty-first Annual Meeting.* By HUGH CLEGHORN, M.D., F.R.S.E., late Conservator of Forests, Madras.

GENTLEMEN,—The time has again returned when, according to custom, a word of encouragement, and I hope I may say of instruction, is wont to reach you from this chair. Twice you have been pleased to elect me your President, and this is the third time that I have been called upon to address you at the Annual Meeting.

The framing of an annual address is no easy task, and many general subjects suitable to bring to your notice have been discussed over and over again by my predecessors. Perhaps, however, I cannot do better on this occasion than refer briefly to the rise and progress of arboriculture, and advert to some facts and proceedings in this and other countries which bear upon the advancement of the science which has brought us together to-day.

I think that our Society has reason to regard its quiet progress during the past year with some degree of satisfaction. The roll of members has received a considerable number of working recruits, and the new part of our Transactions contains some excellent articles, and quite sustains the character of its predecessors. There are fifteen essays to be reported upon by the judges to-day, relating to nine subjects offered for competition, and only five of the subjects advertised have not been taken up.

Arboriculture comprises all that relates to the culture of trees, and is one of the great divisions of agriculture. It is a branch of rural economy of much more recent date than either the culture of grain and herbs, or the breeding and rearing of cattle. The cultivation of those plants which supply the food of man and of the domestic animals occupied his attention exclusively for many ages; whilst the timber required for houses, ships, machines, and for fuel, was found in the native woods. Artificial plantations appear to have been formed in Germany sooner than in any other country, apparently in the fifteenth century. In Britain planting was begun, though sparingly, a century later.

The Hon. G. P. Marsh ("The Earth as Modified by Human Action, 1847, p. 307") thus describes the condition of Britain in the sixteenth century, when wood fuel began to be scarce:—"Contrivances for economising fuel were of later introduction in this country than on the Continent. Before the introduction of a system of dainage, the soil, like the sky, was, in general, charged with humidity; its natural condition was unfavourable for common roads, and the transportation of so heavy a material as coal by land, from the remote counties where alone it was mined in the Middle Ages, was costly and difficult. For all these reasons, the consumption of wood was large, and apprehensions of the exhaustion of the forests were excited at an early period. Many authors of the sixteenth century express fears of serious evils from the wasteful economy of the people in this respect." Harrison, in his curious chapter "Of Woods and Marishes," date 1550 A.D., in Holinshed's compilation, complains of the rapid decrease of the forests, and adds:—"Howbeit this much I dare affirme, that if woods go so fast to decaie in the next hundred year of Grace, as they have doone and are like to doo in this, . . . it is to be feared that the fennie bote, broome, turfe, gall, heath, firze, brakes, whinnes, ling, dies, hassacks, flags, straw, sedge, reed, rush, and also sea cole, will be good merchandize even in the citie of London, whereunto some of them euen now haue gotten readie passage, and taken vp their innes in the greatest merchants' parlours. . . . I would wish that I might live no longer than to see foure things in this land reformed, that is: the want of discipline in the church; the couetous dealing of most of our merchants in the preferment of the commodities of other countries, and hindrance of their owne: the holding of faires and markets vpon the sundaie to be abolished and referred to the wednesdaies: and that evrie man, in whatsoeuer part of the champaine soile enjoieth fortie acres of land, and upwards, after that rate, either by free deed, copie hold, or fee farme, might plant one acre of wood, or sowe the same with oke mast, hasell, beech, and sufficient prouision be made that it may be cherished and kept. But I feare me that I should then liue too long, and so long, that I should either be wearie of the world, or the world of me." (Holinshed, reprint of, 1807, i. pp. 357, 358.) It is evident from this passage, and from another in p. 397, that though sea coal was largely exported to the Continent, it had not yet come into general use in England. "It is a question of much interest when coal was first employed in England for fuel. I can find no evidence that it was used as a combustible until more than a century after the Norman Conquest (1150 A.D.). It has been said that it was known to the Anglo-Saxon population, but I am acquainted with no passage in the literature of that people which proves this. . . . Coal is not mentioned in King Alfred's Bede, in Glanville, or in Robert of

Gloucester, though all these writers speak of jet as found in England, and are full in their enumeration of the mineral products of the island."*

Planting was not general in Britain till the end of the seventeenth century, when the introduction of exotic trees was facilitated by the interchange of plants by means of botanic gardens, which in that century were established in various countries. The Botanic Gardens at Oxford and Chelsea, the oldest in England, were in existence in the middle of the seventeenth century, and the Edinburgh Botanic Garden was founded nearly two hundred years ago, though it was only in 1822 that it was established in its present site. Evelyn's "Sylva," which appeared in 1664, gave a great stimulus to arboriculture, and there is no doubt that the ornamental plantations in which Britain surpasses all other countries, are in some measure the result of his labours in this direction.

During the general war at the beginning of this century, the price of timber became very high, owing to the greatly increased demand, and the difficulty, from the unsettled state of affairs, of obtaining supplies. Under the expectation that such prices were to continue, planting was by very many in Britain ardently undertaken and carried out. It has, however, long been evident that capital invested in this way does not yield an early return; hence the rage for planting merely with a view to profit has declined, but there is a greatly increasing taste for the planting of parks and pleasure grounds, and for the introduction of trees and shrubs from foreign countries.

The rapid growth of the timber trade in the last decade might be illustrated from official records: while our hedgerows have been stubbed out and our strips of planting disappear, often unwisely, to make way for cereal crops and rearing of stock, foreign timber, now so essential to our constructive requirements, has been extensively imported from many quarters.

The Board of Trade returns show how great and increasing is the annual importation of timber, and that the production within our own island is comparatively insignificant. The supplies on our East Coast are obtained from Norway, Sweden, and the Baltic ports, while the wants of our western market are met with timber from the great continent of America.

The following table shows the total imports and their estimated value during the last three years :—

* See also Evelyn's Diary, ii. 25, 26.

	Quantity.			Value.		
	Year ending 31st December.			Year ending 31st December.		
Timber (Hewn).	1871.	1872.	1873.	1871.	1872.	1873.
	Loads.	Loads.	Loads.	£	£	£
From Russia . . .	191,280	258,879	340,702	399,955	559,112	810,284
Sweden and Norway	462,225	509,898	700,097	810,216	910,448	1,551,536
Germany	334,290	275,125	262,818	841,557	854,887	1,009,107
British N. America	451,312	443,484	365,875	1,807,959	1,798,441	1,806,642
Other countries .	209,528	295,247	401,898	822,478	1,047,140	1,504,799
Total	1,648,635	1,782,633	2,071,390	4,682,165	5,170,028	6,682,368
Timber (Sawn or Split, Planed or Dressed).						
From Russia . . .	515,596	634,677	754,666	1,239,170	1,530,745	2,239,243
Sweden and Norway	1,491,988	1,523,195	1,535,852	3,012,345	3,349,616	4,431,184
British N. America	703,800	788,288	954,356	1,830,446	2,206,405	3,130,185
Other countries .	137,117	141,189	170,849	430,265	486,897	723,896
Total	2,848,501	3,087,349	3,415,723	6,512,226	7,573,663	10,524,508
	Loads.	Loads.	Loads.			
Staves (all sizes) . .	88,119	66,102	86,438	606,854	642,046	854,115
Mahogany (tons) . .	29,256	33,291	52,343	280,134	367,471	604,001

—*Timber Trades' Journal*, vol. i. p. 244.

There are several subjects connected with the pursuits of our Society upon which much information has been elicited during the past year to which I shall simply refer before passing on to what is doing in other countries. The "Timber Trades' Journal," a fortnightly paper, has recently been established for the purpose of affording a medium of intercommunication between producers and consumers of wood at home and abroad. It contains much reliable information regarding the principal timber markets in Europe and America. The "Gardener's Chronicle" and "Agricultural Gazette" have also during the year had many articles on the subject of forestry, contributed by well-known members of this Society. Our friend Mr M'Nab has drawn attention to two subjects of considerable importance:—1st, The disfiguration of roadside trees by the unskilful lopping to which they are subjected to make way for telegraph wires ("Bot. Soc. Trans.," xi. 453); 2d, The preservation of remarkable or old trees ("Bot. Soc. Trans.," xii. 44 and 96); which appears to be a matter coming within the scope of our Society, on which his matured views might find expression in our Transactions. Sir Robert Christison has vigorously laboured in the same direction, expiscating the records of old trees and measuring the dimensions of the fossil plants in this neighbourhood ("Roy. Soc. Trans.," xxvii. 203, and "Bot. Soc. Trans.," xii. 167). An interesting work by Mr Menzies, Deputy-Surveyor of Windsor Forest and Park, is in the press ("Forest Trees and Woodland Scenery, as described in Ancient and Modern Poets"), which contains much useful information, and depicts in chromo-lithograph some of the finest specimens of trees in the royal demesne.

The use of steam-power in uprooting trees has been adopted in some districts, with a view to economising labour in stubbing out the roots; but there can be little doubt that the timber, especially of soft-wooded trees, is materially damaged by the process, and the depreciation in value must be set against the diminution of labour.

It is a source of great regret to me that I have never visited the forests of North America, which have given to us so many of the trees successfully cultivated in this country, such as the Weymouth and Douglas pines, *Cupressus Lawsoniana*, the gigantic *Sequoia*, *Taxodium Sempervirens*, the tulip-tree, snowberry, and many others.

When the first settlers landed on the shores of the western world, they found the country covered with primeval forests, which had to be felled and cleared to make room for their settlements and the production of food. The supply of wood was then considered inexhaustible; as cultivation proceeded westwards, new forests revealed themselves, stretching far beyond any knowledge which the settlers possessed of their extent. Gradually the great lumber trade of Canada and the United States sprang up, which has supplied our western ports with timber for ships and houses. The wants of the great American continent itself, with its rapidly-increasing population and its enormous export trade, have meanwhile grown immensely. The unparalleled facilities for internal navigation afforded by the numerous American rivers, have proved fatal to the forests, which have become so sparse in accessible situations, that at last it has been found necessary to legislate for the preservation of what remains; and in place of a superabundance of wood, matters are thus described ("Gard. Chron." 1847, vol. ii. 459:—

"Lumber operators and consumers in Pennsylvania are awakening to a knowledge of the important fact that the timber resources of the province are not inexhaustible, as they have long been considered. The State was once one of the leading pine producers in the Union. The dense forests bordering the Susquehanna, and traversed by its many tributaries; the mountains of the Monongahela Valley; and, in fact, the tall, majestic trees that covered thickly much of the area of whole counties in the State, were a few years ago thought to contain pines enough to comply with the law of supply and demand for the present, and to furnish timber for a future, however distant. That impression the march of events has thoroughly dispelled. The forests of the Delaware Valley have yielded no pine for years, and the resources of the Alleghany and Monongahela have been drawn so largely to supply the markets of the East, that in a comparatively short time their pine forests will be exhausted. . . . A significant and alarming fact is, that the coal regions, once famous pine-producing counties, cannot now supply enough to furnish timber for props for the mines. From supplying all home demands and exporting large quantities of pine, these counties have become importers, paying more per thousand for what they purchase than they obtained when selling the same product. . . . Taking a liberal estimate, less than four years will exhaust the pine supply of the Susquehanna Valley, and the now comparatively neglected hemlock spruce (*Abies Canadensis*) will become the staple in the lumber trade of that section, as it has been for years in the Delaware region."

"In a few years the great lumber marts of the East must necessarily depend entirely on the great forests of the West, and the rapidly-decreasing pinewoods of the South. Are these inexhaustible? Is not the fact that the once mighty pine-producing State of Pennsylvania is so nearly bereft of this great source of wealth, that the date of its exhaustion is easy of computation? There is ample food for reflection on the importance of timber culture in this country contained in these facts."—*Montreal Gazette.*

Let us turn to the forestal condition of the southern provinces of France, the climate of which, as compared with Britain or the northern states of America, is extremely mild. Little snow falls except on the mountain ranges; the frosts are light, and the summers are long. The fig and vine flourish everywhere, the olive up to 43° N. Lat., and on the south coast the orange, lemon, and date-palm grow freely. The forest trees are of a southern type, such as the umbrella pine; various evergreen oaks and many broad-leaved trees of persistent foliage characterise the landscape. In the seventeenth century it was found that there was an increase of prosperity and of population in Lower Provence, while there was an alarming decrease in the wealth and population of Upper Provence. Much land had been rendered arable by clearing of the forest, but it was found that the augmented violence of the mountain torrents (from the Alps) had buried in sand and gravel more land than had been reclaimed by clearing. In 1843 the political economist Blanqui graphically described the great evils which follow extended clearing, and ravages of torrents, where there is not a bush to shelter a bird, and where, when a storm bursts over the mountains, masses of water deluge the valley, overflowing the fields and stripping off the soil. The attention of the State was earnestly directed to the evils of denudation and the action of torrents; and the measures of the French authorities have been vigorous and successful. The conservative action of the woods has been generally recognised by the public of France, and the government has enacted laws for the protection of existing forests and for the formation of new ones.

The quantity of timber required in France is enormous, and the serious point is that the increase in the consumption is in inverse proportion to production. Dearth of wood is certain in the future, unless determined action be taken to replant and bring waste land under forest cultivation. The consumption of wood in the coal mines of France is very large; a great part of the supply is obtained from Switzerland and Savoy, and the cost increases annually. One mining company has purchased all the available land fit for growing timber in the neighbourhood, and already possesses a fine young forest of considerable extent (3000 acres). The government devotes annually a certain sum to replanting forest land, but this is found to be quite insufficient; it therefore seeks to stimulate private enterprise by offering grants and rewards to those who cultivate or extend their forest lands.

It is well known that other countries are not so well supplied with timber as formerly. Russia, Sweden, and Norway, which have to a great extent met the demands of our eastern ports as well as those of the northern coast of France, have begun to consider the state of their forests, and to regulate the annual felling of pines.

Let us now turn for a moment to the state and progress of forestry in British India. On referring to "Loudon's Encyclopedia of Gardening," Edinburgh, 1850, a work constantly consulted by all who are interested in arboriculture and horticulture, I find Indian forests summarily disposed of in the following passage, p. 304:—"Forest trees do not naturally abound in Bengal; the teak tree *Tectona grandis*, is the oak of the East, and grows in abundance in the hilly kingdoms of Burma and Pegu, whence Calcutta is supplied for the purposes of naval architecture. Whether it will ever be found worth while to cultivate this tree in Bengal appears very doubtful. The bamboo is the timber used in the general economy of the country." About the time this was written (1850), the Government of India began to be seriously embarrassed by the scarcity of timber; its attention was directed to the management of the indigenous forests, and as you are aware a special department has been organised within the last twenty years in that great empire, charged with the care of the wood, and a considerable number of trained assistants have been sent out, who are introducing correct principles of management. As the administration of the forests advanced, the want of hand-books to enable officers to acquire a knowledge of the trees, shrubs, climbers, &c., in their ranges was increasingly felt, and nothing perhaps indicates so clearly the growing importance of that department, as the almost simultaneous appearance of two illustrated works of great value on the trees of India, published lately under the auspices of Government. These are Stewart and Brandis' "Forest Flora of North-West, and Central India," and Beddome's "Flora Sylvatica of Southern India." A forest flora of British Burma by S. Kurz, Curator of Herbarium at Calcutta, is now in preparation. These three books comprise descriptions of most trees, a knowledge of which is needful to foresters in British India.

On a former occasion, I alluded to the diversified duties falling to the lot of a forester in India, and to the fact that his range of observation is wider than that of a forester in Britain. It should also be borne in mind, that owing to the ease with which books of reference are obtained in this country, you have the advantage over him. The European forester has to deal with comparatively few trees, and trustworthy information on all of these is readily procured. The forester in India, on the contrary, has to do with perhaps a couple of hundred trees and shrubs yielding timber and various minor products, as dyes, fibres, oils, gums, &c., but he has been without the means of finding out the value of the products around him, except by the purchase of costly and rare books. His forest range may be in great part uninhabited, and even in well peopled districts only partial information is to be obtained—products which are collected and give profitable returns in one range being unknown or neglected in others, as, for example, the Catechu and the Sappan. Again, *Gmelina arborea*, which occurs in almost all the forests of South India, is appreciated as yielding valuable timber in one or two districts, but is supposed to be of little or no value in others. Many such instances might be given.

As Dr Brandis states in the preface to his "Forest Flora" (p. ix.), some "hold that the sole legitimate duty of forestry in India is to provide fuel and timber, and that the forester has no concern with bark, lac, gums, resins, caoutchouc, wax, oil, dyes, fruits, and other marketable products of trees and shrubs. Such views will continue to be maintained until it is generally acknowledged that the principal aim and object of forest management in India is the formation of public estates, to be managed so as to secure large benefits to the country of an indirect nature, as well as a continuous and increasing yield of all descriptions of forest produce necessary to supply the requirements of the people and their export trade. Foresters in India will gradually understand that they are expected to make the utmost of the estates intrusted to their charge for the benefit of the present generation, while steadily improving the capital value and productiveness of their estates; and this will lead them keenly to seek information regarding the various trees and shrubs which may be turned to account. It is not possible to predict in what respect any particular plants may not eventually be found useful, either by their produce, or because they further the growth of the more useful kinds by their shade and shelter, or in other ways. The only safe plan, therefore, is, at the outset, to take a comprehensive view of the whole forest vegetation, instead of confining our attention to those trees which we are accustomed, often erroneously, to regard as most important."

For besides the forests considered with special reference to the value of the trees for manufacturing purposes are others called "fuel forests," in which the timber is used almost entirely for burning. In the Central Provinces, Bombay, Berar, Madras, Mysore, and Burma, "all the inferior woods, that are not specially protected, are cut and used for the fuel supply. But even in the thickly-wooded provinces provision has to be made for projected lines of railway, and in Burma fuel reserves have, with wise forethought, been set apart along the Prome road. The regular demand for fuel of any organised steam service soon makes itself felt. The Irrawaddy steamers have required large supplies of wood, and already tracts of 'Eng' (*Dipterocarpus*) near the river in the Prome district have been denuded, and the fuel stacked in 1873 consisted of wretched billets of thin saplings. *Acacia Catechu*, the valuable wood that yields the catechu of commerce, was ruthlessly cut for this purpose." The wood of many other trees is commonly used for fuel. "With regard to other products, such as gums, resins, fibres, dyes, &c., in some provinces they are of much greater value than in others. In the extreme north the value of these minor products, as they are called, is comparatively insignificant. The Himalaya could yield large supplies of resin, but the difficulty and cost of transport to the plains have hitherto prevented anything being done in this direction. The Punjab has hardly anything worth speaking of; gum from the *Acacia arabica*, *Odina*, and other trees is collected for local use. A little lac is collected in some districts, but very inferior to that of Central and Southern India.

"These minor forest products yield a large revenue in the sub-Himalayan forests, especially in the districts of Kumaon and Garhwal. A system of revenue has been established in these places with marked success, the collection of all sorts of articles of minor produce is allowed; while at the same time all destructive processes, such as the felling of large trees, lopping for resin, &c., are prohibited. Any one may collect these products, "but the forests are so situated that when the exporter leaves the place he must pass by certain routes on which toll-houses are established, and at these his collection is overhauled, and made to pay certain seigniorage rates, according to a fixed and published scale." Amongst the produce so collected are solid and hollow bamboo stems, used for walking-sticks, pipes, boxes, &c.; *Eriophorum cannabinum*, used for ropes; various kinds of reeds, used for matting and for thatching houses; also the numerous gums; the resins of the Sal and other plants, the fruits of *Feronia elephantum*, the Chiretta (*Ophelia chiretta*), a Gentianaceous plant, used as a febrifuge and tonic, which is becoming more and more in repute in this country; Myrobalans, the fruits of *Terminalia Chebula* and *T. Bellerica*, largely imported for tanning purposes; kamela, the red powder obtained from the capsules of *Rottlera tinctoria*, and used both as a dye and as a vermifuge."*

In January of this year a conference of forest officers for the discussion of questions connected with forestry was held at Allahabad, and the proceedings have been fully reported in a volume printed by Government, which constitutes a remarkable contribution to forest literature. The report is edited by Messrs Baden Powell and J. S. Gamble, and prefaced by some comments from the pen of Dr Brandis. The subjects discussed had reference to forest legislation, the relation of forest officers to civil officers, forest revenue, the required forest area in each province, the questions of forest rights and forest licences, the method of planting in the Himalaya, the present state of the Deodar forests, &c. It is proposed to hold another confer-

* Notes on Indian Forest Produce in "Gard. Chron. 1874," vol. ii. p. 490.

ence at Simla in September 1875, and the publication of a quarterly Forest Magazine was resolved upon.

In glancing through the report of this conference it is striking to observe that the same conclusions are arrived at in some points of forest management, as those obtaining in this country under very different circumstances. For example (p. 194), the nursery culture and planting out of Deodar in the Himalaya appears to be very similar to the system most approved in Scotland, as to its congener the larch. "We all agreed that the proper system would be as follows: seed to be sown in nursery beds in November. Seedlings to be bedded out at three inches apart in July following; these seedlings to be transplanted at six inches apart at the commencement of the following rains to remain for twelve months, and then to be finally planted in the forest at four feet apart."

Again the difficulty of confining the rivers in flood within their banks has been great, especially in the sandy districts of Sindh and the Punjab. The following extract from the Report on the Administration of the Punjab Forests for 1872–73, shows that the plan successfully carried out in this country has been adopted on a larger scale in India:—

"A stream, which during the rains becomes much swollen and rapid, runs through the middle of this Bela. During 1871–72 a quantity of land was cut away by the action of this stream, and this year I was determined to do something, if possible, to prevent such damage in future. Accordingly, when the stream was at its lowest, I caused the almost perpendicular bank to be sloped at twelve feet from the old bank and the slope afterwards planted with willow slips at one foot apart. This method has up to the present time—and we have had a heavy flood—acted admirably, even beyond my expectation. Not in a single instance has the slope been broken, and the willow slip and grass having now taken good root, I have no fear for the future. Altogether it is a great success, and I think that more attention should be paid to this branch of forest work, especially with reference to the Belas, the banks of which might, in my opinion, with little difficulty, be made perfectly secure."

In conclusion, I call upon you, especially the young country members, to make good use of the opportunities afforded to you to-day, examining both the museum and the garden, which are arranged with skill and judgment, and which at a glance tell of the eminent and enlightened men of science who have been charged with their formation and maintenance. I trust that the visit may be profitable to you, that the faculties of observation will receive a healthy stimulus and be brought into vigorous exercise, and that you will go home with enlarged views of your calling. Perhaps some influence may lead you, or some dormant power of brain be stirred within you, which after diligent study and patient perseverance may raise you to the rank of a Loudon, a Macnab, or a M'Corquodale.

Geology and botany, chemistry and surveying, are all useful studies to the young forester desirous of rising in his profession, and are sciences of which the smallest amount of sound knowledge cannot fail to be of service.

I understand there is a proposal for the enlargement of this beautiful garden with a view to the formation of an extended arboretum, a scheme which while adding to the usefulness of the garden for educational purposes, will also contribute to the amenity of the city.

I have once again to thank you for having placed me in this honourable position, and before vacating the chair, I would take the opportunity of expressing my great gratification in learning that it is, I understand, the unanimous feeling of the Society that Professor Balfour be your president-elect. By having his name in this way associated with you, honour will be done to the Society, and a just tribute paid to his life-long interest in the success of arboriculture.

XXIV.—*On the Literature of Scottish Arboriculture.* By ROBERT HUTCHISON of Carlowrie, F.R.S.E.

The utility of timber for the supply of an infinite number of man's wants, and its adaptation to his varied domestic and constructive necessities,—applicable as it is to his earliest and to his latest requirements,—to his cradle or to his coffin,—has rendered the growth and culture of trees in every age and in every country throughout the civilized world a subject of primary importance. Nor is the culture of timber trees a topic of an uninteresting nature, apart from the consideration of their utility, for the advantages afforded by their shade and ornament are recognised in almost every country; and the avidity with which, everywhere, the flora of distant regions is ransacked for new acquisitions suitable for a wider geographical area of distribution than nature has allotted them, proves that the love of trees, *per se*, is one of the deepest and earliest impulses of human nature. If this, then, be the case, it must be little matter of surprise that artificial skill and ingenuity, even in rude untutored ages, were called forth to foster and promote, by every conceivable device, the cultivation of the most useful varieties of trees, whether for food, fuel, or mechanical employment, according to the respective wants of the grower. Arboriculture may thus be looked upon as the oldest of all pursuits or occupations; and although its literature, strictly so called, may be of comparatively modern growth, yet its *unwritten* history is cöeval with the existence of man upon the earth. Our common forefather, Adam, was himself a practical arboriculturist, and it would be extremely curious to us now to know what were the principles by which he and his immediate descendants were guided in their propagation and treatment of trees. Their knowledge, however, doubtless handed down by oral tradition,—for as far as we know, *writing* was an undiscovered art in that early period,—would, by its diffusion, become changed, and their modes of operation altered, so that we may be assured the wisdom of our first parent and his more immediate followers died in a great measure with themselves. Still we have in the sacred Scriptures glimpses that show us how, in the dim past, our forefathers laboured as we labour, and interested themselves in the very same pursuits in which we occupy ourselves; and probably, in spite of modern arrogance and pride of civilisation and wisdom in our nineteenth century, their knowledge, if not as extensive, was perhaps quite as accurate as ours upon all the elementary teachings of plant or tree life and culture. Had the book in which king Solomon "spoke of everything" that grew, "from the cedar which is in Lebanon, even unto the hyssop that springeth out of the wall,"* been still in existence, modern arboriculturists might have found much to repay them for its perusal; but in common with much that might have made us humbler and wiser, this treatise by the wisest of men has perished, and we are forced to deduce the principles by which our early forefathers were guided, by simply observing the results of their actions.

All early history shows that trees were carefully cultivated, and particular attention paid to their preservation. Their planting and felling formed subjects of legal enactment even in the remotest centuries, and continued to be so in many countries down to comparatively modern times; while even at the present date, in several continents and empires, State protection to the forests and woods is found to be absolutely essential. In the Mosaic law, for example, we read † that the Israelites were forbidden, in time of war, to cut down trees of any besieged city by forcing an axe against them, lest they should destroy trees of which they might eat; for the tree of the field is man's life. In the early history of many other nations and peoples, we also see that trees were considered and valued. Indeed, in days when the multifarious purposes to which iron can be applied in place of timber were unknown, in peace and in war, tree growing must have been a matter of intrinsic importance; and arboriculture, as a science, must have been studied to some extent, and well understood, although its practice was not reduced to writing, but preserved by oral tradition, and by the successful results of their own and their fathers' experience.

But while it would be very instructive, and no less deeply interesting, to trace out the early history of the literature of arboriculture among all the nations of the old world, we must, for the present, confine our attention in this paper—to endeavouring to decipher, in a cursory manner, its early growth and progressive advance in our own land,—and to investigating both the difficulties it had to contend against, and the advantages accruing from it at the present day.

The earliest distinct glimpse of the internal condition and rural economy of Britain which we have may be dated from the invasion of our island by the Romans in A.D. 78, and although the primitive inhabitants of the country were totally ignorant of any mode of transmitting their ideas other than by word of mouth, yet the

* 1 Kings iv. 33. † Deut. xx. 19 and 20.

invaders, belonging to a race far advanced in civilisation and in the arts and sciences of the period, and boasting in their literature some of the most famous authors and philosophers the world has ever seen, have handed down to us a clear and vivid picture of the condition of this island, and its inhabitants, and their occupations, when they first landed upon its shores. We learn from their records that Britain was then in great part covered with dense forest. Julius Cæsar, the leader of the Roman legions, who took possession of the island, says:—"A town among the Britons is nothing more than a thick wood, fortified with a ditch and rampart, to serve as a place of retreat against the incursions of their enemies." Strabo also, in describing a British town, says:—"Forests were the only towns in use among them, which were formed by cutting down a large circle of wood and erecting huts within it, and sheds for cattle." Groves were also used by the ancient Britons as places of worship; and the altars of the Druids were generally erected in woods, and the oak was regarded by them as a sacred tree. That this densely wooded condition of ancient Britain had existed from very early ages, is quite apparent from the number of whole trees (fir chiefly) frequently found embedded in deep bogs, conclusively proving that many centuries ago, the wolf and the boar roamed unmolested through deep woods and tangled thickets; that the wind, tearing its way through the mighty forest, swept down the trees in its course, and these being unvalued and unmissed, were allowed to lie till the fallen leaves of centuries, silently gathering over them, shrouded them from sight, to be dug up afterwards, in distant years it might be, as the silent historians of far off ages. Assuming, then, that the general condition of Britain, at the time of the Roman invasion, was chiefly that of a forest, or series of forests, and knowing the proficiency of the Romans in all gardening and rural matters, we may very naturally suppose that they taught and introduced many new modes of propagation of timber trees, and various original methods of treatment of them. For the Romans had long been celebrated in the art of gardening, and in the culture of trees; and, indeed, all the nations of antiquity were uncommonly fond of gardening and such like occupations or recreations. Hence we read of the fabulous gardens of the Hesperides, so beautifully described by Virgil,* and of other equally famous gardens and grounds mentioned by other authors,† and repeatedly quoted or referred to when

* Virgil, Æneid, iv. 484.

† Ovid, Am. i. 10, 56. Stat. Sylv. i. 3, 81. Plin. xix. 4. Cic.. Att. xii. 23. Horat. Od. ii. 14, 22; *et* ii. 15, 4.

ideas of pleasure or scenes of blissful delight were desired to be conveyed to the mind of the reader. Virgil, moreover, enumerates the various ways of propagating trees and shrubs, both natural and artificial (Geor. ii. 9), common in his time; and we find, upon a close survey of the writings of the old classical authors, that the usages in vogue in those days for the cultivation of timber trees and shrubs were much the same as we now insist upon at the present time. Propagation by seeds, layers, suckers, "sets," slips or cuttings, grafting, budding, or "inoculation" (Plin. xvii. 16, s. 26), were all well known and practised very extensively. Forest trees were chiefly grown from seeds. The practice of cutting over coppice to sprout again from the stool (*succisæ repullulant*) was quite common (Plin. xii. 19). We have also reference made by Pliny to the existence of a trunk of larix or larch, 120 feet in length, and 2 feet in thickness (Plin. xvi. 40, s. 74). The art of transplanting trees also received due attention, and indeed seems to have been carried on (as many other forest operations were) with careful regard to physiological principles. Thus, for example, we find that in removing trees from one site to another, the Romans marked upon the bark the way each tree stood prior to removal, so that it might, in its new situation, point to exactly the same quarter of the heavens.*

These, and other authorities and facts which might easily be cited, show us how far advanced in the science of arboriculture were the Romans at the time of their invasion of Britain, and we may easily conceive the intelligent observation they would bring to bear upon the woods of the new country they wished to conquer, and the knowledge they would impart to the untutored savage inhabitants of these islands regarding this and other kindred departments of rural matters.

Cradled thus in its infancy among the literati and philosophy of classic Greece and Rome, extolled in praise by bard, philosopher, and historian—the greatest writers of that golden age of early literature,—need we wonder that arboriculture, and a practical love for trees and shrubs, flourished and grew apace in that distant era of the world's history? Nor were the nostrums and principles of rural economy and tree culture simply confined to the writings and theories of these grand old masters of style and rhetoric, for many of them wrote and spoke from intimate personal acquaintance in a practical form with the subjects they described, and whose praises

* Virgil, Geor. ii. 269. Col. de Arbor., 17, 4.

they sung. They were themselves practical arboriculturists, and in their villas and suburban domains they gathered together choice collections of many of the novelties of their day, quite as eagerly as we now-a-days draw into intimate fellowship, in one shrubbery or plantation, the newest acquisitions sent to us by collectors from various and wide-spread climes and habitats. The cause of arboriculture, however, notwithstanding such favourable circumstances, in these classic times, and afterwards for centuries, did not flow on in a prosperous, unchequered tide of continuous development, for the constant thirst for conquest which prevailed in the aggrandising mind of the Roman not only diverted his attention away from peaceful occupations, but tended to foster animosities, and to carry destruction of forests and waste of lands into the territories of the savage inhabitants of these islands. And the progress of conquest led to extensive and widespread devastation of much of the forest land in them. For as the woods were convenient refuges for the natives when attacked, and from whose shelter they might harass and annoy the invading army, retreating again to their cover when retribution was likely to follow, the Romans naturally cut down and destroyed many of the forests; and the same policy was, for similar reasons, adopted by the Saxons and Normans during the periods of their occupation of Britain. Thus we find at the present day, occasional traces of plantations having existed upon hill sides and lofty elevations where now no tree is to be found, and the destruction of which may be traced to the times we refer to. So then it came to pass that, after centuries of denudation, it became absolutely necessary, for many reasons, to plant young woods to replace the old trees which had been destroyed; and from the particular kinds or species of trees so replanted, we may decipher much of the habits, necessities, and modes of life of our mediæval forefathers. The "Saxon Chronicle," remarkable as it is for the minuteness of detail with which it narrates many of the doings and customs of that period, tells us how the Conqueror, not finding land sufficient for his pursuit of sport, cleared "the New Forest" and certain other districts with a high hand. "He planted a great preserve for deer, and he laid down laws therewith."* We also find forest laws marked out, and exacted with great stringency. Charters of the Forest, as they were called, were passed or granted, and thus, probably unintentionally, by the high-handed arrogance and prerogative of the Norman monarch and his successors, the wooded

* Saxon Chronicle, 1087.

lands of our country were saved from the ravages which would otherwise have befallen them in these troublous times.

As civilisation progressed, and the inhabitancy of the country in later ages became removed from the savage wigwam of the woods, or fortresses of the hill tops, or "*duns*," as they were called, to the baron's castle or feudal keep, generally built upon sites surrounded by cultivated land and in alluvial soils in valleys and plains, the necessity for planting timber trees for shelter became a matter of considerable moment, and thus the arboriculture of the early middle ages found an outlet for its development. The requirements, also, of these warlike times for spear-shafts and bows and arrows, and other implements of attack or defence, led to the practice of selecting and planting in convenient situations particular species of trees suited to such purposes. Hence we find the English yew constantly growing beside old castle ruins and dismantled forts, and in old churchyards; not placed in this latter situation, be it remembered, from respect to the dead, as is often supposed, or out of any idea that the gloomy and sombre shade of the yew was more suitable for a grave, than the bright rays of the sun falling upon it, but because the yew tree made the best bows for the archers, and consequently supplies of them were raised by the barons for their numerous retainers, and they were also grown by the monks in the churchyards and abbey lands for the use of their vassals. Thus, also, the ash tree is frequently found growing beside old castle walls, for its timber was also used for warlike purposes, and for the more peaceful requirements of the agricultural serfs, being used to supply the handles or shafts of the lances and pikes, and for the wooden portions of nearly all implements of husbandry. For domestic uses, the beech received much attention in early cultivation, being largely used in the manufacture of common domestic utensils; while the oak was indispensably necessary for centuries for the building of those "wooden walls of old England," which, long before the days of "ironclads," were all the country had to depend upon as a defence from invasion or attack.

While we thus see, from the remains of old forests and plantations of feudal times, some of the varieties of timber trees to whose culture more special attention was given in these early times; we catch more of the details of the principles of planting and rearing trees and shrubs, from an insight into the religious houses and monastic foundations of the thirteenth to the sixteenth centuries, through many of their chartularies and records still preserved.

Whether their arboriculture was of a scientific kind or not, it is certain that, like the agriculture of the period under the supervision of the monks, it was systematic, and under strict regulation. The old Granges, which were the chief houses of each of the abbey baronies, were usually surrounded by plantations tastefully arranged; and it is to the early monks, and their frequent pilgrimages to the East and to continental shrines and countries, that we owe the introduction and acclimatisation in Britain of many species of trees, and shrubs, and plants now common amongst us. It may be noticed, as a type of civilisation developing itself in Scotland, and existing already in no mean degree, that we read "that in the chamberlain's books there is a charge for a gardener at the king's castle at Forfar;"* and in a document of the year 1261, one pleads a right to a garden in Morayshire, whence pot-herbs were to be supplied for the king's table when he dwelt in the castle of Elgin. Forty-two years later, when King Edward was in possession of Scotland, the Dean of Elgin beseeches him for a grant of oak-wood from a neighbouring forest, that he may rebuild certain houses and the enclosure of his garden, destroyed by the conquering army.† Early in the War of Independence there is a claim for damage by the English army on the estates of the nunnery of Coldstream, and of this, one item is for the "*pomer*" or orchard, which yielded the value of a hundred shillings annually beyond the fruit consumed by the house.‡ The enlightened attention and evident interest in all *agricultural* affairs that mark the era of the monastic institutions, from the reign of David I. and for centuries afterwards, spread by degrees from the monastery to the entire population during that peaceful monarch's reign and benign government; and as it is an axiom true of every country and people, that for "agriculture to succeed, arboriculture must precede," so we may safely infer that the art of tree growing, propagation, and planting was in an advanced state in our country in those interesting and early ages. Doubtless, in common with agriculture and other subjects which interested their material prosperity and comforts, the monks of the middle ages compiled and wrote treatises on arboricultural subjects. Unless they had done so, it is impossible to account for the progressive strides made in the culture of trees in their time, and these writings formed probably the earliest written literature of the science.

* Innes' Scotland in the Middle Ages, p. 124.

† Documents illustrative of Scotland, ii. 451.

‡ Hill Burton's History of Scotland, vol. ii. p. 109.

After the discovery of the art of printing in 1438, and its introduction into this country about the year 1471, we are able to trace the development of arboricultural study in Scotland, and notice the attention which was paid to it as a great and important branch of rural economy. While many of the earliest printed books upon miscellaneous subjects refer to topics concerning the growth and planting of trees, &c., one of the first volumes wholly dedicated to the treatment of vegetable economy in its different departments is an old folio, written by an apothecary of London, one John Parkinson, who, in 1629, published his "*Paradisi in Sole Paradisus Terrestris*," which professed to be "A garden of all sorts of pleasant flowers which our English ayre will permit to be noursed up, with a kitchen garden of all manner of herbes, rootes, and fruites for meate or sause used with us, and an orchard of all sortes of fruit-bearing trees and shrubes fit for our land, together with the right ordering, planting, and preserving of them, and their uses and vertues."

In this early botanical work are given full and accurate descriptions of all the various plants mentioned, with their modes of growth, uses, and treatment; and the volume is full of quaint, but very accurate, woodcuts of many of the things described, illustrating the roots, foliage, flowers, &c. The volume is, however, more horticultural than arboricultural, properly speaking. In 1664 was published what may be styled the first standard printed work upon arboriculture. Evelyn's Sylva* is so well-known at the present day, and is still so widely read and admired, that anything like an attempt to describe it in detail, its principles or arguments, seems quite superfluous. The work of a man, an enthusiast in tree-culture, it has survived the wreck of similar works through centuries, and is still an ornament and authority in the libraries of all interested in trees. Like the works of the classical authors, Horace, Virgil, Cæsar, or Livy, Evelyn is turned to in many a quiet country home at the present day, not only to beguile the passing hour, but for improvement and instruction. The earliest edition of this popular book was, we have said, published in 1664; and there have been repeated and frequent republications of it. It was the first book printed by order of the Royal Society, the Sylva having appeared in 1664, while the Terra was not issued till 1675. The fifth edition, in 2 vols. quarto, with plates, was published so recently as 1825, edited with notes by Dr A. Hunter; and in this learned and accurate edition,

* Evelyn, John—"Sylva and Terra," or "Sylva, Pomona," also "Kalendarium Hortense." London, 1664, folio.

the work has received many improvements; but its own intrinsic merit is shown by its popularity during nearly two hundred years. Professing to be a discourse on forest trees, and the propagation of timber in Britain, in reply to certain queries propounded to the Royal Society by the Honourable the principal Officers and Commissioners of the Navy, at a time when the necessity for an adequate supply of oak and other timber for such national purposes was of the very highest importance, the treatise of Evelyn was admirably calculated to meet the requirements of the case, and to stimulate any flagging zeal in the pursuit of practical arboriculture in the land. Living, as Evelyn did, to a good old age, with a singleness of eye and purpose for the good of mankind, his motto and aim seemed to be, in the words of Tacitus—"*Ad utilitatem vitæ omnia facta consiliaque nostra sunt diregenda;*" and in doing so it appears to have been to him rather a relaxation and amusement than an imposed task, so deeply did he love trees and the pursuit of natural knowledge. To the publication of this work, and to the royal patronage extended to it in a very gracious degree by the reigning monarch, King Charles II., we are indebted for many millions of timber trees, chiefly oaks, "besides infinite others," propagated and planted throughout England, and the royal example of cultivating "decaying woods," besides forming new forests, was productive of the highest benefit to the cause of arboriculture.

Evelyn's "address to the reader" shows well the spirit that animated his work, and the good he desired—the publication of it to extend over the length and breadth of the land. He desired to address himself to his "*better-natured countrymen,*" "that such woods as do yet remain entire might be carefully preserved, and such as are destroyed sedulously repaired. It is what all persons who are owners of land may contribute to, and with infinite delight as well as profit, who are touched with that laudable ambition of imitating their illustrious ancestors, and of worthily serving their generation. To these, my earnest and humble advice should be, that at their first coming to their estates, and as soon as they get children, they would seriously think of this work of propagation also, for I observe there is no part of husbandry which men commonly more fail in, neglect, and have cause to repent of, than that they did not begin planting betimes, without which they can expect neither fruit, ornament, or delight from their labours. Men seldom plant trees till they begin to be wise, that is, till they grow old, and find by experience the prudence and necessity of it. When Ulysses, after a ten years' absence, was returned from Troy, and coming home found his aged father in the field planting of trees, he asked him 'why, being now so far advanced in years, he would put himself to the fatigue and labour of planting that of which he was never likely to enjoy the fruit?' The good old man, taking him for a stranger, gently replied, 'I plant against my son, Ulysses, comes home.' The application is obvious, and instructive for both old and young."*

Nor did Evelyn insist upon promiscuous planting, and by unskilled labour. He warned young planters against "committing themselves to the dictates of their ignorant hinds and servants," "who are," says he, "generally speaking, more fit to learn than to instruct." Would that his advice were still adopted and inculcated at the present day, when ignorant labourers, destitute of any knowledge of the forester's art, are too often entrusted with important operations, when a skilful knowledge of the physiological principles of vegetable life and tree economy are superlatively requisite and indispensable to future success.

No easy or insipid study did Evelyn discourse upon, but he continually throughout this very important book dignified the business of planting into an art or science, and recommended its prosecution in such a spirit. His work gives a detailed account of each timber tree, its uses, habits, cultivation, adaptability to different soil, situations and purposes, modes of propagation, and botanical description of each are appended. The illustrations in the later editions of the book are excellently rendered, and altogether Evelyn's work may be ranked as the earliest pioneer of the study of arboriculture, whose deeds and teachings have left an indelible impress upon the whole country. His work is the best early standard authority upon planting and treatment of trees; and although, as he himself in his preface admits, it is not written "for the use of mere foresters and woodmen, but for the benefit and diversion of gentlemen and persons of quality, who often refresh themselves in these agreeable toils of planting and gardening," still, his style and matter are such that the work cannot fail, at the present time, to be very intelligible and appreciable to the intellect of the improved status of foresters of our day of advanced civilisation and knowledge. Appended to the Sylva is "an historical account of the sacredness and use of standing groves," showing in eloquent terms in what estimation old trees were held for their divine as well as for their civil uses.

* Evelyn's Sylva, edit. Hunter, 1825, vol. i. p. 32.

In 1675, we find the next work of importance published in an octavo volume of much curious information by the gardener to the Earl of Essex, Moses Cook by name. He styled his book "The Manual of Raising, Ordering, and Improving Forest Trees." In this interesting relic of bygone times are given, with great clearness and precision, directions how to plant, make, and keep woods, walks, avenues, lawns, hedges, &c.; and there are also given rules and tables showing how the forester may acquire the art of measuring superficial figures, divide woods or lands, and measure timber. This quaint old gardener remarks, that "it has been and is observed that those who are wasters and wilful spoilers of trees and plants, without just reason so to do, have seldom prospered in this world." He carefully inculcates upon his readers the due conservation of trees, narrating those specially useful for different purposes in planting; and he proceeds to warn his readers against many of the "*rocks*" or errors then prevalent both in regard to sowing, grafting, "watering with coloured water," "boring holes in trees, and putting honey or other sweet things into them, to make them bear more and sweeter fruits," or believing "that the sap of trees at the approach of winter falleth from the head into the root." Rules are laid down for pruning forest trees, and all the arguments used by Cook are derived from his own personal observations and experience of actual results arising from the various modes of treatment he adopted. This worthy father of the planting art strongly urges the proper preparation of the ground intended for plantations. "*A thing once well done is twice done*," says he; so those about to plant are advised "not to bury their plants in a hole like a dead dog, as too many do," but to give them "good and fresh lodgings suitable to their quality, and good attendance also, to preserve them from their enemies till they be able to encounter with them; they that will not do this, let them never resolve to plant trees." His descriptions of the various modes of procedure in sowing and planting the different varieties of forest trees are thoroughly practical, and the book is altogether a complete hand-book of the time in which it was written, and by one who has evidently been an enthusiast in his profession, and under the supervision of an employer who was no less skilled in tree-culture, and such kindred subjects, than the author was himself, and from whom, probably, Cook derived many of the hints given in the volume. He had evidently read and studied Evelyn, published eleven years previously, in whose praises he is loud, and whose theories he unreservedly endorses.

In 1677, appeared an elaborate folio from the pen of one John Johnston, "Medical Doctor," entitled "Historia Naturalis de Arboribus," in ten books. This work is, however, devoted more to fruit culture than to a descriptive narrative of tree-growing. Its illustrations, contained in a separate folio of 137 plates, are most accurately and beautifully engraved in copperplate, and contain examples of sections of stem, leaves, fruit, seeds, mostly life-size, with the botanical names attached. But although the major part of the work is devoted to pomological subjects, attention is also given to dendrological; and shrubs, heaths, and flowers are also delineated. This book cannot, however, be regarded as any authority at the present time, or as having attracted much attention even in its own time. It is rather a reflex of the view held of such objects as subjects of illustration to botanical students of the time.

In 1724, was published a translation, by John James of Greenwich, of a French work published in Paris in 1720 by Le Blond, styled "The Theory and Practice of Gardening." It is a quarto volume, and the subject matter is divided into four parts. This book may be called the book of the garden of that period, and like more modern treatises, it enlarges upon laying out and adorning of grounds, pleasure walks, and gardens, giving detailed plans and drawings of the designs recommended. The third part of the volume, however, on account of which alone it is noticeable in this paper, is devoted to the choice of trees and their treatment in policy and ornamental plantations. Le Blond describes with much minuteness the methods of planting, the care to be taken of the young plants, and their protection from insects and vermin; the treatment of nurseries, and of flowering shrubs. He also discourses of hedges, and planting them, and of many other objects in use for ornamental effect in and around country residences. While the book is written more especially for the better climate of France and south of England, there are many useful hints equally adapted to profit and instruct planters and those engaged in laying out ornamental plantations in our own more northern latitude. The book became an authority in its time and for long afterwards, although, owing to the unfortunate rebellions and civil wars with which this country was shortly afterwards visited, little attention was then given for fully half a century to such peaceful arts as those of arboriculture.

We now approach a blank chapter in the history of the literature of arboriculture, and it is not until about the years 1780–90 that public attention found leisure to devote itself to the development of rural economy and the peaceful improvement of agriculture and arboriculture. No doubt, in 1765 the "Scots Gardener" appeared, a small quarto volume of much curious and interesting matter. It related chiefly to subjects and operations suited to the climate of Scotland, and embodied with it the Earl of Haddington's treatise on forest trees. This volume was written and compiled by J. Reid, gardener to Sir G. Mackenzie of Rosehaugh, and was dedicated to the "Ingenious planter in Scotland." We thus see that, despite civil commotion, the minds of the practical men of the country were being fully awakened to the necessity for more careful attention to arboricultural studies, and to more extensive planting of woodlands. Indeed, about this period—1770–1775—a strong current set in, in favour of a general improvement of Scotland, and of a more extensive system of planting, upon what might be styled an almost national scale. This full tide of public feeling and desire gained its height in 1784, when the Highland Society of Scotland was founded. The incorporation of such a Society naturally led to a direct advance in all rural matters. The steady progress in agricultural affairs, which had been quietly making its way amongst the tenantry of Scotland, suddenly received an incalculable impulse; and as by the auspices of the new Society it became necessary to shelter and secure climate for some of the land placed under cultivation, planting became requisite in the first place for shelter, and this led to the adoption of forests and woods, and of arboricultural subjects under the auspices of the Highland Society. The encouragement given by the Society to planters (whether proprietors or tenants), naturally led to increase the popularity of the Society; and the premiums subsequently offered for such arboricultural subjects as were specified for the year, tended greatly to an enhanced knowledge of tree-culture being manifested and followed among practical arboriculturists in Scotland. Indeed, the prize essays of the Highland Society upon arboricultural subjects may be considered as one of the chief features in the literature of Scottish arboriculture for many long years, and down even to the present day. The advantages acquired from the intercourse and mutual interchange of opinions with practical men, rendered necessary for writers of monographs for this Society, have led to the notice of many curious and singular phenomena in tree-life and its development under peculiar circumstances, which would probably, but for the auspices of such an association, never have been observed. The dissemination of such views and opinions throughout the country, and especially amongst landed proprietors and their tenants and foresters, has been productive of the highest good. The general views of the agriculture of the various Scottish counties, with observations on the means for its improvement, drawn up by eminent and reliable local reporters for the "Board of Agriculture and Internal Improvements," which had been organised about this period, were of themselves also another considerable impetus to forestry, inasmuch as land destined for reclamation and improvement, or reported upon for amelioration, necessitated in many districts more extensive planting, and attention to permanent enclosures of woodlands already existing. Although more an agriculturist than an arboriculturist, the proprietors of Scotland at the present day, and society at large, are under a deep debt of gratitude to Sir John Sinclair, the eminent founder of the Board of Agriculture, whose unwearied energy, continued during a long and useful career (one of his latest works * being revised by his own hand, in his 80th year), induced and stimulated others to forward the cause of progress and rural improvement throughout the length and breadth of the land, and to elevate agriculture, and other cognate industrial rural pursuits, from mere mechanical arts to the dignity of a science.

Along with these dawning rays of better days for arboricultural knowledge throughout Scotland, and as might naturally have been expected from the improved state of matters thus happily inaugurated, a whole shoal of authors poured their flood of ideas to swell the tide of enhanced and improved arboricultural literature. About this period (the beginning of the nineteenth century), the number of works which appeared upon tree-culture, and such kindred subjects, was quite unprecedented; and it would occupy more space than we can afford in this cursory sketch, even to notice these productions in anything like the manner which their merits deserve. It must suffice that the names only of a few of the more noticeable books upon arboricultural subjects are given in this paper. To review the matter contained in them would swell this essay into a very considerable volume. We have, first of all, the various admirable works of Gilpin, whose classical taste and skill in landscape effect are well known; and in several places at the present day his treatment of the subject is quite apparent in the harmony and pleasing effect produced by his labours. His essays on Picturesque Sub-

* Code of Agriculture, 5th ed. 1832.

jects,* his "Forest Scenery,"† and other works, are still standards of classical writing, purity of taste, and cultured ideas, and are as such worthy of reference for the planter or landscape gardener, no less than for the practical arboriculturist.

In 1800, Wm. Pontey published his "Profitable Planter,"‡ a treatise on the theory and practice of planting forest trees. It appeared in 1 vol. 8vo, and met a ready sale. The thorough practical knowledge of its author, narrated in plain language in every page, gave this volume what many others about this time much lacked—an impression of earnestness and complete fitness to inculcate useful teaching, which unfortunately many of the volumes appearing about this period sadly wanted. It was really, as he styled the book, as "*The Profitable Planter*," that he desired to appear before the public; and his whole volume teems with interest, and with an evident strong wish to teach others how to make the most of their trees and plantations, and how to plant with prospective benefit in a pecuniary view. About the same time, or a few years later, Mr Pontey published his "Forest Pruner,"§ which was destined to initiate the young forester into the art of pruning and treating physiologically timber trees. How he succeeded is best narrated by the fact that this book ran through several editions; and Mr Pontey himself long occupied the responsible office of "*forest pruner*" to two Dukes of Bedford. In publishing these works Mr Pontey disclaims all idea of writing with a view "*to sell*," but that his views and principles might become "*extensively useful.*"

But along with the appearance of those works upon arboricultural subjects just now cursorily noticed, there were others about the same time published, and all of more or less value, in so far as they touched upon the various phases or points of the art or science of tree culture, then so rapidly developing itself. We have thus, Marshall on "Planting and Rural Ornament," a standard work of the time, in 2 vols. 8vo, published in 1803. This, as it professed to be, was really a "*practical treatise*," and narrated in detail planting operations, descriptive notices of hedges and hedgerow timbers, seasons for planting, defending newly-planted trees, underwood management, timber groves, coppice, and modes of filling up wooded wastes, with details of the duties of foresters, &c. His second volume is devoted to

* Three Essays on Picturesque Beauty and Landscape, &c. W. Gilpin. 3d ed. 1808.

† Remarks on Forest Scenery, by W. Gilpin. 2 vols. 8vo. 1796.

‡ Pontey, W.—The Profitable Planter. 8vo, 1800.

§ Pontey, W.—The Forest Pruner. 8vo, 1806.

botanical descriptions, classical arrangement, and an index of English names, and an alphabet of plants. This is altogether a work of much merit, and well worthy, even at the present date, of the attention of young foresters. Besides these, we have Cruickshanks' "Practical Planter;"* Monteath's "Foresters' Guide;"† and also the works of Nichol, Sang, Billington, and various others, in each of which the usual operations of planting, thinning, transplanting, pruning, &c., form the prominent features, together with the treatment of planting waste lands, measurement of timber, and disposal of felled wood, bark, and other forest produce.

But while most of the works upon arboriculture about this period (1800–1830) were chiefly devoted to the principles that should guide the general operations of planting, one work appeared whose attention was wholly directed to an especial branch in the treatment of trees, namely, the transplanting of large trees for immediate effect. "*The Art of creating Landscape Effect*," or "*of giving immediate effect to wood on scientific principles*,"‡ as Sir Henry Steuart styled his "Planters' Guide," is a volume of much merit, of purely classical style and feeling, and contains many useful hints for those who choose to adopt this method of making haste to be rich in ancestral timber trees. He certainly did more than any other man then living to carry out the idea of removing large timber to other sites for effect and utility, whether of ornament or shelter, and he succeeded. His book is an admirable account of his modes of procedure, and worthy the attention of all at the present day who meditate the creation of landscape effect. Sir Henry Steuart's love of trees led him to do much to obtain them for immediate effect, but whether the cost of doing so, compared with the cost of planting young trees in favourable situations among nurses, is surpassed by the process adopted for immediate effect, the reader of Sir Henry's book must judge for himself. The old Scotch proverb, that "*the cost o'ergangs the profit*," may perhaps be found true in this instance, if any ardent enthusiast in tree-lifting should try the experiment upon an extensive scale. Sir H. Steuart, however, deserves much credit for his indomitable exertions in this behalf, and for his having so well achieved what he so laboriously undertook.

While thus the patient labours of literature and careful observation and study were doing their utmost for arboriculture, the following table of the dates of introduction of many new species of trees

* Cruickshank, Thos.—Practical Planter. 8vo, 1830.

† Monteath, R.—Forester's Guide and Profitable Planter. 2d ed. 8vo, 1824.

‡ Steuart, Sir H.—The Planters' Guide. 8vo, 1827.

into Britain will show that practical men were no less forward in their attempts to stimulate and advance the cause of tree-culture and the improvement of timber growing in this country, by adding to the already acclimatised varieties such others as seemed suited to the climate of Britain, and which have since become well known and established denizens of our woods and pineta :—

Pinus Cembra,	introduced	1746.
P. Laricio,	,,	1759.
P. pumilio,	,,	1779.
P. Pallasiana,	,,	1790.
P. calabrica,	,,	1823.
P. canariensis,	,,	
P. austriaca,	,,	1835.
P. pyreniaca,	,,	
Picea cephalonica,	,,	1824.
Pinus Pinsapo,	,,	1839.

Prior to that period there had been added to the flora of the British woodlands many varieties from the seaboard of North America, about the beginning of the eighteenth century, and from India early in the nineteenth century, viz. :—

Abies alba,	introduced about	1700
,, nigra,		
Pinus Strobus,	,,	1705
P. Tæda,	,,	1713
Banksian Pine,	,,	1735
Pinus (Abies) canadensis,	,,	1736
P. inops,	,,	1739
P. mitis,	,,	1739
American Larch,	,,	1739
Pinus serotina,	,,	1740
P. pungens,	,,	1742
Red Spruce,	,,	1754

Pinus resinosa,	introduced about	1755
P. rigida,	,,	1758
Araucaria excelsa,	,,	1793
Pinus longifolia,	,,	1801
Abies Smithiana,	from India	1818
Picea Pichta		1820
Pinus Gerardiana,		1822
Picea Webbiana,		1822
Pinus excelsa,		1827
Cedrus Deodara,		1832
Picea Pindrow,		1837
Abies Brunoniana,		1838

Among the more remarkable of the Californian species, the following varieties had been introduced during this era of activity in arboricultural literature down to the present day :—

Pinus ponderosa,	introduced in	1826
Abies Douglasii,	,,	1826
Pinus tuberculata,	,,	1825
Pinus monticola,	,,	1826
P. muricata,	,,	1827
P. Lambertiana,	,,	1827
Picea grandis,		
,, amabilis,	,,	1830
,, nobilis,		

Abies Menziesii,	introduced in	1831
Picea bracteata,	,,	1832
Pinus Coulteri,	,,	1832
P. Sabiniana,	,,	1832
P. insignis,	,,	1834
Taxodium sempervirens, (but known in 1796).	,,	1840
Wellingtonia gigantea,	,,	1853
Cupressus Lawsoniana,	,,	1854

These dates sufficiently prove the zeal which had been awakened in arboricultural matters, and the interest which planters in this country were evincing in the matter. The avidity with which, during the latter part of the eighteenth and the early part of the nineteenth century, arboriculturists ransacked foreign climes for new and rare species of *hardy* timber trees was fairly appeased, but only so to burst out afresh in new channels, with fresh longings and aspirations after new acquisitions.

About this time appeared Loudon's great work, the "Arboretum et Fruticetum Britannicum," one of the most stupendous undertakings in book history which has ever been achieved. This unparalleled testimony to indomitable perseverance and application which has ever been published, either in ancient or modern times, first appeared in 1838, and in a few years ran through several editions. It originally came out in numbers; and as all the trees which were figured in its pages were drawn from nature, they were published as they could be obtained, blanks being left for those of which good specimens could not be found. This doubtless led to some confusion, and inaccuracies in the plates arose from different names being given to the same plant, and only one tree was thus sometimes found to fill two spaces. In later editions this was rectified. The "Arboretum Britannicum" amply fulfilled the intentions and professions of its illustrious author, and may be briefly styled or described as an accurate and full record of all the trees and shrubs of Great Britain, whether these were indigenous or foreign; it correctly defines their hardihood, and suitability of constitution in that respect to the climate and situation of soil and otherwise; they are described in the most popular manner, and yet are scientifically treated at the same time, so that the systematic botanist, no less than the mere amateur in tree knowledge, can peruse Loudon's work with pleasure and satisfaction. The propagation, culture, and management of each species are carefully given, and the uses of the various trees or shrubs, whether in commerce or as useful for ornament or shelter, minutely described. The genus and species are delineated according to the Natural Orders; and one of the not least interesting divisions of this great work is the very complete historical and geographical vidimus given of the trees and shrubs throughout the temperate climates of the world, as known at the time the author wrote. This most comprehensive work, in itself a living monument to the patience, industry, and accuracy of an eminent botanist, occupies no less than eight thick octavo volumes—four of letterpress, illustrated by upwards of 2500 woodcuts, and the other four being composed entirely of octavo and quarto plates of reference. Some general idea may be formed of the great labour and research undertaken by Loudon in the preparation of this magnificent work, when it is stated that the list of books of reference to which he had recourse in the preparation of the Arboretum, and which he truthfully gives as showing his different authorities, occupies no fewer than thirty-seven closely printed and small-type pages of the first volume!

Other important works upon arboricultural subjects, and filling conspicuous niches in its literature in the earlier years of the nineteenth century might be named, such as the Hortus Kewensis, Miller's Dictionary, in which are rendered, along with portraits of the plants themselves, the names of their first introducers. The magnificent "Salictum Woburnense," and the no less interesting treatises of Cook and Hanbury, originally published contemporary with the earlier editions of Evelyn's Sylva, were still regarded as authentic even about the close of the eighteenth century.

Coming down to more recent times, we find in 1842 the issue of a book bearing the traces of careful study of trees and their management, in Selby's "History of British Forest Trees." This work, beautifully illustrated with steel engravings, is still an acquisition to any library where the collection of works on trees is desired to be complete. The monographs and critical notices of the various species are well and carefully digested, and contain many interesting particulars. The writer proceeds a good deal upon the style and manner of Evelyn, but his facts are more modern, and the book is more a handbook to the knowledge of the various trees than the more elaborate work of Evelyn.

In later years the attention of arboriculturists seems to have been directed more particularly to specific branches of the science; and, indeed, as it became more a study, and the treatment of trees came to be considered more with regard to the physiological laws of nature, and in accordance with these, it is natural to suppose that such subjects as pruning, transplanting, felling, draining, enclosing plantations, and diseases of trees, &c., would form material for many different exponents, giving to the world their views in their own specific department. Hence, we find such works as M'Intosh on the Larch Disease,* the Tree-Lifter by Colonel Greenwood,† Köllar on the insects which

* M'Intosh, C.—On Larch Disease. Fcp. 8vo.

† The Tree-Lifter, by Col. W. Greenwood. 8vo, 1844.

affect Forest Trees,* arresting public attention, and directing foresters and others interested in tree growth to the correctness or fallacy of their special views.

Again, we have "*the pine mania*," as it has been called, affecting enthusiastic tree growers, for whose special benefit, volume after volume and paper after paper upon the Coniferæ issue from the press. These have chiefly been printed since 1850. Thus we have the able standard work upon Conifers by Gordon,† with its valuable and indispensable supplement,‡ giving the synonymous names of the different pines of more recent introduction, with botanical nomenclature and descriptions, and other interesting details as to their hardihood, habitats, &c. Messrs Noble and Standish add another useful and valuable little handbook of these newer members of the flora of our ornamental woods, in their treatise on Evergreen Trees and Shrubs; while it is impossible to overlook the great undertaking of the late firm of Messrs Lawson in their truly magnificent fragment, viz., "Pinetum Britannicum," published in upwards of 30 parts hitherto, and the continuation and completion of which it is to be sincerely hoped is only delayed, not abandoned. Of the more recent introduction of the Japanese pines, we find in 1863 our esteemed fellow-labourer in the cause of arboriculture, Mr Andrew Murray, contributing his quota to the literature of the science in his "Firs of Japan," a useful and instructive guide to those planters who may be adding these newer varieties to their pineta. Nor would it be right to omit to mention here without a passing tribute of esteem the labours and writings of Mr Fortune, the pioneer of discovery and conquest from the Chinese and Japanese flora; for he has individually done more to enrich our gardens and pleasure grounds with treasures from the distant East, as well as from other remote climes, than any other man living; and while thus actively engaged in adding to the store of material wealth of our collections, his pen has been no less able and successful in giving us clear and interesting descriptions of the countries whence his captives were brought, and histories of the treatment and uses of these plants in their native habitats, of the highest value to us in their acclimatisation in this country.

Grouped together as interesting and instructive volumes for the training up of youthful minds to a right appreciation of and interest

* Köllar on Insects which affect Forest Trees. Fcp. 8vo, 1840.

† The Pinetum, Gordon and Glendinning. 8vo, 1858.

‡ Supplement to The Pinetum, Gordon and Glendinning. 8vo, 1862.

in the love of trees, we may mention here "English Forests and Forest Trees," 8vo, 1853, published under the sanction of the Society for Promoting Useful Knowledge. In this book an historical account is given of all the old English forests, from the times of the Druids, with their traditions, laws, and customs, and with individual trees described, and their historical associations referred to. "Trees and their Nature," by A. Harvey, M.D., published in 1856, is another valuable and instructive book for the young forester or boyish student of trees. The information, botanical, historical, and physiological, &c., is given in a pleasant, gossiping style, in the form of a series of letters from a father to his sons. "Forest Trees of Britain," by Rev. C. A. Johns, 8vo, and "British Forest Trees," 2 vols. 8vo, both issued by the Society for Promoting Christian Knowledge, are useful and entertaining for the general reader, or for the young forester's fireside of a long winter's evening.

Amongst the more modern works upon the subject of arboriculture generally, or upon the details of work of the practical forester, we must refer to three, as being each in its own line eminently calculated to meet the special requirements which its publication was intended to supply. These are "The Forester," by J. Brown, LL.D., Stirling, whose practical skill in the Arniston woods enables him to speak with the wisdom of experience upon all the various duties of the forester in their many forms, while his descriptions of the various species of trees are accurate and concisely given. A recent edition of this valuable work brings the information down to the present day, and embraces notices of the more recently introduced Coniferæ in Scotland and England. The second volume, to which we have referred, is "Grigor's Arboriculture," 8vo, 1866. This is also an eminently practical work, and is compiled chiefly from the successful papers which the author had contributed from time to time to the Transactions of the Highland and Agricultural Society. It is a book well worthy the careful perusal of all foresters, and it might be advantageous to the proprietors of large estates to place a copy in the bothies of their foresters and woodsmen, while its perusal and attentive study will qualify an intelligent young man for almost any department of practical forestry or planting. The third volume alluded to, and the most recent addition to the literature of arboriculture in this country is "Forest Trees for English Climate," by A. Montgredien. This beautiful volume contains a valuable catalogue of the different trees of recent introduction, showing their progress and hardihood in this country, with a carefully adjusted list of places where good collections exist. Several chapters are given upon the special adaptation of trees in this country for town culture, for foliage, for form of outline, grouping, or for planting in single line or solitary position. It is an admirable work and well written, but is certainly more adapted for the proprietor's library table than for the use and instruction of the practical forester.

A more recent work still than that of Mr Montgredien, is the octavo volume published last year by Messrs Longman, entitled "Hand-book of Hardy Trees, Shrubs, and Herbaceous Plants," by W. B. Hemsley (late of Kew Herbarium). This work is based upon the French production of Messrs Decaisne and Naudin, and deals largely with technicalities of detailed descriptions, nomenclature, &c. It contains a very full and complete glossary of terms in botany and plant economy. It gives the generic names, with their derivations in detail, for the benefit of such as have not a ready knowledge of Greek or Latin; and it gives very full descriptions, with the native countries and habitats, of the trees referred to, and adds general remarks upon the hardiness and comparative suitability of each to different situations and circumstances. The notice of herbaceous plants and flowers gives the work more a general botanical aspect than a merely arboricultural work requires, but still we are justified in awarding it a place in the literature of arboriculture from the value of the remarks and classifications, &c., allotted in it to tree culture, and the general excellence of the entire book. Its only fault appears to be that too much space is prominently given to some genera to the exclusion of some remarks that might have been made upon others. The nomenclature of Coniferæ, as in many other works at the present day, is sadly confusing and unsatisfactory.

The volume upon Old and Remarkable Trees,* edited under the superintendence of Mr W. Thomson (late of Dalkeith), gives a very fair and complete list of the largest trees throughout the country, specifying their girths, dimensions, soil, situation, and exposure, grouped into counties, and the different species of trees classified accordingly, with a letterpress description of the genus. But while this volume, as a record of what is old and remarkable, is good so far as it goes, there is much yet to be done in this particular branch of the literature of arboriculture, and in collecting

* Old and Remarkable Trees in Scotland. Thomson, Ed. 8vo. A Highland Society publication.

fuller statistics, for many of the best and largest monarchs of tree-growth in Scotland have been omitted.

But while much has been written, as will be seen from the foregoing cursory remarks, regarding the study of arboriculture in our own country, other nations have been increasing and perfecting their knowledge also of this engrossing subject. It would be impossible to enumerate the long list of works upon forestry published during the last two centuries in France, Hanover, Germany, Austria, and even in Italy of recent years. In these countries, the forest schools lend an immense impulse to the progress and development of such literature. But while thus passing over, with the mere mention of its existence, so important a feature in the world's history as the literature of arboriculture, we must not fail to refer to a volume upon a most important chapter of arboriculture, affecting the British Crown in a most material degree, namely, the arboriculture of the forests of our Indian Empire. So many young foresters from Scotland now go forth to seek their fortunes in the jungle and forest stretches of India, and in the Deodar-clad heights of the snow-peaked Himalaya, that it seems to us this paper would be incomplete in itself, and we should be wanting in respect to the services of one, of whom the Scottish Arboricultural Society should ever be proud as a worthy President, did we not notice Dr Cleghorn's excellent manual of the "Forests and Gardens of South India," published in 1861, and well worthy the careful and attentive perusal of any one proposing to join the forest staff of the Indian Government. In fact, it seems to be an indispensable handbook to such a life in India. We cannot close this somewhat discursive paper without reference to our own series of arboricultural papers, which ought to form, and probably, by and bye, will form the essence of the literature of Scottish arboriculture. This Society has now been in existence for twenty-one years, and during that long period, from a small and weakly nurseling, through a very chequered career, has now emerged into her full strong majority, with a constitution invigorated and strengthened during recent years. Throughout these two decades, and without one blank, this Society has published her small annual volume of Transactions, or prize essays of the year, upon prescribed subjects connected with arboriculture in its varied departments. We have therefore in the seven volumes of Transactions already published, the thoughts of practical men upon the different phases of tree-growth, and culture, and treatment. Crude and imperfect although these papers may often be, progress has been made, and improvement is visible as year by year rolls on; and we fondly hope, if indeed we may not believe and assert, that with such a phalanx of the flower of Scottish forestry—that cradle of the literature of the science in which some of her ablest and most practical writers and authors were reared in bygone years—the future is bright with expectation; and that so long as the members of this Society manfully and cheerfully hand in hand pull together as a united brotherhood in the interests of arboriculture, the literature of that important department of rural economy will not be allowed to become a thing of the past, nor the researches of any labourer in her cause be forgotten.

XXV.—*On the Present State and Prospects of Arboriculture in Aberdeenshire.* By William Gilchrist, Forester, Cluny Castle.

Aberdeenshire is allowed to be one of the best wooded counties in the north of Scotland, and in some parts the work connected with the management and rearing of plantations, and the manufacture of wood, have been the chief industries of the people. The extent of ground under wood has been ascertained by detailed statements to be about 115,000 acres. The Board of Trade Returns for 1872 give it at 93,680 acres, but these returns may well be doubted, as, where so many parties are interested, it is almost impossible to procure accurate information.

West Aberdeenshire—or the district drained by the Dee and the Don, with their tributaries, is the principal wood-growing portion of the county. An old couplet says:—

> "The Dee for fish and tree;
> And the Don for corn and stone."

But at present, taking into consideration the amount of ground suitable for, or what could be most profitably used for the growth of trees, the basin of the Don, at least, the upper part of it, is fully equal to that of the Dee. The part of the basin of the Deveron in Aberdeenshire is also well wooded, the famous Binnhill (2600 acres), said to be the largest plantation within one ring in the county, being on the north bank.

Towards the end of last century the planting of wood on waste land was prosecuted vigorously, and had it been continued the income of some estates, where large tracts of suitable land still exist, would now have been considerably increased. The impetus, from some cause, did not continue long; but it was revived about thirty years ago, and at present the more extensive planting of the waste land is a practical problem to be solved before any great extent of it can be improved and kept in cultivation.

The introduction of water-power sawmills, and of portable engines with saw machinery, has developed the wood trade of the country considerably, and increased the sums obtained for rough wood. The high prices which for sometime have been realised from the sale of timber has forced proprietors to appreciate it as an important item in the income of an estate, so that much more waste land has been planted during the past few years than for a long period previously. Taking all this into consideration, and making due allowance for what may yet be planted, the probabilities are that the future arboriculture of Aberdeenshire will be better than the past. No doubt extensive tracts of waste land suitable for growing trees will still remain unoccupied; but in a large county it is impossible to get the proprietors all of one mind, even though the object aimed at be the clothing of our waste and barren hills with wood.

Valley of Dee.—About fifty years ago, Deeside was the best wooded portion of the county; but as a demand set in for home wood, and as the prices increased, the wood on Deeside was fully taken advantage of, and in some instances large revenues were for a time realised. In the districts of Aboyne, Glentanner, Balfour, Birse, Ballogie, Finzean, and the borders of the county near Banchory, large quantities of wood have been cut, and in some instances whole hillsides have been cleared. Parts of the famous Glentanner Forest have been replanted, but the greater proportion remains waste. The ground and situation is most suitable for the Scots fir; it has been the principal variety used, and is doing remarkably well. Larches also grow well, but they are not so numerous. Opposite Aboyne, on the south side of the river, an extensive tract of plantation has been formed recently, principally Scots fir, with a few larch and mixed hardwoods. The forest of Birse still remains unplanted, but portions of the hill ground adjoining have been planted, and, considering the exposure, are doing well, so that the district will in a few years have somewhat of its former appearance. Portions of the low ground, after being cleared of wood, have been reclaimed and made arable, but the greater part, especially about Ballogie and Aboyne has been replanted. Judging from the progress that the second crop of wood is making, it is generally allowed that a good deal of the ground recently made arable would have paid the proprietors as well under timber. In several young plantations about Ballogie the ordinary varieties of hard wood, as also some of the newer conifers, are growing luxuriantly. Near Aboyne Castle, specimen hardwood trees, oak, ash, elm, &c., are numerous in the parks and policies, as also old larch and Scots fir.

For some time large quantities of good wood, principally larch and Scots fir, have been cut in the Ballater district, but much still remains, especially about Birkhall, Abergeldie, and Balmoral, including the fine old wood of Ballochbuie. At Glenmuick most of the old wood has been cut, but contracts for planting on an extensive scale have been entered into and begun lately—25s. per acre being the price of plants and planting. As a rule, the planting at these places has not kept pace with the cutting, but at Balmoral some belts and clumps of mixed hardwood trees, as also some of the newer conifers, have been introduced, principally it is said at the instance of the late Prince Consort. These have been most judiciously arranged, and considering the district are doing remarkably well. Natural birch grows freely throughout this part of the district, but it can seldom be grown profitably.

At Invercauld large quantities of first-class wood have been recently cut, but a good deal of the ground thus cleared has been replanted, so that the arboricultural prospects of that district and of Upper Deeside may be said to be fully as good as the past. A large extent of ground has been planted on the right bank of the river, between Invercauld and Braemar, as also on the lower slopes of Benavon and Benabuird, but the extent is small when compared with the available waste land suitable for the growth of trees, and it is apparent that the banks of the upper part of the Dee are not nearly so well wooded as they ought to be, large tracts of land which would grow good Scots fir and larch, being occupied with natural birch, aspen, alder, rowan, &c.

The remains of old forests are still found in the district, conspicuous among these are Glen Derry, Glen Lui, and the remains of an old pine forest near the source of the Quoich, and farther down this glen both banks are well wooded with fine thriving Scots fir. In Glen Derry and Glen Lui little now remains except a few straggling trees and clumps of old Scots fir. It is said that a few years ago, when clearing out the dam of Derry, which was formerly used for floating timber, some fir logs were found bearing the date 1656. These logs when taken up were comparatively fresh and sound.

In the district between the Dee and the Don, including Cromar, Tarland, Kincardine O'Neil, Cluny, Midmar, Echt, and Skene, there is some very useful wood, principally larch and Scots fir. The larches are in general not very heavy, but they are good and useful. About Tarland and Cromar some good plantations, chiefly Scots fir and larch, may be seen at all stages of growth. These have been mostly formed during the last forty years, and are chiefly on the estates of Cromar, Tillipronie, Blelack, Melgum, Coldstone, &c. Some plantations in this district have been formed remarkably cheap; for instance, in 1862, the hill of Craigton, near Lumphanan, was planted for 11s. 6d. per acre, one-fifth of the plants being larch; and in 1867 the hill of Hilton was planted for 10s. per acre. Since that time prices have gradually increased, the same class of planting costing 30s. per acre at Glenmillan this year. The Learney woods are extensive compared with the extent of the property. A great deal has been cut there lately. On the Hill of Fare, which extends from Learney to Echt, including part of Crathes and Midmar, the larch is frequently covered with "moss" sometimes 8 or 10 inches in length,—and yet the wood does well and is of fair quality. The Scotch fir does not succeed so well on this hill, except on low grounds, but in some of the glens on the north side there are specimens of very large dimensions. The north-east, east and west sides of this hill are well wooded, but not the north and south sides, although they are in every way suitable for growing good wood.

A large portion of a long ridge of hill stretching almost from Dee-side to Don, through the parishes of Kincardine O'Neil, Craigievar, Tough, Cluny, and Monymusk, has been recently planted by the several proprietors, especially on the south and east slopes. A large portion of this hill was planted by contract at from 18s. to 22s. per acre, and has been quite a success. The trees are principally larch and Scots fir, with spruce in the soft and mossy ground. Though planted at intervals during the last twenty years, the hill side begins to have a uniform appearance, so that the district will soon be considerably changed and the climate ameliorated. This tract of plantation is mostly virgin soil, having been planted in heather land. The greatest drawback to its growth is a moorband pan, which often occurs near the surface, the portions where it occurs most frequently have been partially drained, to counteract the pan if possible. Most of the plants are doing well and growing rapidly. In the Cluny district there are some splendid Scots fir plantations, the size of the trees and quality being second to none in the county, if we except the famed wood of Ballochbuie on Deeside. Larches are also large and of good quality, but not nearly so numerous as the former. The districts of Craigievar and Tough are fairly wooded, but not to the extent that the waste land and the hill ground seems to warrant. Towards the lower end of Tough, and about the centre of Cluny, on some small properties, a good deal of wood has been cut recently, but little planting has been done. Echt, Skene, and Castle Fraser are all well wooded, the second crop being in some instances almost fit for cutting. In proportion to its extent, the parish of Echt is the best wooded in the county. Since the estate of Dunecht came into the possession of the present proprietor, the conservation of the plantations has been steadily kept in view. At Castle Fraser some of the hard wood trees, but especially sycamores, oaks, and beech, grow as well as in most of the southern counties. The larch and Scots fir are, however, the principal crops; the latter being mostly at maturity, cutting down has been going on for some time, and the greater part will soon be cleared off. In the Skene district there has not been much cutting of wood for some time, although there are several Scots fir and larch plantations fully matured. Some of the young plantations are the second crop, and consist principally of Scots fir, spruce, and larch. Much of the ground was previously occupied by Scots fir. In some of the plantations there are still a few of these standing, along with some good beech, sycamore, and oak. From this towards Aberdeen there are several thriving patches of young wood, mostly narrow belts and clumps, the most extensive being at Hazelhead, Countesswells, and Craigiebuckler, where there are some good broad belts and clumps, chiefly of mixed hardwoods, with firs as nurses. The Scots fir and larch do not seem to grow so well, but there are some good silver firs, and elm and ash grow freely. Besides the ordinary forest trees there are good collections of shrubs, including rhododendrons, laurels, and holly, the three latter being quite at home. There are also a number of the newer coniferæ. At Drum Castle there are some good old Scots fir of the "Highland bonnet" type, but the Scots firs of from thirty to fifty years old do not appear to be so vigorous. Hardwoods are growing among the old Scots firs. Several young plantations have been formed, and in most of these, besides Scots fir, larch, and spruce, there is a mixture of the black Italian poplar. This tree seems to be well suited for the district, and there is reason to believe that it will occupy a prominent place in future arboriculture, especially in situations not suited for the growth of the Scots fir and larch.

From Park to Aberdeen, plantations are more detached and cultivated for ornament than profit. Several exceptions may be noted, as on the estates of Culter, Deebank, and Murtle, there are some fair sized plantations of mixed hardwoods with Scots firs, larch, and spruce, as nurses. None of the trees are of remarkable size, and many seem to have suffered from the want of thinning and judicious pruning during the earlier stages of their growth. Near to the mansion-houses there are good specimens of larch, Scots fir, beech, birch, chestnut, ash, *Cedrus Deodara*, &c. There are many villas and small mansionhouses in the outskirts of Aberdeen, and round these there are many interesting exotics. The different varieties of holly seem to grow with more luxuriance than is usual in the immediate neighbourhood of large towns. Visitors often remark that hollies seem to be natural to Aberdeen. Many fine specimens of the newer Coniferæ are grown in the suburbs of Aberdeen, such as *Cupressus Lawsoniana* and *Nutkaensis*, *Araucaria imbricata*, *Cedrus Deodara*, *Picea nobilis*, *Nordmanniana* and *Lasiocarpa*, *Abies Douglasii*, and species of *Thuja*, *Taxus*, &c. Besides these, varieties of deciduous trees are numerous and good.

Valley of Don.—Following the course of the Don from Aberdeen, except at Parkhill, there are no remarkable arboricultural features until Kintore is reached. Several patches of mixed hardwoods and fir clothe some of the steep banks, but of no great extent; the ground is better suited for growing corn than wood.

Parkhill is one of the best wooded properties near Aberdeen; the revenue from the woodlands is not neglected, but conservancy is the chief consideration. Thinning and pruning have been carried out in a judicious manner. The Scots firs are not of fine quality, but are healthy and growing well. Larch and spruce are smaller, and not so numerous. Oak and beech have had ample room for development, and having been judiciously foreshortened, the result is better specimens than are generally found in the north of Scotland. Coniferous trees are also numerous, not only in the vicinity of the mansion house, but throughout the woods; wherever a vacant space occurs a Douglas pine is planted, and it is wonderful how well these thrive amongst the old trees. Most of the coniferous trees are growing remarkably, and are tall for their age; they have been pinched and foreshortened until they are formal almost to a fault. Shrubs of many varieties are growing in great luxuriance. To the south, on the hill of Tyrebagger, there are some Scots fir and larch plantations, which are mostly at maturity.

In the district of Kinaldie and Fintray the plantations are mostly belts and clumps of mixed hardwood and firs. Most of these have been laid out with great care and taste, but there is not much old wood, and no great extent of young plantation.

At Kintore the woody district is again entered, and in this valley there is a great extent of wood under twenty years old, a large part being a second crop. It consists chiefly of Scots fir and spruce, with a small proportion of larch.

At Keithhall there are some good specimens of old ash, elm, gean, and spruce, the ornamental plantations and clumps are numerous, and laid out in a most systematic manner. They are chiefly hardwoods, planted close for immediate effect, with a few firs as nurses. On the high ground the plantations are extensive, and the firs are more numerous. The present management is good, and augurs well for the future. On the left bank of the river the Kemnay woods are fast disappearing, but these are mostly mature. As most of the ground thus cleared is unsuitable for agriculture, it will probably be replanted. On the right bank the plantations are small and detached. In some of the older plantations young trees (especially silver firs) are planted freely, to produce cover for game, the conservation of the woods being a secondary consideration. At Fetternear, park trees and ornamental clumps have been planted, and these are beginning to have some effect at a distance. The revenue to be derived will, however, be small compared with regular plantations.

Monymusk and Castle Forbes come next in succession, and are two of the best wooded properties in the county. At both places there are extensive sawmills, and the wood is manufactured at the instance of the proprietor. All the ordinary varieties of forest trees are numerously represented, but Scots fir and larch are the principal crop. At Monymusk the old wood of Paradise is the great attraction. Besides the famous larches, which take rank among the best in Scotland, there are splendid specimens of Scots fir, spruce, silver fir, and Scotch yew; also oak, elm, beech, ash, plane, and other hardwood trees. It would be difficult to name a place in the north of Scotland better furnished with fully grown arboricultural specimens. There is also a good collection of the newer coniferæ, but being much overshadowed by the larger trees, they cannot be expected to attain to great perfection, although the soil is most suitable for their growth. Near the mansion-house there are many large specimen hardwood trees, mostly at maturity. As a rule, more ground has been planted than cleared, but the young plantations have made little progress although some have been replanted. A hill-side, where a fine crop of old wood was cleared off a number of years ago, has been several times planted, but without encouraging results. Oak and hazel copse grows freely, but this is being gradually cleared out, and larch and oak substituted. A bobbin factory and a manufacturing sawmill being on the property the chief consideration in the management is a regular revenue. For some time this has decreased, but under ordinary circumstances there will be no difficulty in maintaining, and in a few years increasing, the revenue, so that the arboricultural prospects will compare favourably with the past, especially as there is a great extent of wood (Scots fir and larch) ranging from fifteen to fifty years old. The Castle Forbes woods are in many respects similar to Monymusk, and for many years a great trade in manufactured wood has been carried on. Larch and Scots fir of large size are now becoming scarce; but there is still a good extent of well-grown wood, between fifty and sixty years old, on both sides of the river between Benachie and Cairn William.* The young plantations are principally larch and Scots fir, the former predominating and thriving best. Most of these young plantations have been planted on virgin soil, and they promise to yield a handsome revenue at no distant date. In the parks around the castle there are good specimen trees of most of the common hardwoods and firs, and a few newer coniferæ have been lately introduced. On the right bank of the Don, above Castle Forbes, the plantations are more detached, the principal ones being on Whitehaugh, Littlewood, and Braes of Forbes; a number of them have been recently formed.

On the left bank of the river the principal plantations are at Tonley, Lynturk, Haighton, Breda and Brux. At all these places Scots fir and larch are the principal crop, and are growing in small plantations, belts, and clumps. There are also some fine old trees in the parks near the mansion-houses, but except the beeches at Breda, and some fine hardwoods at the Kirk of Tough, none of them require special notice. In the Cushnie and Towie districts, larch and Scots fir thrive moderately well, but there is *comparatively* little wood grown. A great part of the land suited for growing wood is at present pastured or lying waste, and some of the cultivated land would yield a higher rent under wood than under rotation cropping. The probabilities therefore are that a great extent of wood will be grown in these districts at no distant date.

Returning to the north side of the Don, there are some good mixed fir plantations, extending from the Braes of Forbes towards the Clova district. Although these are not so extensive as the woods of Castle Forbes and Monymusk, still they add considerably to the value and appearance of the district.

In some of the glens, particularly at the Burn of Craig, there are fine larches from seventy to ninety years old, tall, straight, and

* Since the above was written, 300 acres of this wood have been sold for the sum of L.17,000.

apparently free from disease. Along the hillside belonging to Clova, Craig, Leithhall, Wardhouse and others, several fine plantations are getting up rapidly, and useful sparwood has already been supplied from this district. At Clova the larch grows with a good deal of taper, but the wood is of good quality. Spruce is growing freely on deep moss, and in the garden there is a good specimen of the *Araucaria imbricata.* Throughout the whole district there is still a great extent of ground—hill and dale—well suited for the growth of trees, and there is not nearly so much planted as the soil and the area of the district seem to warrant. At Kildrummy there are some fine specimen trees, especially larch. Scots fir is also of good quality. The hardwoods in the vicinity of the old castle are growing particularly well considering the district. Large tracts of young wood have been planted on the hills of Ardhuncart and Glasgul, principally Scots fir and larch. From Kildrummy upwards towards Strathdon young plantations are not so numerous, but there are some good belts and clumps of Scots fir, larch, spruce, and hardwoods at Glenkindie, as also some good specimens of old ash at Mains of Glenbucket. On the estates of Newe the Scots fir are of fine quality, and seem to be in their native habitat. At Forbes Lodge and Edinglassie there are good Scots fir and larch plantations on both sides of the water, with hardwood trees near to the mansion-houses. As yet not much has been sent to the market, as from some plantations it will scarcely pay the carriage. It is, however, used for local and building purposes, and for whatever is thus required good prices are readily obtained. Pit props from some parts of Strathdon would hardly pay the expense of transit, though got in the plantations free of expense. Wood grows so well throughout this district that it is probable a much greater extent of land will be planted, and if such were the case, the railway might be extended for the special transit of wood.

Valley of Deveron.—Leaving the Don, the next best wooded district is on the banks of the Deveron at Huntly Lodge,—the famous Binnhill, one of the largest plantations in the county, being on the north side, not far from the river. It is a mixed plantation of Scots fir, larch, and spruce. Larch is most numerous on the north and west sides, Scots fir on the south and east sides, with spruce on the mossy ground. The outside boundary line of the whole is Scots fir. The north, east, and west boundary is convex, and the south a double concave. On the north side of the river, from about a mile to the west of the Binnhill to the boundary of the county, a great extent of wood has been planted within the last twelve or fifteen years,—the whole of which is doing well. On the south bank the wood has been recently cut, but as the ground is unsuitable for agriculture it will probably be replanted.

The principal trees in the parks and policies at Huntly Lodge are beech, oak, lime, (very old) silver fir, elm and maple, plane, spruce, Scots fir, and larch; all of these are extra good when found close by the river. Most of the Huntly Lodge woods have been well thinned. Thinnings and firewood command a ready sale at fair prices. From Forman Hill to Huntly Lodge is well wooded, principally with mixed firs, the principal plantations being on the estates of Cobairdy and Lessendrum, some fine hardwoods grow by the waterside, chiefly ash, beech, oak and plane. Near to Turriff there is some good wood on the estates of Delgaty, Carnoustie, Auchry, Craigston, and Hatton Castle. The most thriving varieties are elm, plane, ash, spruce, and silver fir. Except in the glens the wood is not nearly so well grown in this district as in the western part of the county. At King Edward the wood is mostly grown in belts and clumps, and hedge-rows, and is chiefly mixed hardwoods. The principal young plantations are at Byth and Eden. Returning to the valley of Bogie there is good wood on the banks of the Bogie near its junction with the Deveron, as also at most of the mansion-houses in the district, but wood is not plentiful in Strathbogie,—the district being chiefly agricultural. The lower slope of the Benachie range might with advantage be more extensively planted as the trees already there are doing well. At Pitcaple and Logie-Elphinstone wood of all sorts grows freely, and there is a good extent extent of young plantations (chiefly Scots fir, spruce, and larch) coming on. Most of the matured wood has been felled, and a great extent of the ground replanted, which is doing well. Elms, planes, and oaks are plentiful in the parks and policies and along the road side, but not of any great size. There is very little wood grown in the upper part of the Garioch district, the ground being chiefly arable, but there are a few hedge-row trees, and hedges, which are doing well. On the south slopes of the Foundlin hills there are some larch and fir plantations, and also some good hardwoods; but the subsoil is slate, and not adapted for the growth of wood; still the result is not discouraging, as the wood that has grown is more profitable than any other crop would have been. In some of the sheltered glens about Sheelegreen larch and Scots fir, and even plane, beech, and oak, are doing remarkably well considering the situation. The Scots fir are coarse but useful, and the larch are "carroty shaped," but of fine quality, and when used for fencing purposes last for a very long period. Throughout the Formartine and Buchan districts the woodlands occupy a small area compared with the extent of the district, with the exception of Meldrum and Haddo House, the principal plantations being in the immediate vicinities of the mansion-houses and policies, and are cultivated more with a view to ornamental effect than for profit. The plantations at Meldrum and Haddo House are the most extensive in the district, and manufacturing sawmills are kept up at both places. Larch and Scots fir are the principal varieties, but oak, birch, and hazel copse grow freely in some of the glens. A number of young woods have been formed recently; the most prominent of these being the hills of Barra, Bourtrie, and Thornton, the former was planted by contract at 13s. per acre. Thorn and beech hedges grow freely. The district is highly agricultural, and in a country where there is so much land suited for growing trees (where a crop of wood is the only profitable crop it will produce), it would not be advisable to occupy much of the arable land with wood. Still, even in this district a good deal of wood could be grown with advantage, and there is no doubt that in future a fair proportion of wood will be planted to provide shelter for the agricultural crops and cattle. Some of the waste lands might also be planted with advantage, and if the Foveran sands or such places could be covered with wood a great advantage would have been gained. It is probable that a fair trial of this experiment will be made at no distant date.

Hedges form a prominent arboricultural feature, and in districts such as Buchan, Formartine, and Garioch, where trees are not extensively grown, live fences might be more extensively introduced, especially where stones for building dykes are scarce.

Such is a brief outline of the present state of arboriculture in Aberdeenshire. The extent under wood is 115,000 acres, the greater portion being in the western division. Scots fir and larch are the principal trees grown for profit. The hardwoods are chiefly found within the parks and policies as specimen trees in belts or small clumps. There are scarcely any hardwood plantations, or even mixed plantations with hardwood, as the principal crop far removed from the mansion-house or policies, some woods of natural birch being the only exceptions.

An exact classification has not been arrived at, but the following is an approximation of the relative ages of the woodlands at this date, viz. :—

	Acres.
Wood at 70 years old and upwards, . .	4,500
Do. from 50 years to 70 years old, . .	26,000
Do. from 20 years to 50 years old, . .	35,000
Do. under 20 years old, ...	47,000
Do. within policies, ...	2,500
Total, . . .	115,000

From these figures it will be seen that, in regard to acreage, the future will compare favourably with the past and present. Still there are many obstacles to prevent the future plantations from realising the same revenue as at present. No doubt in many cases a much higher revenue may be reasonably expected, but many of the young plantations recently formed are distant from the market, and some occupy places almost inaccessible. In such situations, (unless a great expense is incurred by the proprietor in the formation of roads previous to disposing of the wood) the receipts must necessarily be very small. It is probable that as the wood traffic increases, railways may be extended, or temporary tramways laid down as feeders for the permanent lines. Some years ago, when traction engines were introduced, it was thought that the transit of wood would be effected more expeditiously and cheaply; but the use of traction engines having met with opposition from the road trustees, there is little advantage to be expected in that direction for some time. Workmen's wages are also increasing rapidly, and with the present outlets and depôts for wood, there are many places in West Aberdeenshire where even good pitprops scarcely pay the cost of cutting and transit.

That is the dark side of the picture; but with improved management of woods, it is reasonable to expect that a better class and crop of trees will be grown. Appliances for the cheaper manufacture and transit of wood may also be introduced. Besides, as the prosperity of the country advances, the demand for wood will also increase, and it will consequently rise in value. Such has been the experience gathered from the past.

Foreign wood will also become more difficult to procure; and as general cultivation advances, even in these countries where the wood supply has been considered inexhaustible, the woodlands will recede from the rivers and lines of transit. All these circumstances tend to make wood scarcer, and the price will necessarily increase; in fact, during the last three years the price of wood has increased at least 20 per cent. Apart from the direct value of timber, wood exercises a benign influence on the agriculture of a district, so that to improve the agriculture, the aid of arboriculture must be called into requisition in providing shelter for the crops and herds. This is especially requisite in a county like Aberdeen, the north and east coast of which is much exposed to the cold cutting blasts. It is not necessary to cultivate large tracts of wood in that part of the county, but without doubt there ought to be a fair proportion of belts and clumps of wood, along with the more general introduction of hedges. There is considerable room for improvement in respect to these points throughout the greater part of East Aberdeenshire.

Looking at the future of the county, it is probable that arboriculture will occupy a more important position in estate management than now, although the present time compares favourably with the past. From the approximate classification, it will be seen that the woodlands have increased considerably during the last twenty years. It is also to be observed that a great part of the new wood is on hilly ground, not previously occupied by trees. The prospective value of the whole, taken at an average of L.45 per acre, which is a low estimate, would be L.5,175,000, or sufficient to yield a yearly revenue of upwards of L.100,000. Besides this, it is no exaggeration to state that the area of woodland in the county could be doubled, and a great extent, which at present is covered with natural birch, &c., could, by judicious management, be made to grow more profitable kinds. It is therefore probable that if the woodlands of Aberdeenshire were fully developed and extended, an annual revenue of about L.200,000 might be realised. This sum, besides increasing the income of landed proprietors, would indirectly benefit the railway companies, and tend to develop the rural industries.

The want or neglect of thinning is one of the greatest dangers to be apprehended in the recently-formed plantations. Many of these have been planted at $3\frac{1}{2}$ to 4 feet apart, and some at 3 feet apart, and as most of them have succeeded well, they invariably are, if not previously thinned, perfect thickets at from 12 to 16 years old. The distance from market makes the thinnings of no value at that age, and workmen's wages being high, it is often difficult to have the plantations thinned judiciously in due time. The usual plan is to leave all alone until they are fit for pit-wood, &c., or till the strong overgrow the weak. This apparent difficulty may in the future be more easily overcome than at present.

In agricultural and grazing districts, where the principal consideration in growing wood is other than its pecuniary value, the proper conservation should be the chief aim in the management. On several estates in the county this is at present the principal object, and in agricultural districts it is often the most profitable management that can be adopted, and as its indirect benefits are seen, it will be more general than at present.

The largest ornamental plantations are in the parks and policies of Haddo House, Fyvie, Pitfour, Parkhill, Dunecht, Fetternear, and Keithhall. Scots fir, larch, and spruce are the trees mostly grown throughout the county, but it may be interesting to note where good specimens of the following trees may be found :—

Norway Spruce (*Abies excelsa*)—Aboyne, Invercauld, Abergeldie, Midmar, Monymusk, Whitehaugh, Castle Forbes, Haddo House, and Huntly Lodge.

Silver Fir (*Picea pectinata*)—Pitfour, Strichen, Huntly Lodge, Cluny, Midmar, Ballater, Invercauld, Breda, Haughton, Monymusk, Hazelhead, and Culter.

Plane (*Acer Pseudo-Platanus*)—Craibstone, Kinmundy, Leithhall, Glenkindy, Newe, Cluny, Aboyne, Castle Fraser, Drum, and Monymusk.

Alder (*Alnus glutinosa*)—Birse, Aboyne, Invercauld, Huntly Lodge, Delgaty, Haughton, Breda, Strichen, Culter, and Drum.

Horse Chestnut (*Æsculus Hippocastanum*)—Craibstone, Culter, Echt, Pitfour, Balfling, Skene, Aboyne, and Invercauld.

Birch (*Betula alba*)—Invercauld, Abergeldie, Birkhall, Finzean, Aboyne, Breda, Kildrummy, Ballogie, Cluny, Monymnsk, and Haughton.

Hawthorn (*Cratægus oxyacantha*)—Aberdeen, Pitcaple, Cluny, Leithhall.

Spanish Chestnut (*Castanea vulgaris*)—Waterton near Ellon, Pitfour, Tonley, Monymusk, Castle Fraser, and Aboyne.

Beech (*Fagus sylvatica*)—Huntly Lodge, Aboyne, Balfling, Cluny, Philorth, Pitfour, Kemnay, Echt, Midmar, Hallhead, Meldrum, Balbithan.

Ash (*Fraxinus excelsior*)—Huntly Lodge, Cobairdy, Craibstone, Strichen, Cluny, Castle Fraser, Kemnay, Leithhall, Glenkindy, Abergeldie, Invercauld, Aboyne, Tonley, Haughton, Newe.

Walnut (*Juglans regia*)—Westhall, Kemnay, Craibstone, Midmar, Huntly Lodge.

Holly (*Ilex aquifolium*)—Ellon, Culter, Drum, Midmar, Finzean, Balogie, and Aboyne.

Mountain Ash (*Pyrus aucuparia*)—Invercauld, Glengairn, Glenmuick, Midmar, Newe, Strichen, Edinglassie, Dee Castle.

Wild Cherry (*Prunus Cerasus*)—Cluny, Edinglassie, Huntly Lodge, Echt, Keithhall, Glengairn, Birkhall.

Poplars (*Populus monilifera* and *canescens*)—Kemnay, Manar, Tonley, Aden, Strichen, Aboyne, and Echt.

Aspen (*Populus tremula*)—Aboyne, Invercauld, Ballater, Dee Castle, Castle Forbes, Glenkindy, and Kildrummy.

Huntingdon Willow (*Salix alba*)—Edinglassie, Philorth, Aden, Echt, Castle Forbes, Fetternear, Glenkindy, Birkhall, and, Aboyne.

Lime (*Tilia europæa*)—Ellon, Philorth, Birkhall, Aboyne, Strichen, Huntley, Aden, Monymusk, Castle Fraser, Cluny, and Leithhall.

Oak (*Quercus Robur*)—Philorth, Pitfour, Aden, Strichen, Culter, Drum, Skene, Monymusk, Cluny, Breda, Haughton, Huntly Lodge, Aboyne, Ballater (natural).

Scots Fir (*Pinus sylvestris*)—Seaton, Parkhill, Drum, Philorth, Strichen, Wardhouse, Leithhall, Haughton, Castle Forbes, Whitehaugh, Monymusk, Cluny, Midmar, Newe, Huntly Lodge, Aboyne, Ballater, Abergeldie, Invercauld, Mar Lodge, Fyvie.

Larch (*Larix europæa*)—Aden, Strichen, Culter, Kemnay, Ward-House, Cobairdy, Newton, Abergeldie, Invercauld, Mar Lodge, Aboyne, Leithhall, Clova, Breda, Haughton, Monymusk, Cluny, Learney, Midmar, and Drum.

Yew (*Taxus baccata*)—Culter, Ellon, Midmar, Leithhall, Monymusk.

Elm (*Ulmus montana*)—Huntly Lodge, Cobairdy, Pitfour, Craibstone, Cluny, Monymusk, Drum, Echt, Edinglassie, Invercauld, Aboyne, and Birkhall.

XXVI.—*On the Draining of Plantations, by Open or Covered Drains.* By Lewis Bayne, Forester, Kinmel Park, Abergele.

The influence of the drainage of land on the growth of crops of all kinds must be apparent to every one engaged in agricultural pursuits. Its introduction is one of the greatest improvements in farming, and also in modern forestry; for the preparation of the ground by thorough and judicious draining is essential to the proper formation of plantations, and to the renovation of ill-thriving ones, as there is small chance of success where trees are planted in wet undrained soil.

To draw away from the ground a commodity, which in dry seasons is so useful, and the want of which causes many young trees to die, seems strange. But it will be found that, by judicious draining, the necessary supply of moisture is not taken from the soil, but only the *excess*, and that the soil will retain a supply of moisture; while neither extremely dry nor very wet seasons will so injuriously affect the plants as on undrained land. But drainage produces beneficial effects besides removing superfluous water from the ground. When land of a clay or tenacious nature is filled with *stagnant* water, all atmospheric influences are curtailed, and the plants are not only deprived of their proper nourishment from the soil itself, but the presence of noxious substances in their vicinity injures their health and cheques their growth. Ground in such a condition is naturally in a very cold state; and as the water can only, to a certain extent, be got rid of by the process of evaporation, the heat of the sun's rays, instead of warming the soil, is taken up with this operation. But while the ground is relieved of the water by this process, its poisonous ingredients remain in the soil, and the greater coldness of the atmosphere and of the ground, along with the excess of moisture, in time rots the roots of trees, and renders them more liable to be blown down by wind.

Having noticed the bad effects of an excess of moisture on the soil and its crops, we come to the benefits arising from thorough and proper drainage. By removing superfluous water from the soil, a way is made for the air to aid in decomposing the organic substances, which become the food of the plants, and ingredients which are hurtful to plant growth, and which cannot otherwise be removed, are carried off by rain. Not only does the removal of extra moisture make land more dry, but it allows the soil to have the full benefit of the sun's heat, rendering it warm and congenial to plant growth, and ready to benefit by the least shower of rain, at the same time raising the temperature of the surrounding atmosphere. Draining also makes soil of a stiff or tenacious nature more friable, and better prepared to receive the fibrous rootlets of plants, and by the action of the atmosphere hard pans or crusts are broken and pulverised, so that the roots may enter them, a result which could not otherwise be obtained without subsoiling or trenching.

Before commencing the operation of draining many things are to be considered, such as the kind of drains to produce the best and most lasting effect upon the ground, whether they should be open or covered? Again, if covered drains be best, whether they should be laid with drain pipes, or tiles; or should the bottom consist of stones set on edge in a triangular form, with a few inches of broken stones over them, or be filled with broken stones to the depth of a foot or 15 inches? and the best line to run the drains, the depth, and the distance one from another, so as most effectually to dry the ground at the least expense, are points calling for careful consideration. These may be usefully dealt with in detail.

First, As to the kind of drains. Open drains are most used for plantations, and have many advantages over covered ones, whether laid with tiles or stones; the greatest objections are, the liability to become choked with soil, leaves, branches, &c., which necessitates their being often cleared out; the width necessary to keep them from falling in when of good depth; their inconvenience in the removal of timber, and their unsightly appearance in home plantations. But where the surface water is the great evil to be removed, they render the ground dry although of no great depth, and are therefore not so objectionable in such circumstances. In few cases, however, is surface water the only moisture to be removed, and open drains are seldom effective if less than two feet deep, however close they may be to each other. Covered drains, on the other hand, especially in hardwood plantations, are liable to be choked by the roots of trees, and this, after heavy rain, causes the water to burst up and saturate the ground, making it more wet than if it had not been drained; another result of this is that the roots of the trees are starved and rotted, and the ground made so spongy and soft, that the least storm of wind may overthrow the trees. Such effects are often seen in home parks and demesnes, where trees are growing near to covered drains, and the work of lifting, clearing, and relaying the pipes, while destructive to the roots of trees, entails considerable expense, because, after the roots have once reached the pipes, these operations have to be often repeated. We have seen pipes, tiles, and stone drains so choked with tree roots, that it was impossible to extract the mass without breaking the pipes. In such cases, the drains had been made after the trees had arrived at considerable size, but the result would be equally bad in young plantations, although the time of destruction might be postponed. Elm, ash, and poplar are most destructive to covered drains, as they choke them with their roots in a short time, even if growing at some distance. Larch, spruce, and other surface rooting trees are not so liable to cause injury in this way, and covered drains may therefore be adopted more effectively in fir plantations, than among hardwood trees, for the removal of bottom water.

The liability to injury of covered drains in hardwood plantations is much to be regretted, because they can be made with equal convenience to any depth, and but for this objection, would not only dry the ground to a greater depth, but would save the trouble and expense of clearing open drains, which often get filled with soil, leaves, branches, herbage, &c. It has often been observed that drains which had not enough of water to run when open, on being laid with pipes, and covered in with soil, worked efficiently; and the effect is the same in the case of drains with little fall or nearly level, the water will stand in the drains when open, and even follow the drainer as he finishes the drain, but when it is laid with pipes and covered in, the water will flow immediately.

Notwithstanding what has been said, however, open drains are to be recommended generally for plantations in respect of their non-liability to be damaged and plugged by the roots of trees. If kept clear of leaves, branches, &c., and cleaned out as often as may be necessary, they will in most cases produce the desired effect, if properly and thoroughly made. It may not be out of place to make some observations in regard to covered or furrow draining, as well as open draining, as there are situations in the range of most foresters, where open drains would be out of place and impracticable. Of the different kinds of covered drains, those laid with pipes or tiles claim the first place, with this qualification, that where stones are abundant, and pipes or tiles are distant, stones may be used for this purpose as a good way of disposing of them, when not required for fencing, road-making, or other estate purposes.

Covered drains should never be less than 3½ feet deep, while they need seldom be more than 4 feet. The main drains will, of course, be a few inches deeper, according to the size of pipes to be used, and this will depend upon the wetness of the soil, and the number and length of the common drains to run into the mains. Pipes with a bore of $1\frac{1}{2}$ to 2 inches are usually large enough for common drains. Pipes with collars have many advantages over tiles or pipes without collars. These assist to keep the pipes in their proper position, and prevent any sediment from entering the joints, and the pipes are more easily and quickly laid in the drains. Before the pipes are laid, a little straw is good for forming a clean and firm bed where the ground is soft, or very wet and slushy; the wooden and tile soles often used are liable to sink at the ends in soft ground, and the straw bed therefore is preferable. If main drains or leaders are of great length, or if two or three unite at a given place, a cesspool or tank may be made to receive any sediment that may be in the pipes; it may be built with bricks, or stones and mortar, as most convenient, say 6 feet long, 2 wide, and 2 under the flow of pipes in depth, floored with pavement stones, and covered with the same material, or wood, to open with a lid or door. The length stated facilitates its being cleared out, giving room for the use of the necessary tools, which would not be the case if the cesspool were 2 or 3 feet square.

Open drains should seldom be less than 2 feet deep, and they are inconvenient in many respects if more than 3 feet deep, except in particular cases. In young plantations, open drains 2 feet deep, 3 feet 4 inches wide at top, 6 inches at bottom, and from 24 to 40 feet apart, act well and give satisfactory results. A width of 3 feet 4 inches at top gives a good slope to drains 2 feet deep, and with corresponding widths at top they may be made to any desirable depth. But the narrower open drains are at the bottom, the better will the water run, and the less liable are they to be choked by leaves, &c. Confined to a limited space, the water acquires force, runs more regularly, and thus more easily carries away leaves and small particles of soil with it. If the water were allowed to spread over a foot or more of bottom surface, any small obstacles would be backed up with such soil or leaves as might come down the drains, and in a short time the deposit would become quite fast, and when heavy rains came, causing an extra flow of water, the flood would be forced into the sides, and undermine the slopes of the drains, which in time would fall in, causing trouble and expense in repairs. It is evident that the greater the breadth at the top, the more secure will the sides of the drains be from falling in, for when cut straight down in loose and friable soil, and especially after frosts and heavy rains, when the ground is soft, and a strong run of water flowing, the risk of injury to the sides is very great. But when the soil is stiff or tenacious, less slope will be necessary. Open drains $1\frac{1}{2}$ feet deep are sometimes sufficient to dry the ground, where there is only surface water to contend with; but as a general rule, drains less than 2 feet deep will not dry even the surface soil sufficiently for the reception of young plants. On the other hand, when over 3 feet deep, they are not only inconvenient in the removal of thinnings or timber from the plantation, but they require great width at top, and take up more room than can be spared where close draining is necessary. It is however impossible to fix any definite depth for open drains, as 2 feet might answer the purpose on some soils, as well as 3 feet in others, but $2\frac{1}{2}$ feet is a good average depth. In draining peat bog or other soft soils, containing a large quantity of organic substance, an additional depth should be allowed for subsidence as the water is removed, and if a stratum of gravel or clay occurs at no great depth, it is well to reach it so as to give the drains a solid bottom, as well as to dry the ground more thoroughly. In forming plantation drains, the soil taken therefrom should be spread between the drains, so as to make little weight on the sides. If such soil be left on the margin, its weight would tend to make the sides fall in, and the soil so left would crumble and be washed into the drains by heavy rains in a short time; but by spreading it towards the middle, the centre is in a manner ridged up, and during heavy and continued rains (especially in tenacious land), the water, instead of remaining on the surface, at once flows towards the drains, and the roots of the plants are free from stagnant pools; the ground is thus more dry after the trees have grown up, even should the clearing out of the drains be neglected.

The distance between drains, whether open or covered, depends upon circumstances. The nature of the soil and the depth of the drains require to be considered, as the more open and porous the soil is, and the deeper the drains are formed, the greater will be the distance at which they may be made, and *vice versa* in stiff tenacious soils with drains of less depth; but it is seldom necessary to have covered drains closer than 15 feet from one another, and open drains 24 feet apart between centres, or at greater distances from each other than 40 feet. When open drains are closer than 24 feet at 2 feet deep, they become inconvenient, taking up much room, and leaving so little space between, that trees cannot sufficiently spread their roots, and are thereby liable to be overthrown by wind. When, therefore, that interspace (24 feet) is too great for open drains 2 feet deep, it would be preferable to have covered drains, rather than open drains of that depth, closer to each other, or the ground may be intersected say every 50 or 60 yards with open drains 4 feet deep, running into a leader or main drain 3 inches or so deeper, with open drains $2\frac{1}{2}$ or 3 feet deep, and 30 feet apart between the 4 feet drains. If merely surface water is to be removed, and the soil is of a retentive nature, drains 18 inches deep and 20 feet apart may produce the effect without adding to the cost. On the other hand, when open drains are cut at a greater distance apart than 40 feet, even if 3 feet deep, they have little effect in removing either bottom or surface water from the centre of the intervening space, and in land requiring so little drying, a few well laid out drains 2 feet deep may answer the purpose. Open drains 4 feet deep alone, at the required distance apart for the draining of wet ground, are objectionable, on account of the great width at top required to keep them from falling in, and they are otherwise inconvenient and costly.

The direction or line in which drains are run, so as to produce the best and immediate effect, by the removal of stagnant water, &c., must depend on the natural lie or fall of the ground. Main drains or leaders should always be made in the lowest parts of the ground, and have as free an outlet as possible. Too great a fall should, however, be avoided, as the water received from the sub-drains after heavy rains acquires such force as, in the case of open drains, is liable to damage the sides or bottom. When, therefore, the ground is hilly, or has a steep slope, with an extent of level land at the bottom, a main or leader or sub-leader drain may be cut along the bottom, so as to drain the level ground, and another for the reception of the water from the slopes. Without such an arrangement, if there is much water running in the small drains down the slope, it will flow with great force to the bottom, and run more slowly on the level portion, thereby any soil or sediment carried down by current is left on the more level part from the want of force to carry it to the outlet, filling up and choking both open and covered drains in the course of one or two seasons. But by having a main drain for each portion this is avoided, as the greater run of water in the main drain from the small ones carries any sediment from the slopes towards the outlet.

Many opinions exist as to the direction in which small drains, whether covered or open, should run. For a long time, and until lately, it was a prevailing idea among practical men that oblique drains, whether covered or open, *across* the natural inclination or fall of the ground, were the most effectual, in the belief that such drains would in that way *catch* the water as it came down the slopes; and many still consider this the proper course as regards open draining. But as drains are made to receive infiltrated water from the soil as well as surface water after heavy rains, the best system is to make the drains run with the natural inclination of the ground. In this way the drains have a good run or declivity, which is important to promote an easy flow of the water collected, and they are also of nearly equal depth on both sides, and so have the greatest drawing or receiving powers in all directions, and from all quarters. On the other hand, when drains are run obliquely or at right angles, on moderately sloping ground, say at 24 or more feet apart, the bottom level of the drains will be reached at a few feet from the under side, while the water will have to descend several feet before arriving at the level of the adjoining under drain, and such drains would therefore in a great measure act from the upper side. Again, by the former method, springs and wet patches are more sure to be tapped and the water removed than by the oblique or cross system; the latter in many cases misses them, even if of greater depth than drains cut in a straight line down the slope, and so the ground is little benefitted by the labour and money expended. But in the case of very steep hills or mountain sides, where there is a great flow of water, the perpendicular system may with advantage be deviated from, especially as regards open drains, as the sides are liable to be undermined by the too rapid flow of the water. In such circumstances, therefore, the drains should run in an oblique direction, not quite at right angles, but at as acute an angle as practicable ; and it is advisable to shorten the length of the drains, and thereby lessen the quantity and run of water, rather than have the drains at right angles.

All drains should be made with as equal a gradient as possible, so that they may run regularly, and not have a rapid and slow flow alternately, causing them to be filled up and choked in the lower places.

The length of drains, open or covered, must be determined by the fall of the ground and the quantity of water they are likely to contain ; but in no case, except under special circumstances, should covered drains run more than 300 yards,—and 200 yards will generally be sufficient for open drains ; while, if the flow of water is strong, and the ground very steep, half that distance will be enough.

In draining a portion of ground for planting or other purpose, a great variety of soils may be found within a small area, requiring the drains to be made of various depths, and at different distances. For example, in 1872-3, thirty acres of land to be planted varied so much, both in the nature of the soil and in its wetness, that in some parts drains 2 feet deep were cut at distances varying from 24 to 40 feet, and a portion did not require any draining at all. The drains were all 40 inches wide at top and 6 inches at bottom, and the soil well spread back between the drains; and although the subsoil was in many cases of a tenacious nature, the result of the draining has in every way proved satisfactory, as on the most wet and level parts the ground has become firm and dry. It may also be mentioned that the ground had been deeply ploughed in preparation for the planting, which materially assisted in producing the successful result. Indeed, it will invariably be found that stirring or loosening the soil, either by trenching or ploughing, is an essential preliminary operation, and gives the drains a better chance of producing an early effect than would result from draining alone.

The beneficial effect of drainage of wet and cold land upon the health of plants is sometimes seen in a striking manner when performed some time after trees have been planted. An instance of this was observed by me four years ago. A plantation, consisting of Scots fir, larch, and spruce, had been made some years previously; the ground had been sown with gorse as a cover and for shelter, the position being very exposed. The gorse in some parts grew only a little, while in other parts it never made its appearance, and the trees over the whole space made small progress. The spruce had assumed a yellowish-green colour, and the larch was covered with a superfluity of cones, two unmistakeable signs of disease and premature decay, caused by unsuitable soil and excess of moisture. Only a few cross or oblique drains had been made at the time of planting, and these were placed about 30 yards apart, and were 15 inches deep. With the view of improving the growth and appearance of the plantation, by rendering the soil more suitable for the trees, it was all thoroughly drained to a depth of 2 feet, the drains running parallel with the natural slope of the ground, and 24 feet apart. In casting the drains it was seen that the first foot would be of little use in drying the ground, as much water was below, but the second foot had the desired effect; a great quantity of water flowed off in a short time after the drains were cut to that depth. The subsoil was of a hard gravelly clay, with numerous large stones, and therefore the drainage was a difficult operation, requiring great labour, but when finished it was completely successful in drying the ground, and the effect on the plantation was very marked. The first summer after draining the spruce and larch assumed a more healthy look, and the whole plantation is now in a thriving state; and this, I believe, is entirely due to the drainage of the ground.

In draining old plantations, say over thirty years old, containing hardwood trees, great care must be taken in selecting the more open parts, and laying out of the drains to avoid cutting the roots of the trees as far as possible, even should the drains not be equi-distant, nor in altogether straight lines. Again, in cases of extreme wetness, it is advisable to drain the ground moderately at first, and to deepen the drains at different times afterwards, until the desired effect is attained, as it will be found that after the trees have been growing a length of time in extreme wetness, a sudden change in the moisture and temperature of the soil, caused by draining off all the water at once, would injuriously affect them.

The difference between drained and undrained land was remarkable during the very wet season of 1872, when even the best made drains were taxed to the utmost, and well drained land was not too firm or dry, while undrained land inclined to be wet became a regular marsh.

When trees are planted on undrained wet land, they soon become sickly, and covered with lichens; the fir and evergreen kinds become yellowish green, stunted in their growth, and covered with cones, sure signs of premature decay and disease, sooner or later followed by the death of the plant.

In forming covered drains, it is best to have the pipes laid and the soil filled in each night as the work proceeds. To execute drains badly, whether covered or open, is a useless sinking of money, especially covered drains, the making of which requires the greatest possible care in laying out, having proper depths, and laying pipes properly in a smooth well finished bottom.

From the differences and varieties of soil and subsoil, the value of labour in different localities, and the various depths to which drains are made, no definite statement as to prices can be given in this paper, farther than that, in ordinary circumstances, open drains might be made 2 feet deep, and the soil spread, from 1s. 10d. to 2s. 9d. per chain, and 4 feet covered drains, opened and filled in, at from 2s. 6d. to 3s. 6d. per chain of 22 yards, and at proportionately less rates in peaty soils.

XXVII.—*On the Conservation of Old and Remarkable Trees in Britain.* By Robert Hutchison of Carlowrie, F.R.S.E.

There is at the present day, in the mind of every true lover of Arboriculture, the same deep-felt and wide-spread desire to preserve the bloom and vigour of life's early years in the hoary and venerated forms of the remarkable trees that fall under his notice, as, in the middle ages, existed in the thoughts and aspirations of the alchemists and physicians who sought, by the aid of the "*philosopher's stone*," or the "*elixir vitæ*," to ward off the ravages of time or the infirmities of old age, and to restore the fair freshness of youth to the withered form and wrinkled visage, in whose well-marked furrows disease and decay were too plainly, though silently doing their work. In fact, rejuvenescence is the one grand poetic idea of the universe; it pervades all the operations and minutest processes of nature. In the vegetable world, death and decay are everywhere followed by renewal; from the tiniest hedge-flower to the giant forest oak, the lesson is taught us of active and incessant decay, counterbalanced by active and ceaseless reconstruction; so that the earth's surface is maintained, as fair and as verdant in youth as it was when the first morning's sun shone upon creation.

Notwithstanding this compensating and recuperative power in nature, however, the slow growth of most of the species of timber-trees in this country renders the conservation of old and remarkable subjects, whether they be notable on account of their dimensions or appearance, or from some historical association, highly desirable; and any measures that can be suggested for arresting the ravages of time and age must be valuable, and deserving of the careful attention of every lover of the picturesque and beautiful. Nor is it wonderful that the desire to preserve fine old individual trees should be so general, when we consider the value which scientific observation, and the experience of many years on continents, such as that of India, have taught us, of the preservation of a due balance of wooded land for the benefit of climate and rainfall. In the present utilitarian age, we are too apt to overlook the value of plantation ground, and to wish rather that it were devoted to the culture of food-producing cereal crops for the increasing population of our islands; but this is now shown to be a mistake, and it is clearly demonstrated, that a sufficient area of wooded land is as essential for the due development of the agricultural economy of any country, as the tillage of the soil itself, or the application of the seed to the ground. It may be partly owing to our climate, but chiefly to the vast supplies of coal with which our island is favoured, that the British nation throughout the globe is known as the most regardless of the value of forests; and in many foreign parts, emigrants from our shores are now feeling the want of timber, for shelter, shade, or climate adjustment, which their own reckless indifference has destroyed. The proper conservation of individual old trees fosters a general feeling for a careful attention to the growth and treatment of groups, plantations, and forests, and leads to a better acquaintance with a branch of Arboriculture too little understood at the present day.

In considering the question of the conservation of large trees, the subject naturally divides itself into two heads, each of which in its mode of treatment is entirely distinct from the other. 1*st*, Conservation may be directed towards the maintenance and development of trees *in progressive vigour*—to old large timber trees still enjoying health, and whose grateful shade, or graceful outline, in sweeping arms, it may be desirable to foster for amenity or picturesque effect in the landscape or park. Or, again, 2*d*, It may be requisite that steps be taken for the conservation of some old gnarled bare trunk, whose hollow stem and blasted head bear witness to the flight of many centuries, and around whose venerable form cluster memories and associations of historical or family interest or traditionary lore, which it is well to keep alive in the minds of a countryside by the preservation of the trees themselves, whose very names refer to the events their presence commemorates.

The steps to be recommended for the conservation of old trees, under either of the foregoing heads, are naturally much alike, and simply embrace measures of a remedial nature, taking in both instances due cognisance of the elementary principles of vegetable life in the tree. If trees were, in the early stages of their growth, to receive that care and attention which their importance demands, and which their ultimate value will show to have been necessary, there would be little need for the adoption, in later years, of measures to promote their progressive vigour and ultimate recovery from premature decay or decline. Early and fearless thinning, so that the young tree may find ample scope and free air for the development of its youthful form, is one essential requisite too often neglected, and the oversight of which is one of the most fruitful sources of early decline in old trees. In trees, as in the animal kingdom, the true secret of success in promoting a full physiological development, and maintaining a healthy frame, consists in prompt attention to early habits and appearances, and in checking in youth what might prove baneful to the constitution of the plant in later years. This may be called *the prospective or active treatment* for the maintenance of progressive vigour in trees. The other treatment involves the arrestment of decay or decline in individuals already evincing symptoms more or less defined; and, while the measures to be adopted are based on the same principles of the growth of vegetable tissues in the tree, they can never be so satisfactory, nor so remedial, as the same steps would be if taken in the case of younger and more vigorous subjects. The method of treatment in regard to such trees may be styled *the retrospective* or *passive.*

Before, however, proceeding to suggest the various remedies which seem limited to these two classes of old trees, it may, perhaps, be as well that we should cursorily notice the principles of vegetable growth and structure in tree-life, to which reference has been made.

All organic beings commence their existence at the bottom of the scale, and assuming one type of life after another, finally acquire the parent type or form. The perfect state of one organism is only the embryo form of another—the highest forms being merely the sum or aggregation of all the lower series. Thus the oak tree combines within itself all the various divisions and peculiarities of structure upon which the classification of plants is based. Its wood is, as all are well aware, *exogenous, i.e.*, growing from within outwards; its bark is *endogenous, i.e.*, growing from without inwards—hence its rugged and serrated appearance of trunk,—and its roots are *acrogenous, i.e.*, growing at their extremities. So it is that the various distinctive characteristics of the vegetable kingdom are embodied in the oak. The cell is the organic atom, the basis of all life. How the cells forming the tissues of the smallest plant, or the wood of the heaviest oak were formed, we cannot comprehend. It is one of the profoundest mysteries of creation. All the innumerable varieties of form, colour, and condition in the vegetable kingdom, arise or result from the conglomeration or combination of cells, and from this source spring the various phenomena of growth in the higher plant life, such as that of trees. In these the cells, as soon as formed, die and give birth to others; but they do not, as in the case of animal cells, decay and dissolve or change into gases or mineral substances, but become enclosed in the tissues of new cells, and are thus preserved from the action of weather and alternations of temperature, the exposure to the influences of either of which would rapidly decompose them. "They afford soil and mechanical support to the new cells. The new cells in their turn give birth to other cells, and in their turn die, and their offspring encloses them again in their protective mantle. Thus the growing tree goes on and stops, grows old and becomes young again, ends and begins, until it has reached its highest ideal of form, and its longest term of existence." The difference between plant life and animal life is, that the former exists and is promoted by the growth of *additional* cells, while the latter is maintained by the means of *substituted* cells. Thus a tree may be said to have within its trunk only one generation of active living cells at one time; year by year this one series of active cells becomes dormant, and is replaced or rather is added to by another series or generation, while there are as many generations of dead or inert and inactive cells built up in the tissues of the wood of the tree as it is old. Only the present year's growth may be held to be active; the rest is entirely composed of past generations of heart-wood, not literally dead, but inactive and passive, and which would decay were it not for the protection from the weather and alternations of climate which the living layers of tissue outside afford. Year by year the sap adds new tissues to the structure, just as the blood circulation in animal economy is requisite to repair and replace the decayed waste tissues; and as in the animal world, in the period of youth, the restorative process is more powerful, and new tissues are then added to the old; and in maturity, the relative processes of reproduction and decay are equally balanced; while in old age the destructive or declining process outruns the restorative,—so, in the vegetable kingdom, during the younger years of plant or tree life, corresponding processes are at work, which tend, during the various stages of growth, maturity, and decay, to similar results.

In attempting, therefore, to conserve old timber trees, and bearing these vital principles in view, attention must be directed, in the case of large trees still vigorous, though evincing incipient signs of decay, to the prolongation of the growing period of the tree, and efforts must be directed to stimulating the formation of additional cell tissue, and thus keeping the health of the tree in a progressively vigorous condition. On the other hand, should the subject of treatment be in a declining state, whether from accidental or natural causes, efforts must be used to arrest the decline, by stimulating the growth of young wood, branchlets, and leaves, so as to aid in the elaboration of sap throughout the head of the tree.

The causes of what may be styled, for want of a better epithet, "*backwardness*" in large or old trees, are frequently obscure and puzzling. It may arise from many sources, such as exposure to sudden extremes of temperature in spring, chilling the young foliage, and stunting its development to such an extent as seriously to interfere with the leaf functions for the season. The penetration of the rootlets into an ungenial substratum or subsoil, inimical to the further progress of the tree, is another cause of "backwardness" in large trees; and this is one of the most difficult and fruitful sources of mischief with which the arborist has to contend. Defective root action, arising from bad drainage, or from a water-logged state of the young spongioles and rootlets, also frequently tends to incipient stagnation of wood formation and to a hide-bound unhealthy appearance of bark, resulting shortly in a "stag-headed" condition of the upper branchlets. Recently transplanted trees of large size are peculiarly prone to suffer from this last form of "*backwardness*," through the interference with the rootlets in the process of removal and subsequent drought.

One of the first symptoms of a check having been sustained in the continued progressive vigour of any tree, is an appearance of scanty foliage during the summer months along the very top of the upper branches and at their extremities. If this is allowed to go on, in another season these outer and upper branches present a bare, dead appearance, appropriately called "*stag-headedness*," from the resemblance of these denuded branches to the antlers of a deer. Trees in exposed situations are most liable to suffer from this evil, especially if the subsoil be shallow, and of a cold damp nature. The remedy therefore lies in stimulating, by such artificial means as suggest themselves, according to the soil and situation and nature of the tree, the action of its vegetative powers, and the formation of cellular tissue at such extremities of the branches as have become bare and dead like. This will be found to be almost invariably attained by giving the tree, around its trunk and for a space outwards as far as the outer tiers of branches overshadow, a liberal mulching of fresh loam or soil of a friable nature. By such an application to the soil, increased energy is imparted to the more fibrous roots, which are always situated nearest the surface of the ground, and any lack of chemical food-agents in which the site of the tree may be deficient, from long occupation and consequent exhaustion, will be supplied. The application of such fresh soil may be made at any season of the year. Autumn is probably the most advantageous period, and it may consist of road scrapings in a loose, well-turned over, friable condition, mixed with lime, or applied alone; or of old well decomposed leaf-mould mixed with peat soil; the scourings of ponds or ditches, which have been allowed to dry, and been well turned over and aerated by the frequent use of fork or spade; or, indeed, of any good clean fresh earth of open texture. The surface of the ground about the tree should be lightly forked over previous to its application. The depth to which this compost or top-dressing should be laid, depends upon the situation of the tree to be operated upon, but it should be deposited round the trunk to a depth of not less than two feet (in some cases, when the trunk is exposed at the neck, to a depth of three or four feet), and be gradually tapered off, so as not to offend the eye, from the stem outwards to a final depth, at the extremity of the circumference of the branches, of one foot of fresh soil. In the following season all the dead branchlets in the head of the tree should be cut back to where young wood will have formed, and it is a considerable assistance to the formation of young wood to thin out the head of the tree carefully, by cutting off several of the side shoots springing from the main branches; thus admitting light and air, and promoting a condition favourable to the development of young wood and foliage. In some cases, ash trees, from 60 to 70 feet in height, and growing in strong loam with a clayey subsoil, thus treated after they had shown evident signs of incipient decline, have been known to recover their former vigour. Horse chestnut and lime trees, in the same situation, and from 200 to 250 years of age, have been also successfully treated by the same process, after having been allowed to remain "*stag-headed*" for fully three years. Hollies injured in the memorable winter of 1860–61, and from 20 to 30 feet in height, after presenting an almost dead appearance, were treated in this manner, and the dead branches cut back to the very stem, in some instances leaving almost nothing but the quasi-dead trunk above, and are now fully furnished with dense masses of foliage of the most healthy hue of glossy brightness; and although now lacking the large wide-spread arms, they have been by this treatment *saved*, and their height, as tall evergreens, secured, where absence would have created an unsightly blank. The growth of young wood under this treatment is sometimes so thick that it is necessary, after the first season, to thin it out, removing superfluous shoots, and singling out leading twigs into which the force of the resuscitated action may be directed for the formation and development of new cellular tissue. It may sometimes be necessary, where the natural soil in which the tree is placed is inimical to its habits and nature, to use as a compost or top-dressing a mixture of earths of various kinds, and the reverse in their chemical composition, of the soil in which the tree has begun to wane. In cold, clay, damp, or wet tilly soils, for example, in which few hardwoods will thrive for any long time, or acquire large dimensions, it will be found advantageous to use a mixture of coal ashes or wood ashes (the cinders having been removed), compounded with road scrapings (silicious) or well decayed peat, in the proportion of one part of coal ash to three of road scrapings, or mould of peat or decayed leaves. A compost of this description need not be laid on thicker than about one foot at the tree neck, gradually tapering off to about four inches thick at the outer circumference of the circle. It should be applied in autumn, and during the fall of the leaf, and carefully stirred into the soil in which the tree is growing. The use of ashpit refuse from dwelling-houses, from which all cinders have been carefully removed, is not so generally appreciated as it ought to be for the promotion of vigour and healthy foliage in trees. If administered to young specimens, and dug into the soil in which they are intended to be placed, its effects very soon become apparent in the increased root action, and consequent improved health and appearance of the plants.

In cases of large trees whose condition seems to be stationary, although not positively backward, it will be found beneficial to use a top-dressing of rich loam mixed with leaf-mould and police manure, or house coal ashes, in the proportion of one cart of the latter to four or five of the former, and to lay the compost "*barrow thick*" upon the roots under the drip of the branches, without levelling the surface during the first winter. In this way the rains and snows of winter wash in the various chemical agents of which this compound is made up, and carry down to the rootlets fresh supplies of food, along with the quantity of carbonic acid gas derived from the atmosphere; and in this way the powers of exhausted soil in which trees have been too thickly planted are renewed, and the dormant functions of nature in the tree itself receive a revivifying impulse.

The application of police manure or street sweepings as a medium for increasing and intensifying tree life was first suggested by the appearance of several beech trees, of large dimensions, standing in rows in the centre of a field which, after long remaining in pasture, had been broken up for cropping. During the earlier years of the rotation, no difference in the progress or appearance of the beeches was apparent; they had previously exhibited symptoms of decay and *stationary* existence for many years; but one season, after an unusually liberal application to the soil of rich well-turned police manure for a turnip crop, the beech trees suddenly appeared to have taken a new start,—a fresh lease of life as it were,—and their unusually strong growths of young wood quite apparent, while the colour of their foliage lost that sickly hue which had for years distinguished them. It seems, therefore, reasonable to suppose that the suddenly increased sap-action in these trees was due to the chemical agency of the ingredients of the police manure in the soil; and it is perhaps worthy of further experiments, whether the stated application of this manure, in well-regulated quantities, according to the individual requirements of special cases, might not be adopted alone, as in the case of the beech trees referred to, as an active stimulant to promote stagnant tree life, and also as a revivifying agency to restore to comparative vigour trees whose waning appearance may have for years suggested gradual decline and approaching death.

To younger specimens, and chiefly to some of the more recently-introduced coniferæ and evergreens, the application of liquid stable or byre manure has long been known, and its use has been in many instances of much benefit. It requires, of course, to be presented in a highly-diluted form, and either in the autumn or winter months after rain, and while the ground is well saturated with moisture. It is of considerable benefit to the progress of *Araucaria imbricata*, and to many of the *Cupressus* and *Juniperus* families. But it requires carefu luse in the case of those pines (*Abies* or *Piceas*), which are of themselves prone to throw out early buds in spring; for any undue stimulant of growth during the cold frosty winds of March or April must be attended with corresponding failure and disappointment. In using liquid manure, therefore, in such cases, it is better to apply it, well diluted, in May than at an earlier or later period of the year. To stimulate such species, either into too early vigorous growth in spring, or to prolong their active vitality into late autumn, and thereby retard the proper ripening of their young wood, is alike a mistake, and necessary to be guarded against.

When, in any particular instance, it is deemed proper to administer diluted liquid manure to cure stagnant energy in tree-life, it must be applied very slowly and gradually. For the principal object in the application of any manure is to supply as much soluble matter as possible to the roots for their absorption into the system of the plant or tree, and if it be administered slowly and gradually, it must necessarily be the more thoroughly assimilated in the gradual formation of sap and the various tissues.

A mulching of short cut grass has sometimes been found beneficial for top-dressing the soil around and over the roots of choice or rare specimen trees and shurbs, and it has often proved of much advantage to the *Araucaria imbricata*, *Cedrus deodara*, and other newer introductions, in many places, acting not only as a manure, but also as a preventive against evaporation, and as an important agent for retaining the moisture in the soil. Such an application plays a double part, and is worthy of more general adoption than at present is accorded to it. If the covering be neatly laid on, and closely and evenly spread, there is nothing unsightly in this mulching, and it is of very great advantage in many other ways.

Another fertile source of incipient decline, and a means of accelerating decay and death in old trees, is the practice of leaving dead wood, and allowing nature to rid herself, by the intervention of wind or storm, of many a useless dead bare limb or branch, which should have been skilfully removed when death became apparent. The rugged wound which a gale of wind causes in wrenching off dead branches from the heavy limbs of a tree is the source of much ultimate evil. Weather works down into the scar so created, and the dry woody tissues of the stump aid the further spread of decay. Old timber trees should, as regularly as young plantations, be gone over carefully every year, and have all dead or dying big branches and twigs sawn over, the wounds being, at the time, covered with a good coating of strong oil paint.

This leads us to consider the other process of conservation of large trees, referred to in the early part of this paper, viz.,—to the cases of those in which all progressive vigour is beyond recall, but whose picturesque and gnarled trunks or hollow stems, from historical associations or traditionary legend attaching to them, it may be desirable to use every possible means to preserve. The appliances in such cases are mainly mechanical. Painting the shattered wound caused by the livid thunder-bolt, so as to exclude the destructive ravages of the wind and rain; roofing over with zinc or lead the hollow decaying stem of some historical memorial; girding with iron hoop or rod to its parent stem some giant limb, whose swaying form the hurricane has well-nigh wrenched from the old trunk, are remedies too well known and generally practised to call for any notice in this paper. But there is one means for the better protection and supervision of the state of old and historical or remarkable trees throughout Britain, which, we venture to suggest, would do more to call attention to such ancient landmarks and historical fingerposts, and secure their conservation, than any other measures of protection yet adopted. We propose that under the auspices of this Society (within whose province it is clear that such a task would not be out of place), as they are the best medium for obtaining the requisite information, a system of registration, or Census of all the old and remarkable trees throughout the country, should be formed. Full particulars as to their position, age, condition, girth, soil, subsoil, and locality, could easily be obtained, along with a reference to any interesting historical events connected with them, from the numerous zealous members of the Society scattered over the various counties and parishes of the country. The information so collected would be tabulated, arranged, and published in the Society's Transactions from time to time, supplemented with any remarks that may be necessary; and if a series of illustrations of the several subjects described could be added, as doubtless might be easily obtained, we should then have a guide-book, and record of one of the most interesting groups of ancient memorials of which the country can boast; and one which, alas, too surely, if left in its present untended and unrecorded condition, must year by year, suffer blanks to occur in its already attenuated ranks. But if the system of conservancy registration now suggested, were adopted and applied to these ancient landmarks, the record would form, for many years to come, one of the proudest achievements, and most useful, interesting, and successful undertakings of the Scottish Arboricultural Society.

XXVIII.—*On the Use of Steam Power in Forestry.* By D. F. M'Kenzie, Forester, Meldrum House.

The great advantages resulting from the employment of steam power in almost every branch of industry are so generally recognised that it seems out of place to make any prefatory remark. In forestry, however, its application is at present on a very limited scale; but we believe, were it more fully tried, confidence would be gained, and great advantages would follow.

The successful employment of the locomotive engine in aid to forestry depends upon the extent of work contemplated, the condition of the roads in and from the woods, and the distance from market, shipping port, or railway station. It will be apparent that the quantity of wood requiring to be cut must be sufficient to keep the engine in operation all the year round, and this may be one reason why steam power is not more extensively applied, especially in the transit of timber. Yet, on moderately wooded estates, this objection could be got over by causing the same engine to saw the timber and transport it to market, and, in many cases, drag it to the mill side, at a much cheaper rate than by horse power. For this purpose the engine would require to be a road locomotive engine, workable also as a common portable one. However, on estates where the work is very extensive, the employment of two engines would, we think, be more profitable than that of one, as the saw-mill engine might then never require to be moved except from one wood to another, for convenience in carting to the mill, thus saving much labour. The other engine might be always used for the transport of timber, and the same men employed at the same work. The saw-mill engine, if a common portable one, would cost less than a road locomotive of the same power, and, when being moved, it could be drawn by either the road locomotive or by horses. Where the working of two engines is practicable, the proportionate profit will be much greater.

Most of our country roads are quite serviceable for the use of a locomotive of the power described; and in woods, if the soil is hard and tolerably level, a loaded traction engine could travel over it with ease, for the purpose of carting or dragging the felled timber to the saw-mill. As to the distance from shipping port, &c., the distance the engine can go and return in a day is about sixteen miles.

In clearing old woods for replanting, the locomotive would be of great service, as by its aid the beetle pest could almost be got rid of —by having all the old roots removed immediately after the timber. In this way replanting could be proceeded with much sooner after the removal of the old crop than is usually the case. The tearing up of the roots exposes a large surface of soil to the fertilising influence of the atmosphere, and thus prevents the growth of fungus so common among old roots, and so injurious to young plantations. On estates largely wooded the locomotive engine would in this and other ways forward the forest work in a speedy and profitable manner, even should it not be contemplated to manufacture the wood. When the producer fells, but does not manufacture his wood, the road locomotive could be used for the transport of the rough timber to market, but at least from 15 to 20 per cent. would be lost, and this course would only be advisable when the wood is not suitable for manufacture, as pit wood and common burn wood.

A few years ago we had occasion to clear a large plantation of heavy beech trees. Having found a market for the timber eleven miles distant, and advertised for carters, a number came forward with offers, among others an engine-hirer from the district. On opening the tenders it was found that the engine-hirer was 50 per cent. lower than any of the carters, and he, after paying all expenses, including tear and wear, had 7 per cent. profit.

The large amount of capital required to begin operations is a reason given for the locomotive not being largely used in the transit of timber; but putting steam and horse-power side by side for one year, it will be found, as shown below, that a large balance lies in favour of steam. The following is the cost of an 8-horse power locomotive engine with two waggons, and the probable expense for one year, including one horse and cart—a necessary appendage in forest work:—

8-horse power road locomotive, . .	L.525	0	0
Two waggons to carry 8 tons, . .	144	0	0
Horse, cart, and harness, . . .	85	0	0
Interest on capital, at 4 per cent., . .	30	3	2
Keeping, shoeing, &c., of horse, . .	56	12	0
Driver, ...	40	0	0
Fuel for engine for 313 days, . .	110	0	0
Carry forward,	L.990	15	2

Brought forward,	L.990	15	2
Engine-driver, ...	60	0	0
Waggon-man, ...	50	0	0
Lad to precede engine with flag, . .	30	0	0
Insurance, tear and wear, . . .	55	0	0
Rent and taxes, ...	7	0	0
Total,	L.1192	15	2

Cost of an equal amount of horse power—

Nine horses, carts, and harness, at L.85,	L.765	0	0
Interest on capital, ...	30	12	0
Keeping, shoeing, &c., at L.56, 12s. per horse, ...	509	8	0
Nine drivers, at L.40 per annum, . .	360	0	0
Total, ...	L.1665	0	0
Expense of Steam, ...	1192	15	2
Balance in favour of Steam, .	L.472	4	10

In most cases one driver is sufficient for a pair of horses, but in wood work it is generally found to be more profitable to have a man accompanying each horse; the nature of the roads and loads demands this.

Of course a good deal of the profit derivable from the use of steam instead of horses depends upon the management of the locomotive, especially where one engine would be used for both the sawing and transport of the wood; for however much work the engine might be capable of doing more than horses of equal expense, yet, if clumsily managed, the profit might be reduced to *nil*, if not indeed converted into a loss. Still, the management is simple and easy, and, by proper attention, the employment of steam instead of horses may be turned to great advantage, and become a source of profit and satisfaction to the employer.

The use of the portable steam engine in the manufacture of timber is now common, and its great utility universally admitted. With the exception of water there is no cheaper motive power, and in most cases it is more advantageous to use steam than water, as the engine can be shifted so as to reduce the cartage to the mill to a minimum, while the wood requires to be carted to the water saw-mill from however great a distance. This is also the case with stationary engines. If the extent of wood cut down be small, one engine, as already suggested, should be used for both the sawing and cartage. For this purpose the mill should be so constructed that the engine can be easily attached and detached at pleasure, and with a multiplying motion between the engine and saw pulley; as, if the motion is direct, the flywheels of road locomotives generally are too small to drive the saw with sufficient velocity. The common portable engine is usually set on a convenient spot, and worked there as long as the wood around it is within easy cartage to it. With this engine no intermediate motion is required. It may be stated that the situation chosen for the saw-mill should, if possible, be near a constant supply of water, so as to keep the engine supplied, as an 8-horse power engine consumes from 80 to 100 gallons per hour; the quantity of water consumed depending upon the work done. An 8-horse power would work two saws at any ordinary work; but it is convenient to have a cross-cut saw attached to the mill, to be worked at pleasure, either directly from the engine or from the shaft on which the other saws are fixed. Such a mill is suitable for manufacturing wood for both English and Scotch markets. The number of hands required depends upon the nature of the work. One man is required to attend the engine under all cirumstances; and if the mill be cutting staves, for instance, a man and boy at each of the two saws is sufficient—the men to work at the saws, and the boys to remove the backs and staves and convey them to where they are to be built for drying. Though not always necessary, it is often the case that a labourer also is employed for removing the sawn timber and sawdust. When cutting heavy timber it often requires two men at each saw, and a labourer to carry the sawn wood to the drying pile. The wages of the men vary in different localities, but it is most profitable to pay a good price for a good workman of steady habits. At present we pay saw-millers from 20s. to 25s. for sixty hours; engine-man, 17s. to 20s. with free house; labourers, 17s.; boys, 9s. to 12s. These men are engaged by the month, and consequently their wages are liable to rise and fall during the year. These figures seem high for this class of work on an estate, but as we carry on the work on *wood merchant* principles, we must pay the same rate for the same class and quantity of work. Our experience in the use of portable steam engines and saw-mills for a period of sixteen years proves to us that they are indispensable in the manufacture of wood; and we are persuaded that the use of the road locomotive may be made a source of great gain. To those who give the latter a trial, in a year or two they will be surprised to find the large amount of profit arising from its use in all work connected with forestry to which it is applicable.

In conclusion, a word may be said with regard to the engines themselves. They should always be of the best material, which implies lightness as well as durability. From 6 to 10-horse power are proved to be the most serviceable for all purposes; even on turnpike roads an engine over 10-horse power is cumbersome. Aveling and Porter, Rochester, England, are the best makers of road locomotives; but as we have no experience of their common portable engines, we would recommend those made by Hornsby, Grantham, as being complete in almost every particular.

XXIX.—*The Advantages of Planting in Groups, or in Mixed Plantations, so as to combine Profit with Landscape Effect.* By WILLIAM GORRIE, Rait Lodge, Edinburgh.

Were the question merely, whether is grouping or mixed planting most productive of landscape effect? it might be conceded that the unanimous verdict would be in favour of *judicious grouping;* and that on all sizes of landed properties, from the two or three acre villa environs, where groups are necessarily restricted to a few specimens, upwards through increasing sizes of country estates, to the most extensive and varied surfaced demesnes, where they may form masses of tens, twenties, or even hundreds of acres of the same or closely allied kinds. But were grouping only to be deemed admissible on condition of its being equally profitable with mixed or promiscuous planting, I fear that its most strenuous advocates would fail in its defence; more especially were it required that its landscape effects should be maintained unimpaired by other kinds of nurses from the time that the young trees attain to sufficient size for concealing the natural herbage of the ground surface. For, in the first place, there is the additional cost of the young plants; and, secondly, the thinnings will not yield nearly the money returns that would be derived from larch, firs, and other cheap and fast growing nurses. I will return to this subject after making a few remarks on the grouping of trees for landscape effect, under the following heads, viz.,—

1. Soil and situation.
2. Forms and sizes of groups.
3. Grouping with the same and allied kinds.
4. Grouping with different kinds.
5. Grouping with respect to size, form, and colours of leafage.
6. Park clumps, belts, groups, and solitary trees.
7. Avenues.
8. Fences.

1. *Soil and Situation.*—The choice of soils and situations best suited for the healthy development of the different kinds of trees is even more important in ornamental than in economic planting, and as, in the former, the numbers of sorts dealt with is much greater than in the latter, a more widely extended knowledge of arboricultural botany is needed than is usually aspired to by merely practical foresters. Farther, in ornamental planting, a knowledge

of the wind-resisting powers of the different kinds of trees is specially needful, in order to arrange them so that the stronger may shelter the weaker, and prevent that one-sided appearance that, although prized by artists in depicting wind-beaten scenery, is looked upon by tree admirers with feelings of unpleasantness.

2. *Forms and Sizes of Groups.*—Premising that in group planting the operator should have a clear perception of the appearances that all the kinds of plants operated with will present at the successive stages of their after growth, the forms of groups should be irregular, and without hard or harsh outlines, as exemplified on a large scale by the few native forests that are still left in our country, where, from masses of the Scotch fir on the lower flats and hill sides, flakey-like portions run up irregularly into the more or less sheltered hollows and ravines, skirted and interspersed, where the soil is wettish, with groups of birch, alder, and willows; occasionally under-wooded on drier and rocky parts by patches of the hazel, mountain-ash, bird-cherry, holly, and juniper. It is in planting large extents of hill and mountain slopes that grouping or massing can be carried out to the fullest and most effective extent. And although this may be done successfully with the kinds of trees in ordinary cultivation, it can be far better accomplished by employing a much greater diversity of sorts; commencing near the sea-level with chestnuts, the true planes, walnuts, and other natives of southern Europe, or of like climates, associated with poplars and willows by the water-courses, and succeeded in ascending progression by limes, oaks, cedars, elms, maples, ash, beeches, silver firs, spruces, many of the true pines, and others, the hardier of which fringing extensive masses of the more remunerative larch and Scotch fir, till succeeded in turn by the Cembran and mountain pines, birch, upland willows, and other representatives of the higher regions of tree life. Grouping on a large scale may also be done with good effect in low country flattish-lying plantations that are much overlooked from elevated places, as residences, public roads, railways, &c. But with such plantations it is generally more expedient to restrict the grouping to near and at their outer margins. In plantations on such an extensive scale as here indicated, the most remunerative kinds of trees should of course form the larger masses; but no group should be so small as to be ineffective, or indistinctly noticeable in the general landscape, when viewed from important although somewhat distant points of observation. These remarks, with reasonable modifications, are also applicable to plantations of diminishing extent, down to the villa

grounds of a few acres; where the outside appearances should not be forgotten, although the views from the house windows, and internal walks may be deemed of more paramount importance. But even here grouping is decidedly preferable to mixed or what may be more correctly termed higgledy-piggledy planting. Where, however, the space to be operated upon is very limited, it is seldom advisable to plant more than one tree or shrub of the same sort, and that should generally be associated or grouped with its marked varieties or kindred species.

3. *Grouping with the same and allied kinds.*—By far the most generally commendable mode of group planting, is that of associating species with their varieties, and others belonging to the same or allied generæ. Here, however, the question of economy would come in with hindering, if not prohibitory effect, were it necessary that all the kinds should be the same or nearly the same in number. But this is by no means the case; for the kindred kinds deemed ultimately to be most remunerative may predominate so far as to produce the desired landscape effect, the others being introduced as side groups of greater or less sizes, proportionate to the original cost of plants, and their ultimate commercial value. All that are intended to be permanent specimens should be allowed plenty of room for their full development; and they should be arranged so that their decreasing heights will show off the taller kinds behind, and bring down the general outline to connect agreeably with the adjoining ground surface. Where allied dwarf grouping kinds will thrive as underwood, they are the most suitable to plant as such, and next to them shrubs with somewhat similar foliage; for nowhere should the undergrowth contrast harshly or unpleasingly with the general mass when viewed from the outside, unless when only of such low heights as to associate with the grass and other natural ground herbage. As an example of regular and hard outline grouping to be avoided, a plantation of fully 50 years standing may be instanced on the steep rugged slopes of Kinnoull Hill, near Perth, where the different kinds were originally grouped in straightish-sided, square, and parallelogram-like fashion, except where some of the outlines are broken into by the bases of the magnificent precipices which form the preponderating features of the hill. Thinning out, and the irregular spreading tops of the reserved trees, have tended in some measure to tone down the rigid straightness of outline which the groups originally presented; but they still and will remain as blots in landscape arboriculture. Another although less objectionable

example, in which the outlines are more irregular, but not less abrupt and harshly defined, is observable from the decks of Clyde steamers in passing between Roseneath and Kilcreggan, the age of which appears to be between 12 and 15 years.

4. *Grouping with different kinds.*—Trees widely different in their affinities, but having a resemblance to one another in the size and forms of their leaves, may be associated in groups. Mixture of kinds, however, is most commendable when they possess some other marked characteristic in common, such as colour of foliage, bark, and flourish, habit of growth, or form, &c. Thus, when depth or darkness of colour in leafage is desiderated, fit associates exist in the purple beeches, oaks, elms, hazel, barberry, &c. Where light colours are wanted, they are at command in the Corstorphine plane, the golden oak (*Quercus pedunculata, concordia*), golden ash, birch, alder, and elder, as well as in the gold and silver shaded yews, moonlight holly, spruces, and smaller coniferæ; as also among the naturally silvery-foliaged trees, such as the Abele poplar, the Huntingdon, and some other willows; the whitebeam or service tree, sea buckthorn, &c.; while among strictly variegated trees and shrubs there exists a wide field to select from. The autumnal colours and tints of fading foliage deserve marked attention at the hands of planters for ornamental effect. And whether the rich scarlets and purples of our native geans, and of some American oaks, the golden yellow of the Norway maple, or whatever colours are wanted in plants that have been grown from seed, it is a wise precaution to select them in the nursery, when the colours are most marked, as the fading leafage of plants raised from seed is generally much varied, although these be of the same species or kind. Colour in bark is most appreciable when the branches are denuded of their foliage; and small or moderately sized groups, having distinct colours, tend to break up or relieve that dull monotony which prevails in deciduous woodland scenery throughout the winter and early spring. The following may be instanced:—With white or lightish coloured bark—the common and several other kinds of birch, Constantinople hazel, snake-barked maple, the cane or white Welsh willow (*Salix decipiens*), *Cratægus punctata*, and some other hawthorns, &c. With yellow or orange coloured bark—the yellow-barked small and large-leaved limes, golden ash, golden and copper willows, &c. And with reddish, dark, or blackish bark—the red twigged or coral lime; *Salix acutifolia, S. daphnoides, S. purpurea, S. nigra*, and some other willows; *Cratægus M'Nabiana*, and several other hawthorns; the red dog-

woods, &c. With regard to flourish—although the horse chestnut and the gean are the only full or large sized forest trees that produce showy blossoms, there are of smaller trees the Pavias, and other allies of the former; while, belonging to the same natural order as the latter, there are others of the cherry tribe, hawthorns, services, mountain ashes, mespiluses, almonds, and the wild forms of the apple, pear, and plum. In other families there are the Scotch and English laburnums, robinias, lilacs, elders, &c., which, together with rhododendrons, azaleas, wéigelias, and other flowering shrubs too numerous to mention, are admirably adapted, when grouped according to their colours, for decorating the margin as well as the interior of our woodlands. And on prominent rocky snabs, natural sites for the rowan, the gean, and the sloe-thorn, the snowy whiteness of the last two displayed before the earliest leafage of spring, is ever the admiration of all beholders. Of distinct habited trees, drooping or weeping kinds, which only attain to little above their original height, are very serviceable for shutting out lower and near at hand unsightly objects, without impeding the views of more distant and important scenery. In such a case, weepers being comparatively few, a judicious mixture of kinds becomes necessary in order to obviate disagreeable monotony and uniformity. This suggests a procedure that is too generally neglected in opening up views that have become interrupted or shut out by the overgrowth of injudiciously planted trees, viz., that of grafting some of these with weepers at requisite heights, particularly ashes and elms, which are the most easily operated upon: and the more general adoption of this practice would be the means of retaining many a fine stem or bole, where their presence is ornamental as well as needful. Among upright, pyramidal, and conical formed trees, we have the Lombardy poplar as the most important, from the great height to which it attains, as well as from the remarkably fastigiate upright habit of its growth, characteristics which render it highly suitable for certain localities, but most incongruous in others. Thus, when neither too thickly nor over widely grouped at the ends of a bridge, viaduct, or high-level topped embankment, those horizontal lines are, as it were, balanced and supported by the perpendicular lines of the poplars, and the latter have a singularly important landscape effect when seen rising from among ordinary plantations over these horizontal surfaces, as well as over flattish topped ranges of buildings, while, among or rising behind groups of roundish headed trees, their occasional presence has a very pleasing effect. On higher, drier, and more exposed grounds, some of the taller growing conical-topped conifers, such as the silver fir, are productive of similar results; but great care is requisite not to introduce either these or the Lombardy poplars over abundantly. In pleasure-grounds, a lower class of fastigiate trees, as well as of shrubs, may be introduced with equally effective results, such as the different upright growing elms, fastigiate oaks, hawthorns, thorn acacia, elders, yews, junipers, cypress, &c.; but neither should they be over abundantly planted.

5. *Grouping with respect to size, colour, and form of Leafage.*—In planting, as in painting, light and dark colours as well as sizes impart apparent nearness or distance when the trees are equally removed from the observer, and this is still more obvious when the leafage is alike or nearly so in form. For example, if a Corstorphine, a common, and a Jersey plum or sycamore are thus equidistant, the light colour of the first will make it seem nearer than the second, while the darker colour of the last will make it appear as if still farther off. In like manner, with the common sycamore, the sugar maple, and the English maple, the diminishing size of the trees as well as of their foliage would seemingly place the first in advance of the second, while the last, from its much smaller as well as darker green foliage, would appear as if considerably beyond. Again, with very dark colours, such as the purple beech, purple elm, and the like, if these are planted equi-distant with common beech and elm, the purple foliaged trees would appear at further off distances proportionate to the depth of their colouring; and these effects are still more marked when such very dark foliaged plants occupy situations that are shaded from the sun at the time of observation, as on the north or east sides of plantations. Deciduous trees retain the foresaid appearance of nearness and distance according to the size of their foliage, even when it has fallen, from its being a general rule that the strength or thickness, as well as the number or quantity of the young shoots or branchlets, is proportionate to the size of the leaves. This is exemplified in our largest leaved trees, the horse chestnut and common plane, with their few and thick shoots, contrasted with the birch, which is at once the smallest leaved and most slenderly as well as closely twigged of ordinary forest trees. One of the seemingly most difficult problems that the landscape forester has to solve is that of making straight lines appear crooked, and stiff ones easy. This, however, is often a very necessary performance, as in the cases of hedge rows and other lines of trees, as well as in straight or stiff outlined belts and planta-

tions. But it can be often successfully performed by attending to the preceding rules.

6. *Park Belts, Clumps, Groups, and Solitary Trees.*—In the arboricultural decoration of most of the ornamental parks and pleasure-grounds that surround country mansions, there is too much unmeaning sameness and want of design. The outer belts, as well as the interior clumps, are usually planted with unseemly mixtures of overcrowded ordinary kinds of forest trees, rising abruptly to full height from their fence enclosures, without any attempt at rounding or sloping them down so as to associate harmoniously with the surrounding turf, by means of intervening ornamental trees of diminishing stature, and shrubby underwood. Not unfrequently some convenient corner is set apart for conifers or other fashionable novelties so near to the mansion-house, that either it or they will have to be removed before they are half grown. Or, if sufficiently remote from it, they are planted so close to one another, that, to prevent the whole becoming unsightly abortions, the axe will have to be freely applied for thinning ere they are half a century old. Others, it may be, are scattered about at more suitable distances; but with such, a too common fate is injury or destruction from the drip, shade, or wind-falling of too near and much older neighbours. This last remark is not to be taken as recommending the removal of fine old park trees, that may have been favourites with their successive owners for centuries, but is, with the others, designed as an argument against planting choice young trees in like situations, when, in many instances, better accommodation might be had for grouping them in the belts and clumps before mentioned. Park belts and clumps are admirably adapted for grouping trees and underwood in the different manners before described; and detached clumps are specially suited for grouping the different families apart. Thus the oak would form one of the largest and most perfect clump groups; comprising as that genus does not only round and spiry headed trees of the largest sizes, but also many tall as well as dwarf evergreens, and a goodly assortment of low and intermediate growing deciduous kinds, together with a wide diversity in the sizes of their leaves. Compare, for instance, those of the common oak, which are by no means the smallest, with this leaf of *Quercus macrophylla*, brought here by Mr Baxter from Riccarton yesterday, which measures 17 by 7 inches. Clumps of such other families as are deficient in required characteristic particulars might have others of needful forms, colours, &c., tastefully associated with them, both as trees and underwood. Park

groups of separately fenced trees should only be of select fine growing kinds, and single trees still more particularly so; each group of the former generally consisting of allied varieties, species, or genera. And plants of hawthorn, briars, sloe thorn, furze, &c., growing from at and near the base of some of these singly fenced trees, have a good effect by dispelling that sameness that their bare stems would otherwise present.

7. *Avenues* can scarcely be left without a passing notice when treating of group planting. They may either be straight or curved, and are generally associated with a roadway or a grassy ride; and they may either be composed of two lines, all of one kind of tree; four lines of two kinds or tribes of trees, or what may be termed the arboretum avenue, in either two or four rows, all of distinct sorts, grouped or brought together in families. The first, when intended to form a close gothic arch-like covering, should be planted near to one another in line, and they may be as near to the roadway on each side as half its width. The second or double avenue should generally have the rows next to the roadway or drive of one kind, and the other two rows of a different kind; but full space should be allowed for the after development of every tree, from the ground upwards, without touching one another, encroaching upon the roadway, or concealing from it the trees in the back rows. A very usual and generally commendable practice is to have two corresponding rows deciduous and the other two evergreen trees. The third, or arboretum avenue, is better in four than in two rows, where sufficient space can be devoted to them, as they allow of the dwarf kinds being kept in front and the taller ones behind. And in both the second and third kinds of avenues the back lines may be associated with groups of underwood and shrubbery where adjoined by plantations, and where concealment of, or from the outside is intended. This arrangement is peculiarly suitable for the arboretum avenue, as affording scope for a collection of underwood or small trees and shrubs, as well as of the larger trees. In selecting the kinds of trees for forming the first two described avenues, it is most essential to avoid such as are capricious in their adaptation to any diversity of soils or exposures that may present themselves, so that the greatest possible uniformity of healthy growth may be secured throughout the whole length. And they should, by continuous yet almost imperceptible pinching and pruning, be kept in pleasingly symmetrical forms, so as to prevent the growth of double tops and disproportionately large side branches, that are unsightly in themselves, and become liable to wind breakage as they

progress in size and age. In regard to the sites or situations of avenues, whether straight or curved, those are best where they do not cut up fine expanses of grassy greenery, or conceal distant interesting scenery,—as by the outer edges of such expanses, through or by the sides of woodlands, and outside of home parks, where approaches have to be carried through arable fields; for which last the foresaid second and third modes are specially adapted.

8. *Fences.*—With reference to plantation fences, it may be remarked that grouping for the purpose of breaking up stiff outlined belts and margins becomes far from effective when these are fenced by obtrusive stone dykes. When the outside of a plantation thus grouped is looked upon over an intervening knoll which conceals its fence dyke, the apparent distance and nearness that is thus imparted to its margin becomes in a great measure dispelled on advancing till the dyke becomes visible. Hedges, and more especially well-kept ones, are liable to the like objections, but in a less degree; and this may be still farther lessened by suiting them to the trees and underwood behind, as by an entire or thickly mixed hedge of the purple leaved barberry, where backed by purple beech, elm, hazel, &c.; by holly, mahonia, evergreen privet, &c., in front of broad leaved evergreens; and by whins, junipers, &c., where backed by small leaved evergreens, such as the coniferæ. Iron fences, except for shelter, are preferable to either of the preceding when sufficiently out from the drip of high trees, to allow of a thick growth of underwood between. But a fence preferable to either, especially for ornamental park groups, clumps, and belts, can be cheaply formed where stones are abundant, by arranging those in irregular rockery-like outline, say 15 to 18 inches high in front, backed alternately by larger ones in four, six, or even more circumjacent unformal layers or lines, with small spaces between, and only a little rise in the ground surface where requisite to supply soil for the free growth of thorny plants, such as the wild and double Scotch roses, in front; sweet and other wild briars, as well as a mixture of the more robust growing garden roses, furze, barberry, junipers, &c., next; then hawthorns, hollies, sloe thorn, and sea buckthorn, the last in dry, bare places, where the others will not grow; the whole being thickened by an undergrowth of mahonias, brambles, Ayrshire roses, honeysuckles, ivy, and other rambling creepers, allowed to grow in natural wildness. This would form an impenetrable as well as a highly picturesque barrier against the inroads of both man and beast, besides being one of the best for game covers; and the interior might

be fitly occupied by spineless underwood and shrubs, interspersed with strong free growing herbaceous plants, a race far too much neglected in ornamental forestry. The well-known aversion that cattle and sheep have to passing over rough stony surfaces, even when by no means thickly interspersed with thorny vegetation, argues well in favour of this wild-fence notion; and, if fairly tried, it will doubtless be found cheap and effectual, as well as ornamental. As with ordinary hedges it would, of course, require temporary outside fencing.

Returning to the subject of Nurses.—Wherever the landscape effects of group planting are intended to be early and continuous, the nurses employed for sheltering the young permanent plants should be either the same or of the faster growing kinds that assimilate with them in general appearance, for the obvious reasons, that they give the required shelter soonest, and they are the most remunerative as thinnings. For example, the larch as a nurse for the larch; the Scotch fir for itself and other true pines; the common sycamore for its own kind, as well as for others of the Acer family; the Turkey oak for others of its genus; and the ash, in addition to sheltering its own relations, will make a passable nurse for the walnut and others having similarly divided leaves. As a nurse for the silver fir and the darker coloured spruces, the balm of Gilead or balsam fir is especially suitable, from its dying out generally at from 25 to 30 years of age, and thus obviating the tendency that too often exists among woodmen to spare trees after their presence becomes hurtful to their neighbours. When the early effects of group planting are not deemed paramount, the larch will prove a profitable nurse, in situations not calculated for its long enduring healthy existence.

In order to get the greatest number and value of thinnings from a given space, pruning, by shortening or cutting in the side branches of the nurses, so as to prevent them interfering injuriously with the reserves and with one another, as well as for stimulating their upright growth, is a treatment deserving of notice, which was recommended so far back as 1825 by W. Billington, superintendent of planting in the forest of Dean; and in 1841 by the late Gavin Cree of Biggar, whose somewhat different mode has since been very successfully practised on the estate of Sir John M. Nasmyth in Peeblesshire, as well as on that of the Earl of Stair in Midlothian, and elsewhere.

Applying some of the preceding remarks to near-at-hand examples of avenue treatment, you will, on visiting Sir Walter Scott's monument, and the renowned Edinburgh Meadows, have opportunities of estimating the arboricultural taste and skill of our city rulers. At the former, you will see avenue trees selected with the utmost disregard to their adaptation for the soil and situation; the kind being the common or Wych elm—one of the most capricious of ordinary forest trees—each with a stem of a few feet, surmounted by a besom-like head of numerous contending branches, as if (should they ever attain to sufficient sizes) for the easy ascent and comfortable accommodation of city roughs when viewing passing processions. At the latter, where, according to R. Maxwell of Arkland, Mr Hope of Rankeillor, commencing about 1722, "raised beautiful hedges and trees, made rich meadows and pleasant walks, where gentlemen and ladies resorted;" and which, in *Campbell's Journey through North Britain*, 1810, are described as "a Mall lamentably unlike St James's, being shamefully neglected avenues, where there was no longer pleasure in wandering among broken down hedge-rows and blasted trees;" a description highly applicable to their management up to the present time, as you will see by their general appearance, and especially by that of the murderously mutilated, ill grown, distorted, unsightly avenue of trees which cuts in two the lengthy expanse of grassy meadow, and regarding which so much has of late been said and written.

XXX.—*Report on the Meteorological Observations made at Carnwath, Lanarkshire, on the Influence of Forests on Climate, particularly Rainfall.* By ALEXANDER BUCHAN, M.A., F.R.S.E., Secretary of the Scottish Meoteorological Society.

In carrying out this inquiry Mr Maclean of Carnwath very materially assisted the Committee by placing three stations at their disposal. Dr Cleghorn and Mr Buchan visited the three places, and fixed on one which presented conditions of a very favourable character. The forest selected contained about 62 acres, and a little outside, to the north-west, was a green knoll called Gallowhill, quite clear of trees. In the interior of the wood, and 320 yards distant, was another knoll called Winterlaw, of precisely similar character as regards height, exposure, and relation to the ground immediately surrounding it. Immediately on the top of the western slope of this knoll was a bare patch about fifty feet in diameter, which was surrounded on all sides with trees of various sorts, varying from forty to fifty feet in height. The growth of the green sward and of the plants around showed that the situation was well fitted for the inquiry. Two complete sets of meteorological instruments were procured, with proper protection in Stevenson's louvre-boarded boxes, exactly similar to each other. The instruments, consisting of maximum and minumum thermometers, and a hygrometer, were placed—one set on each knoll—at exactly the same height, viz., 4 feet above the ground. The observer, Mr Currie, than whom no better could be named for intelligence, care, and accuracy, began the observations on 16th September 1873, and these were continued till the end of September 1874. The instruments showed the highest and lowest temperature each day, together with the temperature of the air and the temperature of evaporation at 9 A.M. and 9 P.M. The precise points to be elucidated were the conditions of the atmosphere as regards temperature and moisture outside the wood as compared with the interior of the wood. The results of the observations are given in the table accompanying this report, the more important points of which will now be detailed.

Results of the Self-Registering Thermometers.—At Winterlaw, in the interior of the wood, the highest temperature during the period was 79°·4 on 18th July, and the lowest 19°·0 on 11th February

1874; at Gallowhill, outside the wood, the extremes occurred at the same dates, and were 78°·1 and 19°·8—thus giving an annual range of 60°·4 at Winterlaw, and 58°·3 at Gallowhill.

At Winterlaw the mean of all the maximum temperatures was 52°·2, and of the minimum temperatures 38°·8; these means at Gallowhill being respectively 51°·7 and 38°·7. The means of the night temperatures inside the wood are thus all but identical with those at the station outside; and an examination of the figures of the table will show that they very closely approximated to each other during the whole period. Indeed, if June be excepted, when the difference was 0°·6, the difference did not exceed two tenths of a degree. On the other hand, the means of the day, or maximum temperatures, show an excess of 0°·5 in favour of Winterlaw. A very remarkable difference is apparent when the months are separately examined. This will appear from the following analysis, in which the plus sign indicates that the mean maxima at Winterlaw exceeded, and the minus sign that they fell short of the corresponding means at Gallowhill:—

September, . .	− 0°·6	April, . . .	+ 1°·1
October, . .	− 0°·5	May, . . .	+ 1°·8
November, . .	0°·0	June, . . .	+ 1°·9
December, . .	+ 0°·3	July, . . .	+ 1°·1
January, . .	+ 0°·1	August, . . .	+ 0°·8
February, . .	− 0°·1	1st to 15th September,	+ 0°·6
March, . .	+ 0°·1	16th to 30th do.	+ 0°·2

The remarkable fact here disclosed is this—During the annual rise of temperature in the spring and summer months, the highest temperature of the day inside the wood was from one to two degrees *higher* than that outside the wood; and during the annual fall of temperature in autumn, the highest temperature of the day inside the wood was on the mean about half a degree *lower* than that outside the wood. If the question was looked at solely with respect to the conservative influence of trees on climate in modifying sudden changes of temperature, a different result might have been expected; in other words, with the general annual rise in the temperature of the air during the spring and summer months, the temperature inside the wood might have been expected to have lagged behind, and with the general fall of temperature in autumn, the temperature inside the wood might have been expected to have fallen less quickly than outside.

The explanation of the facts actually observed is probably this:—

(1.) Since the thermometers at Winterlaw are placed in the centre of a circular patch, 50 feet in diameter, cleared of trees, it is evident that, considering the comparatively large portion of unobstructed sky overhead, the influence of solar and terrestrial radiation are very considerably felt at the spot where the thermometers are placed. (2.) Since trees from 30 to 40 feet in height surround the thermometers all round, and since the free circulation of the air is thereby greatly impeded, it is further evident that the effects of solar and terrestrial radiation will tend to accumulate at Winterlaw station to a greater degree than at Gallowhill station. For example, on the last six days of June when light winds prevailed (the average velocity of the wind during the period being only 5 miles per hour), with an average sunshine of 8 hours per day the mean maximum temperature of the six days was 62°·9 at Winterlaw, and 62°·0 at Gallowhill. Again, from the 7th to the 13th of the same month, when high winds prevailed (the average velocity for the seven days being 21 miles per hour), with an average sunshine of 10 hours per day, the mean maximum temperature for the period was 61°·1 at Winterlaw, and 59°·0 at Gallowhill. Hence, with very light winds, the temperature of the days was 0°·9 greater in the wood than outside of it; but with high winds the difference amounted to 2°·1. It is scarcely necessary to remark, that it is in very windy weather that the circulation of the air inside the wood is, as compared with what prevails outside the wood in the open fields, relatively least.

During the spring and summer months the great annual increase of temperature takes place, owing to the gain by solar radiation being greatly in excess of the heat lost by terrestrial radiation. Now it is during this period that, as shewn by the Carnwath observations, the day temperature of confined spaces in woods, to which the sun's rays have access, and where circulation is impeded, most exceeds the temperature outside the wood where the circulation is free all round; and it is to be noted that the difference was greatest in June. During the annual fall of the temperature in autumn, the difference between the day temperatures at the two stations is less marked, and besides it is the station inside the wood at which the temperature is lowest,—the mean difference being 0°·6 in September and 0°·5 in October. In September 1873, one of the more marked cases of higher day temperatures at Gallowhill occurred from the 24th to the 27th October 1873, during which period the air remained all but calm, the mean velocity of the wind being only 2 miles per hour; the sky all but clear, only one-fifth being covered with clouds; and an average of nine hour's sunshine a day. The means of the observations of the daily maximum were 43°·0 at Gallowhill and 41°·6 at Winterlaw. The heights of the trees surrounding the instruments at Winterlaw, taken in connection with the greater obliquity of the sun's rays in October, are probably sufficient to account for the difference. An examination of the whole observations at both stations at this season shews that the point requires further observation for its elucidation; the question being greatly complicated by the fluctuations of temperature which repeatedly occur in connection with the frequent autumnal storms at this season.

Results of the Dry and Wet Bulb Hygrometer.—The results of the dry-bulbs, giving the temperature of the air, shew that at 9 P.M. the temperature at both stations is very nearly the same during all the months, the difference in no month exceeding two-tenths of a degree, thus shewing a remarkable agreement with the results of the minimum thermometers at both stations.

Equally remarkable is the agreement of the results of the 9 A.M. observations of the dry-bulb thermometer with those of the maximum thermometers at both stations. Comparing the two results, as those of the maximum temperatures were compared, we obtain this result:—

September,	− 0°·	April,	+ 0°·4
October,	− 0°·7	May,	+ 1°·1
November,	0°·0	June,	+ 1°·5
December,	+ 0°·1	July,	+ 0°·6
January,	+ 0°·1	August,	+ 0°·4
February,	− 0°·1	September,	0°·3
March,	+ 0°·2		

Combining the two sets of results, it is seen that during 1873–74 the mean temperatures at 9 P.M. inside and outside the wood, at Carnwath, were practically the same, and remained so, at least, till the time of occurrence of the minimum for the night; that in the spring and early summer months, by 9 A.M. the mean temperature inside the wood had risen higher than that outside, and continued to rise still further above it till the time of occurrence of the daily maximum; and that in autumn, by 9 A.M. the mean temperature inside the wood was lower than that outside, and continued lower till, at least, the time of the daily maximum.

Dew-point.—The mean dew-point at Winterlaw at 9 A.M. was 42°·5, and at Gallowhill 42°·0, and at 9 P.M. 42°·2 and 42°·0 respectively, thus shewing at both hours, but particularly at 9 A.M., a greater amount of vapour in the air inside than outside the wood. These results, taken in connection with those of the temperature, shew that in the spring and early summer months the air inside the wood is warmer and moister than that outside, but during the fall of the year it is colder and damper. The months during which the excess of vapour in the wood was greatest were September, May, June, July, and August.

It is scarcely necessary to dwell on the importance of these results in their relation to the interspaces in woods which are sheltered more or less from the wind, whether these interspaces be over treeless patches, or over patches of wood where the trees are of less height than those surrounding them. From their obvious connection with the rainfall, the temperature and humidity of the air of these interspaces, which differ so markedly from those of the surrounding air outside the wood, call for fuller investigation, and for this reason the observations made last year at Carnwath should be continued for at least another year.

But other points call for inquiry in carrying out this investigation. (1.) The daily extremes of temperature, and the humidity of the air at a station in the interior of the wood, not cleared of trees as at Winterlaw, but covered with the usual complement of trees; (2.) Underground temperatures at say three depths at the stations of Gallowhall, Winterlaw, and the new proposed station; (3.) The evaporation at the same three stations; and (4.) The temperature of the trees themselves, ascertained by means of thermometers permanently fixed in them, in the manner adopted at the Forest Stations of Bavaria.

ood of Carnwath, from 16*th September* 1873 *to* 30*th September* 1874.

WIND.										RAIN.	
Number of Days it Blew in Certain Directions.									Mean Velocity in Miles per Hour.		
N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.		Days.	Amount.
											Inches.
0	0	1	2	3	2	6	1	0	14	6	2·81
2	1	2	0	8	9	6	0	3	11	15	5·78
1	5	5	3	3	5	6	1	1	13	14	2·41
1	0	0	1	7	13	7	1	1	17	17	2·66
1	0	0	1	2	14	13	0	0	19	17	3·21
1	1	2	4	8	7	3	1	1	11	12	1·50
1	1	2	1	4	11	9	2	0	17	13	2·21
1	2	1	3	7	9	6	0	1	16	12	1·77
6	6	10	0	2	2	4	0	1	10	12	1·21
2	3	4	0	3	7	7	4	1	13	7	1·06
0	1	1	2	6	15	5	0	1	10	14	3·05
0	2	2	3	2	10	11	1	0	12	18	5·21
1	0	2	1	7	13	6	0	0	13	17	3·32
17	22	31	19	59	112	83	10	10	14	168	33·39

TABLE.—*Abstract of Meteorological Observations made by* Mr WILLIAM CURRIE *at Gallowhill and Winterlaw, both places being in the immediate neighbourhood of Carnwath, from 16th September* 1873 *to* 30*th September* 1874.

		THERMOMETERS IN STEVENSON'S LOUVRE-BOARDED BOX AT A HEIGHT OF 4 FEET ABOVE GROUND.																		WIND.										RAIN.	
		REGISTERING THERMOMETER.							HYGROMETER.											Number of Days it Blew in Certain Directions.									Mean Velocity in Miles per Hour.		
									9 A.M.					9 P.M.																	
		Highest in Month.	Lowest in Month.	Monthly Range.	Mean of all the Highest.	Mean of all the Lowest.	Mean Daily Range.	Mean Temperature.	Dry.	Wet.	Dew Point.	Elastic Force.	Humidity. — Sat. 100.	Dry.	Wet.	Dew Point.	Elastic Force.	Humidity. — Sat. 100.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.		Days.	Amount.
1873.		°	°	°	°	°	°	°	°	°	°	Inch.		°	°	°	Inch.													Inches.
SEPTEMBER,	Gallowhill, .	68·8	33·8	35·0	57·2	41·8	15·4	49·5	52·2	48·4	44·5	·294	75	47·3	45·6	43·7	·285	88	0	0	1	2	3	2	6	1	0	14	6	2·81
	Winterlaw, .	68·6	34·1	34·5	56·6	42·0	14·6	49·3	51·6	48·6	45·6	·307	80	47·2	45·9	44·5	·293	91												
OCTOBER,	Gallowhill, .	55·1	20·9	34·2	48·6	35·8	12·8	42·2	43·3	42·0	40·4	·252	90	40·9	40·3	39·5	·243	95	2	1	2	0	8	9	6	0	3	11	15	5·78
	Winterlaw, .	54·7	21·4	33·3	48·1	35·9	12·2	42·0	42·6	41·5	40·3	·249	91	41·0	40·4	39·9	·242	95												
NOVEMBER,	Gallowhill, .	51·1	20·0	31·1	43·3	34·0	9·3	38·7	39·3	38·3	37·0	·221	92	38·7	37·9	36·8	·220	94	1	5	5	3	3	5	6	1	1	13	14	2·41
	Winterlaw, .	51·0	20·7	30·3	43·3	33·8	9·5	38·6	39·3	38·4	37·2	·223	93	38·5	38·0	37·3	·223	96												
DECEMBER,	Gallowhill, .	52·4	22·4	30·0	45·0	36·1	8·9	40·6	41·1	40·2	38·9	·237	93	41·4	40·7	39·8	·246	95	1	0	0	1	7	13	7	1	1	17	17	2·66
	Winterlaw, .	52·0	26·0	26·0	45·3	36·1	9·2	40·7	41·2	40·4	39·4	·242	94	41·4	40·9	40·3	·251	96												
1874. JANUARY,	Gallowhill, .	48·5	25·0	23·5	43·4	34·0	9·4	38·7	39·0	38·1	36·9	·220	93	39·2	38·3	37·1	·222	93	1	0	0	1	2	14	13	0	0	19	17	3·21
	Winterlaw, .	50·2	25·0	25·2	43·5	33·9	9·6	38·7	39·1	38·3	37·3	·223	94	39·2	38·5	37·6	·226	94												
FEBRUARY,	Gallowhill, .	48·3	19·8	28·5	42·5	31·3	11·2	36·9	38·2	37·0	35·3	·206	90	36·6	35·7	34·5	·201	92	1	1	2	4	8	7	3	1	1	11	12	1·50
	Winterlaw, .	48·4	19·0	29·4	42·4	31·5	10·9	37·0	38·1	37·1	35·7	·209	91	36·6	35·6	34·2	·198	92												
MARCH,	Gallowhill, .	56·6	19·9	36·7	47·4	35·4	12·0	41·4	42·8	41·1	39·1	·238	86	39·8	38·7	37·3	·223	91	1	1	2	1	4	11	9	2	0	17	13	2·21
	Winterlaw, .	57·4	19·7	37·7	47·5	35·4	12·1	41·5	43·0	41·6	39·9	·247	89	40·0	39·1	37·9	·228	93												
APRIL,	Gallowhill, .	69·6	30·5	39·1	53·1	37·4	15·7	45·3	47·5	44·2	40·5	·252	77	43·8	42·2	40·3	·249	87	1	2	1	3	7	9	6	0	1	16	12	1·77
	Winterlaw, .	71·9	30·0	41·9	54·2	37·4	16·8	45·8	47·9	44·1	40·6	·253	76	44·0	42·3	40·3	·250	86												
MAY,	Gallowhill, .	62·2	28·0	34·2	51·7	37·2	14·5	44·5	46·5	43·3	39·7	·245	78	43·7	42·5	41·1	·258	90	6	6	10	0	2	2	4	0	1	10	12	1·21
	Winterlaw, .	64·9	27·5	37·4	53·5	37·3	16·2	45·4	47·6	44·1	40·2	·249	76	43·7	42·5	41·1	·258	90												
JUNE,	Gallowhill, .	70·6	31·1	39·5	62·1	42·5	19·6	52·3	55·5	50·8	46·4	·317	72	51·1	49·0	46·8	·322	85	2	3	4	0	3	7	7	4	1	13	7	1·06
	Winterlaw, .	72·1	31·3	40·8	64·0	43·1	20·9	53·6	57·0	52·1	47·6	·329	70	50·9	49·0	47·0	·323	87												
JULY,	Gallowhill, .	78·1	40·1	38·0	64·7	49·5	15·2	57·1	59·5	55·7	52·3	·393	78	56·2	54·6	53·1	·403	89	0	1	1	2	6	15	5	0	1	10	14	3·05
	Winterlaw, .	79·4	40·1	39·3	65·8	49·7	16·1	57·8	60·1	56·4	53·2	·405	78	56·1	54·4	52·8	·401	89												
AUGUST,	Gallowhill, .	70·7	39·8	30·9	60·6	47·1	13·5	53·9	54·8	51·7	48·7	·343	79	51·7	50·6	49·5	·354	92	0	2	2	3	2	10	11	1	0	12	18	5·21
	Winterlaw, .	71·1	40·1	31·0	61·4	47·2	14·2	54·3	55·2	52·8	50·5	368	85	51·7	50·7	49·7	·357	93												
SEPTEMBER,	Gallowhill, .	63·3	32·0	31·3	57·2	44·2	13·0	50·7	53·4	51·2	49·0	·347	85	49·7	48·9	48·1	·336	94	1	0	2	1	7	13	6	0	0	13	17	3·32
	Winterlaw, .	63·4	34·0	29·4	57·6	44·4	13·2	51·0	53·7	51·2	48·8	·343	83	49·8	48·9	48·0	·335	94												
YEAR,	Gallowhill, .	78·1	19·8	58·3	51·7	38·7	13·0	45·2	46·7	44·5	42·0	·268	85	44·4	43·3	42·0	·267	92	17	22	31	19	59	112	83	10	10	14	168	33·39
	Winterlaw, .	79·4	19·0	60·4	52·2	38·8	13·4	45·5	47·1	44·9	42·5	·272	85	44·4	43·4	42·2	·269	92												

APPENDIX (A.)

Scottish Arboricultural Society.

PATRON.

HER MOST GRACIOUS MAJESTY THE QUEEN.

LIST OF MEMBERS

CORRECTED TO AUGUST 1873.

* *Life Members.* † *Members who have given Subscriptions, in order to form a Capital or Sinking Fund.*

All Subscriptions are payable at the Annual General Meeting in November. Members whose Subscriptions are Two Years in Arrear are not entitled to receive the Transactions.

HONORARY MEMBERS.

BALFOUR, John Hutton, M.D., A.M., F.R.SS.L. and E., Professor of Medicine and Botany in the University of Edinburgh.

BULLEN, Robert, Curator of the Botanic Garden, Glasgow.

†HUTCHISON, Robert, F.R.S.E., of Carlowrie, Kirkliston.

LAWSON, George, LL.D., Ph.D., Professor of Natural History and Chemistry, Dalhousie College, Halifax, Nova Scotia.

M'NAB, James, F.B.S.E., Curator of the Royal Botanic Garden, Edinburgh.

†THOMSON, William, Deputy Surveyor, H.M. Chopwell Woods, Burnopfield, Durham.

ORDINARY MEMBERS.

ADIE, Alexander J., Esq., Rockville, Linlithgow.

AIRLIE, The Right Hon. the Earl of, Cortachy Castle, Forfarshire.

AITCHISON, William, Forester, Workington Hall, Cumberland.

ALDER, Robert, Assistant Forester, Dunse Castle, Dunse.

ALEXANDER, James, Nursery and Seedsman, Edinburgh.

ALEXANDER, James, jun., 1 Waterloo Place, Edinburgh.

ALEXANDER, John.

ALEXANDER, John, Assistant Forester, Abernethy, Strathspey.

ALLAN, Andrew, Rankeillor, Cupar, Fife.
†ALLAN, John, Forester, Dalmeny Park, Edinburgh.
ANDERSON, Alexander, Forester, St Fort, Newport, Dundee.
ANDERSON, Alexander, Assistant Forester, Darnaway Castle, Forres.
ANDERSON, Alexander, Gardener, Oxenford Castle, Dalkeith.
ANDERSON, James, Bangholm Nursery, Edinburgh.
ANDERSON, James, Meadowbank, Uddingston.
ANDERSON, John, Newstead Abbey, Nottingham.
†ANDERSON, John, Nurseryman, Perth.
ANNAND, Charles, Forester, Cromar Estates, Tarland, Aberdeenshire.
ANNANDALE, Robert Burns, The Gardens, Fonthill, Tisbury, Wilts.
ARCHER, James, Assistant Forester, Culzean Castle, Maybole.
ARCHER, John, Assistant Forester, Culzean Castle, Maybole.
†ARCHIBALD, Thomas, Forester, Virginia, Co. Cavan, Ireland.
ARNOTT, Alexander, Hedger, East Wemyss, Fife.
ARNOTT, Robert A., Messrs Sharpe & Co., Seed Merchants, Sleaford, Kent.
ASHDOWN, Samuel Harding, Land Agent, Uppington, Wellington, Salop.
AUSTIN & M'AUSLAN, Messrs, Nursery and Seedsmen, Glasgow.

BAIGRIE, Andrew, Forester, Mote Park, Ballymurry, Co. Roscommon.
BAIGRIE, William, Forester, Echo Bank, Old Dalkeith Road, Edinburgh.
BAILLIE, William, Wood Manager, Cortachy, Kirriemuir.
BAIN, A., Steam Saw Mills, Forres.
BAIN, William, Lochrin Iron and Wire Works, Edinburgh.
BAIRD, Joseph, Assistant Forester, Drumpelier, Coatbridge.
BALDEN, James, Forester, Lennoxlove, Haddington.
BALDEN, Joseph, Assistant Forester, Hawthornden Cottage, Lasswade.
†BALDEN, Peter G., Forester, Vaenol Park, Bangor, North Wales.
†BALDEN, William, Appleby Castle, Appleby.
†BALLANTYNE & SON, Messrs John, Nursery and Seedsmen, Dalkeith.
BALLINGAL, Robert, Factor, Eallabus, Islay.
*BARBOUR, George F., Esq., of Bonskied, Pitlochry, Perthshire.
†BARRIE, David, Forester, Durris, Aberdeen.
†BARRIE, James, Forester, Stevenstone House, Torrington, Devonshire.
BARTER, Frederick, Assistant Gardener.
BATY, David, Forester, Lowther Castle, Penrith.
BATY, William, Forester, Netherby, Longtown.
BAXTER, Robert, Forester, Dalkeith Park, Dalkeith.
†BAYNE, Lewis, Forester, Kinmel Park, St Asaph.
BEGBIE, Harker, Forester, Littledale Hall, by Lancaster.
BEGG, John, jun., Factor, Durris, Kincardineshire.
BELL, James, Strathfieldsaye, Winchfield, Hants.
BELL, James, Forester, Newcastleton, Carlisle.
*BELL, William, Esq., of Gribdae, Kirkcudbright.
BENNETT, Alexander, Forester.

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O'NEILL, Richard, Auctioneer, Old Castle, Co. Meath.
†ORMISTON & RENWICK, Messrs, Nursery and Seedsmen, Melrose.

†PALMER & SON, Messrs John, Nurserymen, Annan.
†PARKER, James, Forester, Belvoir Castle, Grantham.
PARKER, Robert A., Nursery and Seedsman, Lanark.
†PATERSON, Andrew, Surveyor, Exton, Oakham, Rutland.
PATERSON, Charles, Factor, Castle Menzies, Aberfeldy, Perthshire.
PATERSON, William, Gardener, Balmoral Castle, Aberdeenshire.
PEEBLES, Andrew, Highclere Castle, Newbury, Berks.
PENDREIGH, John, Assistant Forester, Port Bannatyne, Rothesay.
PHILIP, John, Wood Merchant, Bonnyrigg, Lasswade.
†PHILIP, Robert, Minsterley, Shrewsbury.
PIERSON, Joshua, Forester, Old Shields, Airdrie.
PIRIE, John, Forester, Blackhall, Aberdeenshire.
*PORTSMOUTH, The Right Hon. The Earl of, Eggesford, North Devon.
POWERSCOURT, The Lord Viscount, Powerscourt, Enniskerry, County Wicklow.
POWNER, George, Forester, Willey Hall, Broseley, Shropshire.
POWNER, Thomas, British Workman's Rooms, Wellington.
PRESSLEY, D., Gardener, Knockmaroon, Chapelizod, Dublin.
PRICE, J., Forester, Garnstone Castle, Hereford.
†PRINGLE, John, Implement Depot, 1 Victoria Street, Edinburgh.

RAIT, James, Forester, Castle Forbes, Whitehouse, Aberdeen.
RAMSDEN, Sir J., Bart., M.P., Buckden, Skipton, York.
RANKINE, Thomas, Nurseryman, Hamilton.
RATTRAY, Thomas, Forester, Westonbilt House, Tetbury, Gloucestershire.
†RAVENSCROFT, Edward, *Farmer* Office, India Buildings, Edinburgh.
RAYSON, William, Messrs Veitch, Royal Exotic Nursery, King's Road, Chelsea.
†REID, George, Nursery and Seedsman, Aberdeen.
REID, James, Assistant Forester, Dalkeith Park, Dalkeith.
†RICHARDSON, Alexander, Land Steward, Arniston, Gorebridge.
RIGHY, William, Messrs King & Co., 45 Pall Mall, London.
RINTOUL, Henry, Bowerswell, Perth.
RITCHIE, Henry, Eridge Castle, Tunbridge Wells.
†RITCHIE, Walter, Forester, Dinas Mawddwy, Shrewsbury, N. Wales.
ROBERTSON, D., Albert Hotel, Hanover Street, Edinburgh.
ROBERTSON, David, Forester, Myton Hall, Borobridge, Yorkshire.
ROBERTSON, George, Forester, Benmore, Kilmun, Greenock.
ROBERTSON, James.
ROBERTSON, James, Forester, Drummond Castle, Crieff.
ROBERTSON, John.
ROBERTSON, John, Forester, Minto House, Hawick.
ROBERTSON, John, Assistant Forester, Dalmeny Park, Edinburgh.
ROBERTSON, ——, Forester, Markree Castle, Collooney, Co. Sligo.
ROBERTSON, P. S., Nursery and Seedsman, Edinburgh.
ROBERTSON, Thomas, Forester.
ROBERTSON, William W., Forester, Carolside, Earlston.
†ROBSON, Alexander, Overseer, Lude, Blair Athole.
ROBSON, David, Assistant Forester, Arthur Stone, by Meigle.
ROBSON, John, Forester.
ROBSON, Ralph, Nursery and Seedsman, Hexham.
RODGER, Hugh, Factor, Cleland, Motherwell.
*ROSEBERY, The Right Honourable the Earl of, Dalmeny Park, Edinburgh.
*ROSSLYN, The Right Honourable The Earl of, Dysart House, Fife.
†RUSSELL, John, Craigie, Ayr.
RUSSELL, Robert, Forester, Mostyn, Holywell, N. Wales.
RUST, Joseph, The Gardens, Eridge Castle, Tunbridge Wells, Kent.
†RUTHERFORD, Andrew, Forester, Bowmont Forest, Kelso.
†RUTHERFORD, James, Forester, Linthaugh, Jedburgh.
†RUTHERFORD, James, Agent, Kirkleatham, Redcar, Yorkshire.
RUTHERFORD, John, Assistant Forester, Linthaugh, Jedburgh.
RUTHERFORD, Robert, Manager, Invereshie, Kingussie.
RUTHERFORD, Thomas, Hothfield, Ashford, Kent.

†SADLER, John, F.R.Ph.S., Experimental Cottage, Edinburgh.—*Secretary.*

†Samson, John, Forester, Abernethy, Strathspey.
†Sandbach, Henry R., Esq., Hafodunos, Llanrwst, Denbighshire.
Scarth, T. W., Land Agent, Keverstone, Staindrop, Darlington.
Scott, Adam, Forester, Southwick Park, Fareham, Hants.
Scott, Andrew, Assistant Forester, Newton Don, Kelso.
†Scott, D., Wood-Manager, Darnaway Castle, Forres.
†Scott, David, Forester, Dornoch, Sutherland.
Scott, John, Forester.
†Scott, John W., Esq., Delgany, County Wicklow, Ireland.
Scott, Walter, Forester, Oxnam, Jedburgh.
Seaton, Allan, Assistant Forester, Cawdor Castle, Nairn.
Service, George, Assistant Forester, Dunse Castle, Dunse.
Service, James, Assistant Forester, Dunse Castle, Dunse.
Shand, James, Gardener, Meldrum House, Aberdeenshire.
Shanks, John, Forester, Kildrumy Castle, by Mosset.
Sheppard, John, Tweedside Cottage, Roehampton, Surrey.
Sim, William, Nurseryman, Forres.
†Simpson, J., Forester, Alloa Park, Alloa.
Simpson, Peter, Assistant Forester, Daughty Mill, Kirkcaldy.
†Simpson, Thomas, Forester, Glenferness, Nairnshire.
Sinton, David, Assistant Forester, Charlton, Malmesbury, Wilts.
Sinton, J., Stourton, Bath.
Sinton, John, Forester, Charlton, Malmesbury, Wilts.
Skeldon, John, Assistant Forester, Dunse Castle, Dunse.
Skirving, Archibald, Forester, Duncombe Park, Helmsley, York.
Skirving, William, Nursery and Seedsman, Liverpool.
†Slater, Andrew, Forester, Lofthouse, Saltburn-by-the-Sea, Yorkshire.
Slater, Andrew, jun., Assistant Forester, Aske, Richmond, Yorkshire.
†Smart, A. H.
Smith, A., Factor, Douglas Castle, Lanarkshire.
†Smith, James, Forester, Donibristle, Aberdour, Fife.
Smith, James, The Gardens, Exton Park, Oakham, Leicestershire.
Smith, John Crombie, Assistant Forester, Drummond Castle, Crieff.
Smith, Thomas, Nurseryman, Stranraer.
Smith, W. Baxter, Messrs Little & Ballantyne, Nursery and Seedsmen, Carlisle.
Smith & Simons, Messrs, Nursery and Seedsmen, Howard St., Glasgow.
†Smith & Son, Messrs William, Nurserymen, Aberdeen.
Solly, Professor Edward, F.R.S., Parkstone, near Poole.
Somerville, Samuel, M.D., F.R.C.P., 17 Hart Street, Edinburgh.
Spence, Charles, Assistant Forester, Drumpellier, Coatbridge.
Stalker, Donald, Assistant Forester.
Stapylton, Major, Myton Hall, Borobridge, Yorkshire.
Stark, Robert M., 21 Verulam Terrace, Hammersmith, London, W.
Steele, David, Forester, Skene House, Aberdeen.

STEVENSON, David, Forester, Hawkhead, Paisley.
†STEVENSON, James, Forester, Cobham Park, Surrey.
STEWART, Alexander, Chancelot House, Ferry Road, Edinburgh.
STEWART, Alexander, Forester, Grinkle Park, Saltburn-by-the Sea, Yorkshire.
STEWART, D., Manager, Dalnarert, Aviemore.
STEWART, James, Assistant Forester, Drumpellier, Coatbridge.
STEWART, John, Forester, Blair Athole, Perthshire.
STEWART, John, Assistant Forester, Cawdor Castle, Nairn.
STEWART, J. Lindsay, M.D., Conservator of Forests, Punjaub, India.
STEWART, Peter, Gardener and Forester, Castle Wellan, Co. Down.
STEWART, William, Land Steward, Dalhousie Castle, Lasswade.
STEWART, William, Nurseryman, Dundee.
STEWART, William, Assistant Forester, Underley Hall, Kirkby.
STEWART, William, Assistant Forester, Logie Almond, Perth.
STRANG, William, Assistant Forester, New Scone, Perth.
STUART, John, Forester, Castle Grant, Strathspey.
†STUART, Lewis A. G., Forester, Nethesdale House, Turriff.
STUART, William, Forester.
STUART & MEIN, Messrs, Nurserymen, Kelso.
SUTTIE, James, Evington, Ashford, Kent.
SWAN, R. G., Auctioneer, Dunse.
SYME, David, 1 George IV. Bridge, Edinburgh.—*Auditor.*
SYMON, John, Forester, Cawdor Castle, Nairn.
SYMON, Peter, Forester, Forres.

TAIT, David, Forester, Owston Park, Doncaster, Yorkshire.
TAIT, Walter, Seedsman, 45 Chapel Street, Dublin.
†TALBERT, Peter, Forester, Glenericht, Blairgowrie.
TAYLOR, David, Barskimming, Mauchline.
TAYLOR, George, Forester, Monymusk, Aberdeenshire.
TAYLOR, George, Nursery and Seedsman, Inverurie.
THOMSON, James Scott, Castle Strathallan, Auchterarder.
*†THOMSON, John Grant, Wood Manager, Grantown, Strathspey.
THOMSON, Lockhart, Esq., 22 Coates Crescent, Edinburgh.
THOMSON, Thomas, Forester, Penicuik House, Penicuik.
THORNTON, Thomas, Heatherside, Frimley, Surrey.
TIVENDALE, William, Forester, Houston, near Paisley.
TOMLINSON, J., Brocklesby Park, Ulceby.
TOMLINSON, Wilson, Assistant Forester, Belvoir Castle, Grantham.
TROTTER, Colonel R. A., The Bush, Edinburgh.
TURNBULL, James, Nurseryman, Hawick.
TURNBULL, R. E., West Mount, York.
TURNBULL, William, Assistant Forester, Bowmont Forest, Kelso.
TURNER, James, Assistant Gardener, Dalkeith Park, Dalkeith.

TWEEDIE, John, Forester, Dunglass, Cockburnspath, Berwickshire.

*URQUHART, B. C., Esq., of Meldrum, Aberdeenshire.

VEITCH, John, Nurseryman, Falkirk.
VEITCH, William, Hedger, Arniston, Gorebridge.

WADDINGTON, David, Crosshouse, Airdrie.
WADDS, Philip, Gardener, Moore Abbey, Co. Kildare.
WALKER, William, Assistant Forester, Penicuik House, Penicuik.
WALL, G. Y., jun., Esq., Exchequer Office, Durham.
WALLACE, Andrew, Assistant Forester, Drumpellier, Coatbridge.
WALLACE, ——, Forester, Panmure, Carnoustie.
†WARD, James, Forester, Hawkhead Abbey, Paisley.
WATERER, Anthony, Nurseryman, Knaphill, Surrey.
WATERS, Denis, Forester, Kelburn Castle, Largs.
WATERSON, A., Assistant Forester, Penrhyn Castle, Bangor, N. Wales.
WATSON, John, The Gardens, Stravithy, St Andrews.
WATSON, William, Assistant Forester, Peth, Longtown, Cumberland.
WATSON, W. J., Nursery and Seedsman, Newcastle-on-Tyne.
WATT, James, Messrs Little and Ballantyne, Nurserymen, Carlisle.
WATT, William, Forester, Nisbet House, Dunse.
*WAVENEY, Lord, Flixton Hall, Bungay, Suffolk.
WEAVER, James, Forester to the Marquis of Lothian, Mount Teviot, Jedburgh.
†WEAVER, James V., Forester, Mount Teviot, Jedburgh.
WEBSTER, David, Bangholm, Edinburgh.
WEBSTER, J., The Gardens, Gordon Castle, Fochabers.
WELSH, Duncan, Gardener, Mount Merrion, Dublin.
†WELSH, James, Nursery and Seedsman, Edinburgh.
†WELSH, William M., Nursery and Seedsman, Edinburgh.
WEMYSS, Randolph Gordon Erskine, Esq., of Wemyss and Torry, Fife.
WEST, Charles Elis, Land Steward, Cartoon, Maynooth.
WHILLIS, Alexander, Assistant Forester, Penicuik House, Penicuik.
WHITE, George, Seedsman, Paisley.
†WHITEFORD, Robert, Assistant Hedger, Bute Estate, Rothesay.
WHYTE, David, Assistant Forester, Dunse Castle, Dunse.
*WILD, A. E., Assistant Conservator of Forests, Punjab, India (6 George Street, Sheffield).
WILLIAMS, B. S., Paradise Nursery, Upper Holloway, London, N.
WILSON, John, F.R.S.E., Professor of Agriculture, University of Edinburgh.
WILSON, John, Forester, Knowefield Nurseries, Carlisle.
WILSON, John, Forester, Auchendolly, Castle-Douglas.
WILSON, John, Assistant Forester, Arniston, Gorebridge.

WILSON, John, Assistant Forester, Penicuik House, Penicuik.
WILSON, Peter, Forester, Whitehill, Lasswade.
†WILSON, Robert, Forester, Pewsey, Wilts.
WILSON, Stephen, 132 Union Street, Aberdeen.
WOOD, James, Factor, Haighall, Lancashire.
WOOD, John, Gardener, Hatton Castle, Aberdeenshire.
WYLIE, James, Assistant Forester, Douglaston, Milngavie, Glasgow.
†WYLLIE, George, Estate Overseer, Ballogie, Aboyne.

YELLOWLEES, George, Wood Merchant, Galashiels.
YOUNG, John, Messrs Imrie & Son's Nurseries, Ayr.
YOUNG, William, Assistant Secretary, Royal Caledonian Horticultural Society, 33 South Bridge, Edinburgh.

SUBJECTS OFFERED FOR COMPETITION DURING 1872–73.

I. For the best and approved Report on the most extensive, complete, and judiciously arranged Arboretum. 1st Prize, the "Lawson Prize" of Five Guineas; 2d Prize, a Medal.

The arboretums reported on in 1872 are excluded.

II. For the best and approved Essay on the present state and future prospects of Arboriculture in the county in which the competitor resides. 1st Prize, Five Guineas (offered by David Mitchell, Esq., Nurseryman, Edinburgh); 2d Prize, a Medal.

III. For the best and approved Essay on the literature of Scottish Arboriculture. 1st Prize, Three Guineas (offered by the President); 2d Prize, a Medal.

IV. For a full and complete, but succinct and well-written account, from published descriptions,—with authorities distinctly quoted,—personal observation, and experiment of the history and present state of the cultivation in Great Britain and Ireland of *Cedrus Deodara* (*C. Libanotis*, and *C. atlantica*, all now classed as one species). Special Medal, value Three Guineas (offered by Dr J. Lindsay Stewart, Conservator of Forests, Punjab); 2d Prize, a medal.

V. For the best and approved collection of Cones exhibited from and grown in the county in which the competitor resides. 1st Prize, Five Guineas (offered by Messrs Thomas Methven and Sons, Nursery and Seedsmen, Edinburgh); 2d Prize, a Medal.

The prize collection to become the property of the Society.

VI. For the best and approved collection of prepared sections of different kinds of Wood grown in the county in which the competitor resides. (*A Medal.*)

VII. For the best and approved series of geological specimens illustrating the different rocks and formations on which Forest Trees and Shrubs grow in the county in which the competitor resides. The specimens to be accompanied by a Report. (*A Medal.*)

VIII. On the employment of Locomotive Engines in Forestry, especially for the transit of timber, and on the working of portable saw-mills. (*A Medal.*)

IX. For an approved Report on the Plantations of which the Competitor is Forester. (*Three Medals.*) One to be awarded for the best Report from each of the countries—England, Scotland, and Ireland—and competition to be confined to each country respectively.

X. For an approved Report on the management of Forests in Germany, France, and other places on the Continent. (*A Medal.*)

XI. For an approved Report on the different Ages at which the various sorts of Timber Trees usually grown in Scotland may be most profitably felled in different soils and situations. (*A Medal.*)

XII. For an approved Report on the Diseases most incidental to Forest Trees, including those that affect the roots as well as the bark, branches, and foliage. (Limited to Assistant Foresters and Working Woodmen.) 1st Prize, a Medal; 2d Prize (offered by Mr R. E. Brown), copy of "Brown's Forester."

XIII. For an approved Report on the results obtained by experience of Seedlings of Coniferæ, being the produce of trees grown in Britain, as compared with plants obtained from foreign-ripened seed. (*A Medal.*)

XIV. For an approved Report on the natural history of Beetles and other insects which affect Coniferæ—their modes of operation upon the tree, and suggestions as to a remedy for their attack. (*A Medal.*)

XV. For an approved Report on the comparative advantages of the different methods of Pruning. (*A Medal.*)

XVI. For an approved Report on the different modes of profitably disposing of Home-grown Timber. (*A Medal.*)

XVII. To any Member of the Society who shall send to the Secretary from abroad, cones or seeds of Forest Trees of new or rare varieties capable of germination and of thriving in this country. (*A Medal.*)

XVIII. For an approved Essay or Report on any other subject connected with Arboriculture. (*A Medal.*)

XIX. For any marked advantageous improvement on any of the Implements used in Forestry. (Models or Implements to be accompanied by a Report.) (*A Medal.*)

For conditions of Competition, see *Proceedings* of Annual General Meeting of 6th November 1872.

All Essays, Reports, and Implements intended for Competition must be given in to the Secretary not later than 25th September 1873 *—each bearing a motto, and being accompanied by a separate sealed envelope bearing the same motto outside, and containing a card with the motto, name, and address of the Competitor.*

Abstract of the Laws of the Scottish Arboricultural Society, as amended to 6th November 1872:—

The object of the Society shall be the promotion of the science of Arboriculture in all its branches, by periodical meetings of the Members for the reading of Papers; by offering Prizes for Essays and Reports on the Practical Operations of Forestry, and publication of the same; and by such other means as may be found advisable.

The Society shall consist of the following classes of Members:— 1. Proprietors, Factors, Nurserymen, and others, paying an annual subscription of Half-a-Guinea; 2. Head-Foresters, and others, paying an annual subscription of Five Shillings; 3. Assistant Foresters, paying an annual subscription of Three Shillings.

Any Member may become a Life-Member by compounding for his annual subscriptions by a single payment—those of the First Class paying Five Guineas; and those of the Second and Third Classes, Three Guineas.

The Society shall elect a limited number of Honorary Members,—gentlemen who have acquired eminence in the science of Arboriculture, or who are otherwise deemed worthy.

All annual Subscriptions shall be payable in advance, at the Annual General Meeting in November.

In addition to the annual subscriptions above stipulated, the Society shall receive, from those friendly to its objects, Donations of larger or smaller amount.

A Candidate for admission into the Society must be recommended by at least one Member, and shall, on payment of his annual subscription, be immediately admitted a Member of the Society, subject to the revision of the first General Meeting thereafter. Any Member of the Society introducing a New Member shall be held responsible for the first year's subscription of such party.

The affairs of the Society shall be conducted by a President, five Vice-Presidents, Secretary, Treasurer, Auditor, and a Committee of fifteen Members,—these office-bearers to be elected annually at the General Meeting in November; the three Members of Committee at the top of the list to go out annually, but one to be eligible for re-election.

A General Meeting of the Members shall be held on the first Wednesday of November annually, for the election of New Members, the appointment of Office-Bearers, the reading of Papers, awarding of Prizes, and other business.

JOHN SADLER,
Secretary.

OFFICE-BEARERS FOR 1872-73.

PRESIDENT.

HUGH CLEGHORN, of Stravithy, M.D., F.R.S.E.

VICE-PRESIDENTS.

JOHN HUTTON BALFOUR, M.D., F.R.S., Professor of Medicine and Botany in the University, Edinburgh.
WILLIAM M'CORQUODALE, Forester, Scone Palace, Perth.
JOHN GRANT THOMSON, Wood Manager, Grantown, Strathspey.
ROBERT HUTCHISON, Esq., of Carlowrie, F.R.S.E.
WELLWOOD H. MAXWELL, Esq., of Munches, M.P.

SECRETARY.

JOHN SADLER, F.R.Ph.S., Lecturer on Botany in the Royal High School, and Assistant to the Professor of Botany in the University of Edinburgh.

TREASURER.

THOMAS METHVEN, of Messrs T. Methven and Sons, Nursery and Seedsmen, 15 Princes Street, Edinburgh.

AUDITOR.

DAVID SYME, 19 George IV. Bridge, Edinburgh.

COUNCIL.

CHARLES S. FRANCE, Overseer, Penicuik House, Penicuik.
ANDREW RUTHERFORD, Forester, Bowmont Forest, Kelso.
R. T. MACKINTOSH, Nursery and Seedsman, Edinburgh.
JOHN ANDERSON, Nurseryman, Perth.
GEORGE REID, Nursery and Seedsman, Aberdeen.
ROBERT BROUGH, Forester, Balnagowan, Ross-shire.
JOHN M'LAREN, Forester, Hopetoun, South Queensferry.
HUGH FRASER, Stanwell Nursery, Edinburgh.
DAVID MITCHELL, Bangholm House, Edinburgh.
ROBERT FOULIS, Forester, Fordel, Fife.
JOHN M'GREGOR, Forester, Ladywell, Dunkeld.
WILLIAM GILCHRIST, Forester, Cluny Castle, Aberdeen.
ALEXANDER RICHARDSON, Land Steward, Arniston, Gorebridge.
JAMES MOFFAT, Forester, Newbattle Abbey, Dalkeith.
JAMES SMITH, Forester, Donibristle, Fife.

APPENDIX B.

GENERAL ABSTRACT OF THE ACCOUNTS

OF THE SCOTTISH ARBORICULTURAL SOCIETY

for the Year ending 5th November 1872.

CHARGE.

To Balance in Bank,	£9	9	11
,, Annual Subscriptions for 1871–2,	59	18	0
,, Arrears,	5	18	6
,, Subscription to Sinking Fund,	0	3	0
,, Life Membership Subscriptions,	26	5	0
,, Robert Hutchison, Esq. of Carlowrie (Donation),	6	10	0
,, Peter Lawson & Sons (Donation)	5	5	0
,, Thomas Methven & Sons (Prize),	5	5	0
,, C. Y. Michie (Donation),	0	12	0
,, Copies of Transactions Sold,	0	6	0
,, Received for Advertising in Transactions, per Keith & Co.,	13	0	0
,, Interest,	0	8	2
	£133	0	7

DISCHARGE.

By Balance from last Account,	£2	6	5
,, Neill & Co., for Printing,	49	6	0
,, Mould & Tod, for Receipt Books,	0	18	6
,, Secretary's Salary,	20	0	0
,, Paid for Prizes, Medals, &c.,	19	13	0
,, Paid over to Sinking Fund Account,	11	15	0
,, Annual Dinner, Extra Expenses,	2	1	6
,, Postages, &c., per Secretary,	10	10	7
,, ,, per Treasurer,	2	5	1
,, Advertising, Stationery, &c.,	2	14	2
,, Balance in Bank,	4	3	1
,, Balance on hand,	7	7	3
	£133	0	7

CAPITAL OR SINKING FUND ACCOUNT.

CHARGE.

To Donation and Life Membership Subscription,	£11	15	0
,, Interest,	0	2	2
	£11	17	2

DISCHARGE.

By Balance in Bank,	11	17	2
	£11	17	2

I have examined the State of the Affairs of the Scottish Arboricultural Society for the year ending 5th November 1872, comparing the same with the books and necessary vouchers, all of which I find to be correct, leaving balance in bank in connection with General Account, Four pounds three shillings and one penny, and owing by Treasurer Seven pounds seven shillings and threepence, being in all to the credit of the Society, besides unpaid subscriptions, the sum of Eleven pounds two shillings and fourpence sterling, and showing a balance in bank to the credit of the Capital or Sinking Fund, the sum of Eleven pounds seventeen shillings and twopence sterling.

EDINBURGH, 5*th November* 1872. DAVID SYME, *Auditor.*

GENERAL ABSTRACT OF THE ACCOUNTS

OF THE SCOTTISH ARBORICULTURAL SOCIETY

for the Year ending 4th November 1873.

CHARGE.

To Balance in Bank,	£4	3	1
,, ,, on hand,	7	7	3
,, Robert Hutchison, Esq. of Carlowrie (Special Prize),	5	5	0
,, Peter Lawson & Son (Special Prize),	5	5	0
,, Admission to Exhibition of Woods,	0	13	0
,, Transactions Sold,	2	19	5
,, Coniferous Seeds Sold,	2	0	0
,, Annual Subscriptions for 1872–3,	84	15	6
,, Arrears,	5	10	0
,, Life Membership Subscriptions,	42	0	0
,, Sinking Fund,	0	8	0
,, Interest,	1	3	0
,, Balance due, National Bank,	25	15	11
	£187	5	2

DISCHARGE.

By Expenses connected with Exhibition of Woods,	£11	9	4
,, Paid for Medals and Prizes,	31	6	6
,, Advertising, Stationery, &c.,	7	6	1
,, Neill & Co., for Printing,	60	0	0
,, Secretary's Salary,	20	0	0
,, Postages, &c.,	12	18	3
,, Paid over to Capital Account,	36	15	0
,, Balance on hand,	7	10	0
	£187	5	2

CAPITAL OR SINKING FUND ACCOUNT.

CHARGE.

To Balance from last Account,	£11	17	2
,, Paid over from Ordinary Account,	36	15	0
,, Interest,	0	5	7
	£48	17	9

DISCHARGE.

By Deposit Receipt with National Bank,	£48	17	9
	£48	17	9

I hereby certify that I have examined the above Statement of Affairs of the Scottish Arboricultural Society for the year ending this day, along with the necessary vouchers, and find the same correct, showing on the General Account a balance in Treasurer's hands of Seven pounds ten shillings (from which the sum of £5, 13s. falls to be transferred to the Capital Account), and balance due to the National Bank of Twenty-five pounds fifteen shillings and elevenpence; also find in the Capital Account the sum of Forty-eight pounds seven shillings and ninepence sterling, lodged with the National Bank on deposit receipt.

Edinburgh, 4*th November* 1873. DAVID SYME, *Auditor*.

Scottish Arboricultural Society.

PATRON.

HER MOST GRACIOUS MAJESTY THE QUEEN.

LIST OF MEMBERS

CORRECTED TO AUGUST 1874.

* *Members who have given Subscriptions, in order to form a Capital or Sinking Fund.*

All Subscriptions are payable at the Annual General Meeting in November. Members whose Subscriptions are Two Years in Arrears are not entitled to receive the Transactions.

HONORARY MEMBERS.

Balfour, John Hutton, M.D., A.M., F.R.SS.L. and E., Professor of Medicine and Botany in the University of Edinburgh.

Brandis, Dietrich, Ph.D., Inspector-General of Forests to the Government of India.

Bullen, Robert, Curator of the Botanic Garden, Glasgow.

*Hutchison, Robert, F.R.S.E., of Carlowrie, Kirkliston.

Lawson, George, LL.D., Ph.D., Professor of Natural History and Chemistry, Dalhousie College, Halifax, Nova Scotia.

M'Nab, James, F.B.S.E., Curator of the Royal Botanic Garden, Edinburgh.

*Thomson, William, Deputy Surveyor, H.M. Chopwell Woods, Burnopfield, Durham.

LIFE MEMBERS.

Adam, The Right Hon. W. P., of Blairadam, Kinross-shire, M.P.

Barbour, George F., of Bonskied, Pitlochry, Perthshire.

Bell, William, of Gribdae, Kirkcudbright.

Bosanquet, Rev. G. H., Broom-y-Close Court, Llanwarne, Ross, Herefordshire.

BRUCE, Hon. T. C., 24 Hill Street, Berkeley Square, London, W.
CLEGHORN, Hugh, M.D., F.R.S.E., of Stravithy, St Andrews, Fife (*President*).
CRAWFORD, William Stirling, of Milton, Glasgow.
DEWAR, Colonel A., of Vogrie, Ford.
DUNCAN, Alexander, of Knossington Grange, Oakham, Leicestershire.
DUNDAS, Robert, of Arniston, Gorebridge.
FISH, D. T., Hardwick, Bury-St-Edmunds.
*GOUGH, William, Wood Manager, Wykeham, York.
GRANTHAM, George, Barcombe Place, Lewes, Sussex.
GRIMMOND, Alexander D., of Glenericht, Blairgowrie.
HOPE, H. W., of Luffness, Drem.
HUTH, Louis, of Possingworth, Hawkhurst, Sussex.
KINNEAR, William Balfour, Foo-Chow, China.
LESLIE, Charles P., of Castle Leslie, Glasslough, Ireland.
M'GREGOR, John, Ladywell, Dunkeld, Perthshire.
MACKENZIE, Colin J., of Portmore, Eddleston, Peebles.
M'TIER, Alexander Walker, of Durris, Aberdeenshire.
MAXWELL, Wellwood H., of Munches, Dalbeattie.
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MINTO, The Right Hon. the Earl of, Minto House, Hawick.
MOORE, Thomas, F.L.S., Curator, Botanic Garden, Chelsea.
PORTSMOUTH, The Right Hon. the Earl of, Eggesford, North Devon.
ROSEBERY, The Right Hon. the Earl of, Dalmeny Park, Edinburgh.
ROSSLYN, The Right Hon. the Earl of, Dysart House, Fife.
STAIR, The Right Hon. the Earl of, Lochinch, Castle Kennedy, Wigtownshire.
*TALBERT, Peter, Forester, Glenericht, Blairgowrie.
*THOMSON, John Grant, Wood Manager, Grantown, Strathspey.
TROTTER, Colonel, R.A., The Bush, Edinburgh.
URQUHART, B. C., of Meldrum, Aberdeenshire.
WAVENEY, Lord, Flixton Hall, Bungay, Suffolk.
WEMYSS, Randolph Gordon Erskine, of Wemyss and Torry, Fife.
WILD, A. E., Assistant Conservator of Forests, Punjaub, India (6 George Street, Sheffield).
WILSON, John, F.R.S.E., Professor of Agriculture, University, Edinburgh.

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ALDER, Robert, Assistant Forester, Dunse Castle, Dunse.
ALEXANDER, James, Nursery and Seedsman, Edinburgh.

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Alexander, John.
Alexander, John, Assistant Forester, Benmore House, Greenock.
Alexander, William, Assistant Forester, Abernethy, Strathspey.
Allan, Andrew, Rankeillor, Cupar, Fife.
*Allan, John, Forester, Dalmeny Park, Edinburgh.
Anderson, Alexander, Forester, St Fort, Newport, Dundee.
Anderson, Alexander, Assistant Forester, Darnaway Castle, Forres.
Anderson, Alexander, Gardener, Oxenford Castle, Dalkeith.
Anderson, Hugh, Assistant Forester, Hawkhead, Paisley.
Anderson, James, Bangholm Nursery, Edinburgh.
Anderson, James, Meadowbank, Uddingston.
Anderson, John, Newstead Abbey, Nottingham.
*Anderson, John, Nurseryman, Perth.
Annand, Charles, Forester, Cromar Estates, Tarland, Aberdeenshire.
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Archer, James, Assistant Forester, Culzean Castle, Maybole.
Archer, John, Assistant Forester, Culzean Castle, Maybole.
*Archibald, Thomas, Forester, Virginia, Co. Cavan, Ireland.
Arnott, Alexander, Hedger, East Wemyss, Fife.
Ashdown, Samuel Harding, Land Agent, Uppington, Wellington, Salop.
Austin & M'Auslan, Messrs, Nursery and Seedsmen, Glasgow.

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Baillie, William, Wood Manager, Cortachy, Kirriemuir.
Baird, Joseph, Assistant Forester, Drumpellier, Coatbridge.
Balden, James, Forester, Lennoxlove, Haddington.
Balden, Joseph, Overseer, Houghton Estate, Preston.
*Balden, Peter G., Forester, Vaenol Park, Bangor, North Wales.
*Balden, William, Appleby Castle, Appleby.
*Ballantyne & Son, Messrs John, Nurserymen and Seedsmen, Dalkeith.
Ballingal, Robert, Factor, Ellabus, Islay.
*Barrie, David, Forester, Durris, Aberdeen.
*Barrie, James, Forester, Stevenstone House, Torrington, Devonshire.
Barter, Frederick, Assistant Gardener.
Baty, David, Forester, Lowther Castle, Penrith.
Baty, William, Forester, Netherby, Longtown.
Baxter, Robert, Forester, Dalkeith Park, Dalkeith.
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Bell, James, Forester, Newcastleton, Carlisle.
Bennett, Alexander, Forester.

BERRY, George, Longleat, Horningsham, Warminster, Wiltshire.
BERRY, Thomas Walter, Forester, Brynkinalt, Chirk, N. Wales.
BIGGE, Matthew, of Islip, Thrupston.
BIRCH, John, Assistant Gardener, Tinnchinch, Enniskerry, Co. Wicklow.
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BROWN, William, Land Valuator and Estate Agent (N. America).
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BRUCE, T. R., of Slogarie, Lauriestown, Castle-Douglas.
BRYAN, F. G. D., Factor, Drumpellier, Coatbridge.
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BUCHANAN, Robert R., Forester, Dunse Castle, Dunse.
BURNETT, James, Assistant Forester, Durris, Aberdeenshire.

CALDER, Frederick, Forester, Brucklay Castle, Aberdeenshire.
CALLOGHIN, John, Assistant Forester, Houston, Paisley.
CAMERON, Alexander, Forester, Countlich Lodge, Ballinluig, Perthshire.
CAMERON, Angus, Assistant Forester, Altyre, Forres.
CAMERON, Henry, Assistant Forester, Linkwood, Elgin.
CAMERON, Hugh, Assistant Forester, Novar, Evanton, Ross-shire.
*CAMERON, John, Assistant Forester, Fowlis Wester, Crieff, Perthshire.
CAMERON, Robert, Forester, Galtie Castle, Mitchelstown, Tipperary.
CAMPBELL, Alexander, Forester, Gray House, Liff, Dundee.

*CAMPBELL, James, of Tillichewan Castle, Dumbartonshire.
CAMPBELL, John, Forester, Aboyne Castle, Aberdeenshire.
CAMPBELL, Peter, Assistant Forester, Invereshie, Kingussie.
CAIRNDUFF, Andrew, Forester, Abbeyleix, Queen's Co., Ireland.
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CHAMBERS, William, of Haford, Aberystwith, Wales.
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CHAPMAN, James, Assistant Forester, Grinkle Park, Saltburn-by-the-Sea, Yorkshire.
CHAPPLOW, John, Glencoin Cottage, Patterdale, Penrith.
CHRISTIE, A. D., Foreman, Heaton Park Gardens, Manchester.
CHRISTIE, David, Forester, Abington House, Lanarkshire.
*CHURNSIDE, Francis, Forester, Ladykirk, Berwickshire.
CHURNSIDE, Robert, Forester, Edlingham, Alnwick.
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COWE, John, Luffness, Drem.
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*Davidson, John, Forester, Aldbar, Brechin.
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*Davidson, John, Overseer and Architect, Belmont Castle, Meigle.
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Davidson, W., Leager House, Chuseburn Grange, Newcastle-on-Tyne.
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Donald, Alexander, Forester, Woodhall House, Airdrie.
Donaldson, J., Forester, Brechin Castle, Brechin.
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*Dow, Thomas, Forester, Idvies, Forfar.
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*Duff, James, Melgund, Aberlemno, Forfar.
Duff, James, Wood Manager, Bayham Abbey, Tunbridge Wells.
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Duncan, John, Forester, Blandpant, Llandyssil.

DUNCAN, William, Forester, Ardgowan, Greenock.
DUNLOP, Alexander, Factor, Luffness, Drem.
DUNN, David, The Gardens, Heaton Park, Manchester.
*DUNN, Malcolm, The Gardens, Dalkeith Park, Dalkeith.
DURWARD, Robert, Manager, Blelack, Aberdeenshire.
DYKES, Thomas, Factor, Maybole, Ayrshire.

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FAIRBAIRN, William, Land Steward, Manderston, Dunse.
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FERGUSON, James, Forester and Land Steward, Cleghorn, Lanark.
FERGUSON, Joseph, Assistant Forester, Lambton Park, Fence Houses.
FERNIE, Robert, Forester, Balcarres, Colinsburgh, Fife.
FETTES, Francis, Assistant Hedger, Ury House, Stonehaven.
FINGLAND, J., Forester, Drumlanrig, Thornhill, Dumfriesshire.
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FISHER, William, Forester, Wentworth Castle, Barnsley, Yorkshire.
*FORBES, Andrew, Forester, Stracathro, Brechin.
FORBES, Wiillam, Assistant Forester, Castlecary, Denny.
FORGAN, James, Wellwood Cottage, Kinnoull, Perth.
FORREST, William, Melfort Cottage, Lochgilphead.
FOULIS, Robert, M.D., Cairnie Lodge, Cupar, Fife.
FOULIS, Robert, Forester, Fordel, Inverkeithing, Fife.
FOWLER, Archibald, The Gardens, Castle Kennedy, Stranraer.
FRANCE, Charles, Forester, Culzean Castle, Maybole, Ayrshire.
*FRANCE, C. S., Overseer, Penicuik House, Penicuik.
*FRANCE, George, Overseer, Glenelg, Lochalsh.
FRANCE, James, Assistant Forester, Culzean Castle, Maybole, Ayrshire.
FRASER, Archibald, Assistant Forester.
*FRASER, Duncan, Forester.
FRASER, James, Assistant Forester, Drumpellier, Coatbridge.
FRASER, P. Neill, Canonmills Lodge, Edinburgh.
FRASER, Hugh, Stanwell Nursery, Edinburgh.
FRASER, Simon, Forester, Haddo House, Aberdeenshire.
*FRASER, Thomas, Forester, Oriel Temple, County Louth.
FREEMAN, Timothy, Messrs Osborne & Sons, Fulham, London.
FROST, Philip, Gardener, Dropmore, Maidenhead.

*Gardiner, R., Wenalt House, Crosswood, Aberystwith, South Wales.
Gardiner, James, Forester, Hawkstone Park, Salop.
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Gow, James, Forester, Camperdown, Dundee.
Gow, John L., Factor, Raith, Kirkcaldy.
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Grant, John, Assistant Forester, Abernethy, Strathspey.
Green, Alexander, Assistant Forester, Culzean Castle, Maybole.
Green, William, Assistant Forester, Charleston, Malmesbury, Wilts.
Greer, Robert, Assistant Forester, Ardgowan, Greenock.
*Greig, Gavin, Forester, Parkhill, Aberdeen.
Grieve, George, Gardener, Dalkeith.
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Hamilton, David, Forester, Tillichewan Castle, Alexandria, Dumbarton.
Hamilton, John B. Baillie, of Arnprior, Cambusmore, Callander.
Handasyde & Davidson, Messrs Thomas, Nurserymen, Musselburgh.
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*Hardie, Walter, Forester, The Hall, Norwell, Newark, Notts.
*Harley, Andrew, Penybout, Radnorshire.

HARROLD, George, Gardener, Mount Henrie, Queen's Co., Ireland.
HARROWER, William, Forester, Glen App, Ballantrae, Ayrshire.
HART, Thomas, Assistant Forester, Yester, Haddington.
HARTLAND, Richard, The Lough Nurseries, Cork.
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HAYMAN, John, jun., Overseer, Dumfries House, Old Cumnock.
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HELMAN, George, Assistant Gardener.
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HEPBURN, James, Forester.
*HEPBURN, William, Assistant Forester, Altyre, Forres.
HERMISTON, James, Assistant Forester, Floors Castle, Kelso.
HETHERTON, Walter, Forester, Heanton, Satchville, Bedworth, N. Devon.
HILL, John, Land Steward, Whitehill, Lasswade.
HILSON, John, Assistant Forester, Floors Castle, Kelso.
*HOGARTH, James, Forester, Duthill, Strathspey.
HOGG, Thomas, Forester, Hampton Court, Leominster, Hereford.
HOOD, James, Assistant Forester, Langlee, Jedburgh.
HOOD, William, Gardener, Glasslough, Ireland.
HOME, George, Assistant Forester, Drumlanrig, Thornhill.
HORSBURGH, James, Forester, Yester, Haddington.
HUME, Andrew, Forester, Wansford, Peterborough.
*HUNTER, Patrick, Overseer, Glenarm Castle, Larne, Ireland.
HUNTER, William, Forester, Castlemilk, Glasgow.
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JEFFREY, John, Forester, Craighall, Blairgowrie.
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JOHNSTON, William, Fencer, Lee, Lanark.
JOHNSTONE, Alexander, Assistant Forester, Arniston, Gorebridge.
JOHNSTONE, Alexander, Assistant Forester, Penicuik House, Penicuik.
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LENOX, William, Forester, Keir, Dunblane.
LIDDELL, Rev. J. R., The Manse, Kirkliston.
LINDORES, Gavin, Assistant Forester.
LINKSTONE, James, Assistant Forester, Dalmeny Park, Edinburgh.
LITTLE, Alexander, Forester, Castle Menzies, Aberfeldy.
LORAINE, Edward, The Riding Mill, Northumberland.
LOTHIAN, The Most Hon. The Marquis of, Pinnelheugh House, Jedburgh.

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M'CORQUODALE, D. A., Assistant Factor, Panmure, Forfarshire.
*M'CORQUODALE, William, Forester, Scone Palace, Perth.
M'CREATH, Hugh, Assistant Forester, Culzean, Maybole, Ayrshire.
M'CUTCHEON, Robert, Assistant Forester, Cawdor Castle, Nairn.
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M'DONALD, Charles, Superintendent, Phœnix Park, Dublin.
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M'Intosh, Angus, Forester, Glashill, Killeigh, King's County.

Mackay, John, West Dean Estate, Chichester.

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M'Kay, Thomas, Forester.

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*M'Laren, Hugh.

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*M'Laren, John, Forester, Hopetoun House, South Queensferry.

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M'Rae, John, Forester, Auchendennan House, Alexandria, Dumbartonshire.

M'Rae, Robert, Assistant Forester, Cullen House, Cullen.

M'Ritchie, T. E., W.S., 4 Gayfield Square, Edinburgh.

Main, John, Forester, Bryan Hall, Ferrybridge, Yorkshire.

Main & Co., Messrs A. & J., Wire Fence Manufacturers, 7 Renfield Street, Glasgow.

Malcolm, George, Bangholm Nursery, Edinburgh.
Maitland, William, Assistant Forester, Keith Hall, Aberdeenshire.
Marr, John, Assistant Forester, Darnaway Castle, Forres.
*Marshall, J., Forester, Lambton Park, Fence Houses, Durham.
Marshall, James, Forester, Preston, Dunse.
Marshall, Robert, Forester, Horton Manor, near Epsom.
Marshall, Robert, Assistant Forester, Ardgowan, Greenock.
Martin George, Forester, Dunecht House, Aberdeen.
Martin & Sons, Messrs, Nurserymen, Cottingham, Hull.
Mathieson, Donald, Meikleour, Perth.
Maxton, Robert, Forester, Strathallan Castle, Auchterarder.
Melrose, John, Wood Merchant.
Melrose, William, Forester, Byram Hall, South Mitford.
Menzies, George, Agent, Trentham, Stoke-on-Trent.
Menzies, William, Forester, Craigton Cottage, Causewayhead, by Stirling.
Methven, John, Nursery and Seedsman, Edinburgh.
*Michie, Christopher Young, Forester, Cullen House, Cullen, Banffshire.
*Michie, James, Forester, Wemyss Castle, Kirkcaldy.
Middlemass, Archibald, Forester, Dunans House, Colintraive, Greenock.
Milne, James, Forester, Glenmuick, by Ballater.
*Miller, John, Forester, Ochtertyre, Stirling.
*Mitchell, David, Nurseryman, Edinburgh.
Mitchell, Forbes, of Thainstone, Kintore.
Mitchell, Garlies, Nurseryman, Stranraer.
Mitchell, James, Aldie, Kinross.
Mitchell, James, Forester, Knossington Grange, Oakham, Leicestershire.
Moffat, Adam, Forester, Hindlip Hall, Worcester.
Moffat, Henry, Forester, Monkray, Whitehaven, Cumberland.
Moffat, James, Forester, Newbattle Abbey, Dalkeith.
Moffat, John, Forester, Kimmerghame, Dunse.
Morrison, John, Coney Park Nursery, Stirling.
Morrison, R., Nurseryman, Elgin.
Muir, William, of Inistrynich, Inverary, Argyllshire.
*Muirhead, John, Forester, Bicton, Budleigh Salterton, Devonshire.
Mullens, J., Gardener.
Munro, James, Forester, Invermorriston, Inverness-shire.
Munro, James, Assistant Forester, Darnaway Castle, Forres.
Munro, John, Assistant Forester, Cluny Castle, Aberdeen.
Murray, David, Forester, Dunira, Perthshire.
Murray, Robert, Nurseryman, Lanark.
Myles, James, Forester, Portmore, Eddlestone, Peebles.

Neil, Archibald, Forester, West Grange, Culross.
Newbigging, Alexander T., Nurseryman, Dumfries.
Nicol, W., Assistant Forester, Eglinton Castle, Irvine.

Nicol, William, Forester, Pitcaple, Aberdeenshire.
Notman, David, Nursery Foreman, Dean Park Nurseries, Edinburgh.

*Ogilvy, David, Assistant Forester, Cortachy, Forfar.
O'Neill, Richard, Auctioneer, Old Castle, Co. Meath.
*Ormiston & Renwick, Messrs, Nursery and Seedsmen, Melrose.

*Palmer & Son, Messrs John, Nurserymen, Annan.
*Parker, James, Forester, Belvoir Castle, Grantham.
Parker, Robert A., Nursery and Seedsman, Lanark.
*Paterson, Andrew, Surveyor, Exton, Oakham, Rutland.
Paterson, Charles, Factor, Castle Menzies, Aberfeldy, Perthshire.
Peebles, Andrew, Highclere Castle, Newbury, Berks.
Pender, John, M.P., of Minard Castle, Argyllshire.
Pendreigh, John, Assistant Forester, Port Bannatyne, Rothesay.
Philip, John, Wood Merchant, Bonnyrigg, Lasswade.
*Philip, Robert, Minsterley, Shrewsbury.
Pierson, Joshua, Forester, Old Shields, Airdrie.
Pirie, John, Forester, Blackhall, Aberdeenshire.
Powerscourt, The Lord Viscount, Powerscourt, Enniskerry, County Wicklow.
Powner, George, Forester, Willey Hall, Broseley, Shropshire.
Powner, Thomas, British Workman's Rooms, Wellington.
Pressley, D., Gardener, Knockmaroon, Chapelizod, Dublin.
Price, J., Forester, Garnstone Castle, Hereford.

Rait, James, Forester, Castle Forbes, Whitehouse, Aberdeen.
Ramsden, Sir J., Bart., M.P., Buckden, Skipton, York.
Rankine, Thomas, Nurseryman, Hamilton.
Rattray, Thomas, Forester, Westonbilt House, Tetbury, Gloucestershire.
*Ravenscroft, Edward, "Farmer" Office, India Buildings, Edinburgh.
Rea, Archibald Henry, Assistant Forester, Ury House, Stonehaven.
*Reid, George, Nursery and Seedsman, Aberdeen.
Reid, James, Assistant Forester, Dalkeith Park, Dalkeith.
Richardson, Adam, Assistant Forester, Arniston, Gorebridge.
*Richardson, Alexander, Land Steward, Arniston, Gorebridge.
Righy, William, Messrs King & Co., 45 Pall Mall, London.
Rintoul, Henry, Leith Walk Nurseries, Edinburgh.
Ritchie, Henry, Eridge Castle, Tunbridge Wells.
*Ritchie, Walter, Forester, Dinnas Mawddwy, Shrewsbury, N. Wales.
Robertson, D., Albert Hotel, Hanover Street, Edinburgh.
Robertson, David, Estate Manager, Curraghmore, Portlaw, Waterford.
Robertson, George, Forester, Benmore, Kilmun, Greenock.
Robertson, James.

ROBERTSON, James, Forester, Drummond Castle, Crieff.
ROBERTSON, John.
ROBERTSON, John, Forester, Minto House, Hawick.
ROBERTSON, John, Assistant Forester.
ROBERTSON ——, Forester, Markree Castle, Collooney, Co. Sligo.
ROBERTSON, P. S., Nursery and Seedsman, Edinburgh.
ROBERTSON, Thomas, Forester.
ROBERTSON, William W., Forester, Carolside, Earlston.
*ROBSON, Alexander, 10 Hospital Street, Dundee.
ROBSON, David, Assistant Forester, Arthur Stone, by Meigle.
ROBSON, John, Forester.
ROBSON, Ralph, Nursery and Seedsman, Hexham.
RODGER, Hugh, Factor, Cleland, Motherwell.
*RUSSELL, John, Craigie, Ayr.
RUSSELL, Robert, Forester, Mostyn, Holywell, N. Wales.
RUST, Joseph, The Gardens, Eridge Castle, Tunbridge Wells, Kent.
*RUTHERFORD, Andrew, Forester, Bowmont Forest, Kelso.
*RUTHERFORD, James, Forester, Linthaugh, Jedburgh.
*RUTHERFORD, James, Agent, Kirkleatham, Redcar, Yorkshire.
RUTHERFORD, John, Assistant Forester, Linthaugh, Jedburgh.
RUTHERFORD, Robert, Manager, Invereshie, Kingussie.
RUTHERFORD, Thomas, Hothfield, Ashford, Kent.

*SADLER, John, F.R.Ph.S., Experimental Cottage, Edinburgh.—*Secretary.*
*SAMSON, John, Forester, Abernethy, Strathspey.
*SANDBACH, Henry R., Hafodunos, Llanrwst, Denbighshire.
SCARTH, T. W., Land Agent, Keverstone, Staindrop, Darlington.
SCOTT, Adam, Forester, Southwick Park, Fareham, Hants.
SCOTT, Andrew, Assistant Forester, Newton Don, Kelso.
*SCOTT, D., Wood-Manager, Darnaway Castle, Forres.
*SCOTT, David, Forester, Broadford, Limerick.
SCOTT, John, Forester.
*SCOTT, John W., Delgany, County Wicklow, Ireland.
SCOTT, Walter, Forester, Oxnam, Jedburgh.
SCRIMGEOR, James, Under Forester, Altyre, Forres.
SEATON, Allan. Assistant Forester, Curraghmore, Portlaw, Co. Waterford.
SERVICE, George, Assistant Forester, Dunse Castle, Dunse.
SERVICE, James, Assistant Forester, Dunse Castle, Dunse.
SHAND, James, Gardener, Meldrum House, Aberdeenshire.
SHANKS, John, Forester, Kildrummy Castle, by Mossat.
SHEPPARD, John, Tweedside Cottage, Roehampton, Surrey.
SIM, William, Nurseryman, Forres.
*SIMPSON, J., Forester, Alloa Park, Alloa.
SIMPSON, Peter, Assistant Forester, Daughty Mill, Kirkcaldy.
*SIMPSON, Thomas, Forester, Glenferness, Nairnshire.

SINTON, David, Assistant Forester, Charlton, Malmesbury, Wilts.
SINTON, J., Forester, Stourhead, Bath.
SINTON, John, Forester, Charlton, Malmesbury, Wilts.
SKELDON, John, Assistant Forester, Dunse Castle, Dunse.
SKIRVING, Archibald, Forester, Duncombe Park, Helmesley, York.
SKIRVING, John Finlay, Assistant Forester, Duncombe Park, Helmesley.
SKIRVING, William, Nursery and Seedsman, Liverpool.
*SLATER, Andrew, Forester, Lofthouse, Saltburn-by-the-Sea, Yorkshire.
SLATER, Andrew, jun., Assistant Forester, Aske, Richmond, Yorkshire.
*SMART, A. H.
SMITH, A., Factor, Douglas Castle, Lanarkshire.
SMITH, G. B., Wire Fence Manufacturer, 56 West Regent St., Glasgow.
*SMITH, James, Forester, Donibristle, Aberdour, Fife.
SMITH, James, The Gardens, Exton Park, Oakham, Leicestershire.
SMITH, John, Forester, Windmill Cottages, Ladybank, Fife.
SMITH, John Crombie, Assistant Forester, Drummond Castle, Crieff.
SMITH, Thomas, Nurseryman, Stranraer.
SMITH, W. Baxter, Messrs Little & Ballantyne, Nursery and Seedmen, Carlisle.
SMITH & SIMMONS, Messrs, Nursery and Seedsmen, Howard St., Glasgow.
*SMITH & SON, Messrs William, Nursery and Seedsmen, Aberdeen.
SOLLY, Professor Edward, F.R.S., Parkstone, near Poole.
SOMERVILLE, Samuel, M.D., F.R.C.P., 17 Hart Street, Edinburgh.
SPENCE, Charles, Assistant Forester, Drumpellier, Coatbridge.
STALKER, Donald, Assistant Forester.
STAPYLTON, Major, Myton Hall, Borobridge, Yorkshire.
STEELE, David, Forester, Skene House, Aberdeen.
STEPHEN, James, Forester, Dochfour, Inverness.
STEPHEN, John, jun., Assistant Forester, Cluny Castle, Aberdeen.
STEVENSON, David, Forester, Kelly, Wemyss Bay, Greenock.
*STEVENSON, James, Forester, Cobham Park, Surrey.
STEWART, Alexander, Chancelot House, Ferry Road, Edinburgh.
STEWART, Alexander, Forester, Gringle Park, Saltburn-by-the-Sea, Yorkshire.
STEWART, D., Manager, Dalnavert, Aviemore.
STEWART, James, Assistant Forester, Drumpellier, Coatbridge.
STEWART, John, Forester, Blair Athole, Perthshire.
STEWART, John, Forester, Castlecary, Denny.
STEWART, Peter, Gardener and Forester, Castle Wellan, Co. Down.
STEWART, William, Land Steward, Dalhousie Castle, Lasswade.
STEWART, William, Nurseryman, Dundee.
STEWART, William, Assistant Forester, Underley Hall, Kirkby.
STEWART, William, Assistant Forester, Logie Almond, Perth.
STRANG, William, Assistant Forester, New Scone, Perth.
STUART, John, Forester, Castle Grant, Strathspey.

*Stuart, Lewis A. G., Forester, Netherdale House, Turriff.
Stuart, William, Forester.
Stuart & Mein, Messrs, Nurserymen, Kelso.
Suttie, James, Evington, Ashford, Kent.
Swan, R. G., Auctioneer, Dunse.
Swinton, A. Campbell, LL.D., F.R.S.E., of Kimmerghame, Dunse.
Syme, David, 1 George IV. Bridge, Edinburgh.
Symon, John, Forester, Cawdor Castle, Nairn.
Symon, Peter, Forester, Forres.

Tait, David, Forester, Owston Park, Doncaster, Yorkshire.
Tait, Walter, Seedsman, 45 Chapel Street, Dublin.
Taylor, David, Barskimming, Mauchline.
Taylor, George, Forester, Monymusk, Aberdeenshire.
Taylor, George, Nursery and Seedsman, Inverurie.
Thomson, James Scott, Strathallan Castle, Auchterarder.
Thomson, Lockhart, S.S.C., 22 Coates Crescent, Edinburgh.
Thomson, Thomas, Forester, Penicuik House, Penicuik.
Thornton, Thomas, Heatherside, Frimley, Surrey.
Tivendale, William, Forester, Houston, near Paisley.
Tomlinson, J., Brocklesby Park, Ulceby.
Tomlinson, Wilson, Assistant Forester, Belvoir Castle, Grantham.
Turnbull, James, Nurseryman, Hawick.
Turnbull, William, Assistant Forester, Bowmont Forest, Kelso.
Turner, James, Assistant Gardener, Blithefield Hall, Rugeley, Staffordshire.
Tweedie, John, Forester, Dunglass, Cockburnspath, Berwickshire.

Veitch, John, Nurseryman, Falkirk.
Veitch, William, Hedger, Arniston, Gorebridge.

Waddington, David, Crosshouse, Airdrie.
Wadds, Phillip, Gardener, Moore Abbey, Co. Kildare.
Walker, George, Forester, Collessie, Ladybank, Fife.
Walker, William, Assistant Forester, Penicuik House, Penicuik.
Wall, G. Y., jun., Exchequer Office, Durham.
Wallace, Andrew, Assistant Forester, Drumpellier, Coatbridge.
*Ward, James, Forester, Hawkhead Abbey, Paisley.
Waterer, Anthony, Nurseryman, Knaphill, Surrey.
Waters, Denis, Forester, Kelburn Castle, Largs.
Waterson, A., Wood Manager, Glenart Castle, Arklow, Co. Wicklow.
Watson, John, Gardener, Stravithy, St Andrews.
Watson, William, Assistant Forester, Peth, Longtown, Cumberland.
Watson, W. J., Nursery and Seedsman, Newcastle-on-Tyne.
Watt, James, Messrs Little and Ballantyne, Nurserymen, Carlisle.

WATT, William, Forester, Nisbet House, Dunse.
WEBSTER, David, Bangholm, Edinburgh.
WEBSTER, J., The Gardens, Gordon Castle, Fochabers.
WELSH, Duncan, Gardener, Mount Merrion, Dublin.
*WELSH, James, Nursery and Seedsman, Edinburgh.
*WELSH, William M., Nursery and Seedsman, Edinburgh.
WEST, Charles Elis, Land Steward, Cartoon, Maynooth.
WHILLIS, Alexander, Assistant Forester, Penicuik House, Penicuik.
WHITE, George, Seedsman, Paisley.
*WHITEFORD, Robert, Assistant Hedger, Bute Estate, Rothesay.
WILLIAMS, B. S., Paradise Nursery, Upper Holloway, London, N.
WILLIAMS, Robert, of Bodelwyddn, St Asaph, North Wales.
WILSON, John, Forester, Greystoke Castle, Penrith.
WILSON, John, Forester, Auchendolly, Castle-Douglas.
WILSON, John, Assistant Forester, Arniston, Gorebridge.
WILSON, John, Assistant Forester, Sudbourn Hall, Wickham Market, Suffolk.
WILSON, Peter, Forester, Whitehill, Lasswade.
*WILSON, Robert, Forester, Pewsey, Wilts.
WILSON, Stephen, 132 Union Street, Aberdeen.
WOOD, James, Factor, Haigh Hall, Lancashire.
WOOD, John, Gardener, Hatton Castle, Aberdeenshire.
WYLIE, James, Assistant Forester, Douglaston, Milngavie, Glasgow.
*WYLLIE, George, Estate Overseer, Ballogie, Aboyne.

YELLOWLEES, George, Wood Merchant.
YOUNG, John, Messrs Imrie & Son's Nurseries, Ayr.

SUBJECTS OFFERED FOR COMPETITION DURING 1873-74.

I. For the best and approved Essay on the Pruning of Timber-trees, considered physiologically, and in relation to the production of the greatest value. (Prize of Five Guineas offered by George Reid, Nursery and Seedsman, Aberdeen.)

II. For the best and approved Essay on the Literature of Scottish Arboriculture. (Prize of Five Guineas offered by the President.)

III. For a full and complete account, from published descriptions (the authorities distinctly quoted), personal observation and experiment, of the history and present state of the cultivation in Great Britain and Ireland of *Cedrus Deodara* (*C. Libani*, and *C. atlantica*, all now classed as one species). (Special Medal, value Three Guineas, offered by the President.)

IV. For the best and approved Report on the most extensive, complete, and judiciously arranged Arboretum. (*A Medal.*)

The Arboretums described in 1872 are excluded.

V. For the best and approved Essay on the present state and future prospects of Arboriculture in the county in which the competitor resides. (*A Medal.*)

Yorkshire and Aberdeenshire are excluded, having been reported in 1873.

VI. For the best and approved Report on the conservation of Old and Remarkable Trees in Britain. (*A Medal.*)

VII. For the best and approved Report on the Drainage of Plantations, both by Open and Covered Drains. (*A Medal.*)

VIII. For the best and approved collection of Cones exhibited from and grown in the county in which the competitor resides. (*A Medal.*)

Wigtownshire is excluded, having been reported in 1873.

IX. For the best and approved collection of prepared sections of different kinds of Wood grown in the county in which the competitor resides. (*A Medal.*)

X. For the best and approved series of Geological Specimens illustrating the different rocks and formations on which Forest Trees and Shrubs grow in the county in which the competitor resides. The specimens to be accompanied by a Report. (*A Medal.*)

XI. On the employment of Locomotive Engines in Forestry, especially for the transit of Timber, and on the working of portable saw-mills. (*A Medal.*)

XII. For the best and approved Report on the distances at which Forest Trees, coniferous and hardwood of different species, should be planted apart in different soils, altitudes, and situations. (*A Medal.*)

XIII. For an approved Report on the Plantations of which the competitor is Forester. (*Three Medals.*) One to be awarded for the best Report from each of the countries—England, Scotland, and Ireland—and competition to be confined to each country respectively.

Those counties already reported on are excluded.

XIV. For an approved Report on the management of Forests in Germany, France, or other places on the Continent. (*A Medal.*)

XV. For an approved Report on the different Ages at which the various sorts of Timber Trees usually grown in Scotland may be most profitably felled in different soils and situations. (*A Medal.*)

XVI. For an approved Report on the Diseases most incidental to Forest Trees, including those that affect the roots as well as the bark, branches, and foliage. (*A Medal.*)

XVII. For an approved Report on the results obtained by experience of Seedlings of Coniferæ, being the produce of trees grown in Britain, as compared with plants obtained from foreign-ripened seed. (*A Medal.*)

XVIII. To any Member of the Society who shall send to the Secretary from abroad, cones or seeds of Forest Trees of new or rare varieties, capable of germination and of thriving in this country. (*A Medal.*)

XIX. For an approved Essay or Report on any other subject connected with Arboriculture. (*A Medal.*)

XX. For any marked improvement on any of the Implements used in Forestry. (Models or Implements to be accompanied by a Report.) (*A Medal.*)

For conditions of Competition, see *Proceedings* of Annual General Meeting of 5th November 1873.

All Essays and Reports intended for Competition must be given in to the Secretary not later than 25th September, and all Collections of Cones, Woods, and Geological Specimens not later than 25th October 1874—*each bearing a motto, and accompanied by a separate sealed envelope bearing the same motto outside, and containing a card with the name and address of the Author.*

Abstract of the Laws of the Scottish Arboricultural Society, as amended to November 1873.

The object of the Society shall be the promotion of the science of Arboriculture in all its branches, by periodical meetings of the Members for the reading of Papers; by offering Prizes for Essays and Reports on the Practical operations of Forestry, and publication of the same; and by such other means as may be found advisable.

The Society shall consist of the following classes of Members:— 1. Proprietors, Factors, Nurserymen, and others, paying an annual subscription of Half-a-Guinea; 2. Head-Foresters, and others, paying an annual subscription of Five Shillings; 3. Assistant Foresters, and others paying an annual Subscription of Three Shillings.

Any Member may become a Life Member by compounding for his annual subscriptions by a single payment—those of the First Class paying Five Guineas; and those of the Second and Third Classes, Three Guineas.

The Society shall elect a limited number of Honorary Members,—gentlemen who have acquired eminence in the Science of Arboriculture, or who are otherwise deemed worthy.

All annual Subscriptions shall be payable in advance, at the Annual General Meeting in November.

In addition to the annual subscriptions above stipulated, the Society shall receive, from those friendly to its objects, Donations of larger or smaller amount.

A Candidate for admission into the Society must be recommended by at least one Member, and shall, on payment of his annual subscription, be immediately admitted a Member of the Society, subject to the revision of the first General Meeting thereafter. Any Member of the Society introducing a New Member shall be held responsible for the first year's subscription of such party.

The affairs of the Society shall be conducted by a President, five Vice-Presidents, Secretary, Treasurer, Auditor, and fifteen Councillors—these office-bearers to be elected annually at the General Meeting in November; the three Councillors at the top of the list to go out annually, but one to be eligible for re-election.

A General Meeting of the Members shall be held on the first Wednesday and Thursday of November annually, for the election of New Members, the appointment of Office-Bearers, awarding of Prizes, the reading of Papers, Discussion on selected subjects, &c.

JOHN SADLER,
Secretary.

OFFICE-BEARERS FOR 1873-74.

PRESIDENT.

Hugh Cleghorn, of Stravithy, M.D., F.R.S.E.

VICE-PRESIDENTS.

Wellwood H. Maxwell, of Munches.
Robert Hutchison, of Carlowrie, F.R.S.E.
John Grant Thomson, Wood Manager, Grantown, Strathspey.
Robert Foulis, Forester, Fordel, Fife.
William Gilchrist, Forester, Cluny Castle, Aberdeen.

COUNCIL.

John Anderson, Nurseryman, Perth.
George Reid, Nursery and Seedsman, Aberdeen.
Robert Brough, Forester, Balnagowan, Ross-shire.
John M'Laren, Forester, Hopetoun, South Queensferry.
Hugh Fraser, Stanwell Nursery, Edinburgh.
David Mitchell, Nurseryman, Edinburgh.
John M'Gregor, Forester, Ladywell, Dunkeld.
Alexander Richardson, Land Steward, Arniston, Gorebridge.
James Moffat, Forester, Newbattle Abbey, Dalkeith.
James Smith, Forester, Donibristle, Fife.
Professor Balfour, M.D., F.R.S., University, Edinburgh.
William M'Corquodale, Forester, Scone, Perth.
William Thomson, Deputy-Surveyor, H.M. Chopwell Woods, Durham.
John Allan, Forester, Dalmeny Park, South Queensferry.
James Michie, Forester, Wemyss Castle, Kirkcaldy.

SECRETARY.

John Sadler, F.R.Ph.S., Lecturer on Botany and Zoology in the Royal High School, and Assistant to the Professor of Botany in the University, Edinburgh.

TREASURER.

Thomas Methven, of Messrs T. Methven & Sons, Nursery and Seedsmen, 15 Princes Street, Edinburgh.

AUDITOR.

John Ord Mackenzie, of Dolphinton, W.S.

JUDGES.

William Gilchrist (Convener), Forester, Cluny Castle, Aberdeen.
James Rait, Forester, Castle Forbes, Aberdeen.
William Gough, Wood Manager, Wykeham, York.

COMMITTEE ON TRANSACTIONS.

The Secretary (Mr Sadler), *Editor*, with Dr Cleghorn, Mr Hutchison, and Mr William Gorrie, as a Consulting Committee.

GENERAL ABSTRACT OF THE ACCOUNTS

OF THE SCOTTISH ARBORICULTURAL SOCIETY

For the Year ending 31*st October* 1874.

CHARGE.

	£	s.	d.
To Balance on hand,	£7	10	0
,, David Mitchell (Special Prize),	5	5	0
,, Received for Copies of Transactions Sold,	6	4	7½
,, Interest on Sinking Fund Account,	2	5	4
,, Do. on Ordinary Account,	0	9	0
,, Annual Subscriptions,	97	7	0
,, Arrears Recovered,	39	0	6
,, Life Membership Subscriptions,	24	3	0
,, Balance due Bank,	13	18	2
	£196	2	7½

DISCHARGE.

	£	s.	d.
By Printing and Publishing Transactions,	£76	8	0
,, Advertising, Stationery, &c.,	4	3	0
,, Prizes and Medals,	13	9	0
,, Secretary's Salary,	25	0	0
,, Expenses connected with Annual Meeting,	3	2	6
,, Postages, &c.,	13	15	4
,, Paid over to Capital Account,	29	8	0
,, Balance due Bank last year,	25	15	11
,, Interest,	0	1	3
,, Balance on hand,	4	19	7½
	£196	2	7½

CAPITAL OR SINKING FUND ACCOUNT.

CHARGE.

	£	s.	d.
To Balance, including 7s. 9d. interest,	£48	17	9
,, Received Life Membership Subscriptions from Ordinary Account,	24	3	0
,, Paid to Account of Sum due Capital Account,	5	5	0
,, Interest on Deposit Receipts,	1	17	7
	£80	3	4

DISCHARGE.

	£	s.	d.
By Deposit Receipt,	£77	18	0
,, Interest paid over to Ordinary Account,	2	5	4
	£80	3	4

EDINBURGH, 3*d November* 1874.—Having examined the foregoing Account of Charge and Discharge, and the relative Capital or Sinking Fund Account between the Scottish Arboricultural Society and their Treasurer, Mr Thomas Methven, for the year ending 31st October 1874, and compared the same with the vouchers and instructions thereof, I have to report that the same are accurately stated and sufficiently vouched. At the close of the Account of Charge and Discharge there was a balance due by the Society to the National Bank of Scotland of Thirteen pounds eighteen shillings and twopence (£13, 18s. 2d.), and there remained in the hands of the Treasurer a sum of Four pounds nineteen shillings and sevenpence halfpenny (£4, 19s. 7½d.). The amount of the Sinking Fund is now Seventy-seven pounds eighteen shillings (£77, 18s.), which is placed on Deposit Receipt by the National Bank in name of the Society.

JOHN ORD MACKENZIE, *Auditor.*

Scottish Arboricultural Society.

PATRON.

HER MOST GRACIOUS MAJESTY THE QUEEN.

LIST OF MEMBERS.

CORRECTED TO MARCH 1875.

* *Members who have given Subscriptions, in order to form a Capital or Sinking Fund.*

All Subscriptions are payable at the Annual General Meeting in November. Members whose Subscriptions are Two Years in Arrears are not entitled to receive the Transactions.

HONORARY MEMBERS.

BALFOUR, John Hutton, M.D., A.M., F.R.SS.L. and E., Professor of Medicine and Botany in the University of Edinburgh—*President.*

BRANDIS, Dietrich, Ph.D., Inspector-General of Forests to the Government of India.

BULLEN, Robert, Curator of Botanic Garden, Glasgow.

*HUTCHISON, Robert, F.R.S.E., of Carlowrie, Kirkliston.

LAWSON, George, LL.D., Ph.D., Professor of Natural History and Chemistry, Dalhousie College, Halifax, Nova Scotia.

M'NAB, James, F.B.S.E., Curator of the Royal Botanic Garden, Edinburgh.

LIFE MEMBERS.

ADAM, The Right Hon. W. P. of Blairadam, Kinross-shire, M.P.

BARBOUR, George F., of Bonskied, Pitlochry, Perthshire.

BELL, William, of Gribdae, Kirkcudbright.

BOSANQUET, Rev. G. H., Broom-y-Close Court, Llanwarne, Ross, Herefordshire.

BRUCE, Hon. T. C., 24 Hill Street, Berkeley Square, London, W.

CLEGHORN, Hugh, M.D., F.R.S.E., of Stravithy, St Andrews, Fife.

CRAWFORD, William Stirling, of Milton, Glasgow.

DEWAR, Colonel A., of Vogrie, Ford.
DUNCAN, Alexander, of Knossington Grange, Oakham, Leicestershire.
DUNDAS, Robert, of Arniston, Gorebridge.
FISH, D. T., Hardwick, Bury-St-Edmnnds.
FITZWILLIAM, The Right Hon. The Earl, K.G., Wentworth, Rotherham Yorkshire.
GORDON, John, of Cluny Castle, Aberdeenshire.
*GOUGH, William, Wood Manager, Wykeham, York.
GRANT, John, Forester, Bridge-of-Wier, Renfrewshire.
GRANTHAM, George, Barcombe Place, Lewis, Sussex.
GRIMMOND, Alexander D., of Glenericht, Blairgowrie.
HERBERT, H. A., of Muckross, Killarney.
HOPE, H. W., of Luffness, Drem.
HUTH, Louis, of Possingworth, Hawkhurst, Sussex.
INNES, James, of Wroxton, Banbury.
KINNEAR, William Balfour, Foo-Chow, China.
LESLIE, Charles P., of Castle-Leslie, Glasslough, Ireland.
MACDONALD, Ronald, Factor, Cluny Castle, Aberdeenshire.
M'GREGOR, John, Ladywell, Dunkeld, Perthshire.
MACKENZIE, Colin J., of Portmore, Eddlestone, Peebles.
M'TIER, Alexander Walker, of Durris, Aberdeenshire.
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ROSSLYN, The Right Hon. the Earl of, Dysart House, Fife.
STAIR, The Right Hon. the Earl of, Lochinch, Castle Kennedy, Wigtownshire.
*TALBERT, Peter, Forester, Glenericht, Blairgowrie.
*THOMSON, John Grant, Wood Manager, Grantown, Strathspey.
TROTTER, Colonel, R.A., the Bush, Edinburgh.
URQUHART, B. C., of Meldrum, Aberdeenshire.
WAVENEY, Lord, Flixton Hall, Bungay, Suffolk.
WEMYSS, Randolph Gordon Erskine, of Wemyss and Torry, Fife.
WILD, A. E., Assistant Conservator of Forests, Punjaub, India (6 George Street, Sheffield).
WILSON, John, F.R.S.E., Professor of Agriculture, University, Edinburgh.

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AITCHISON, William, Forester, Workington Hall, Cumberland.

Alder, Robert, Assistant Forester, Dunse Castle, Dunse.
Alexander, James, Nursery and Seedsman, Edinburgh.
Alexander, James, jun., 1 Waterloo Place, Edinburgh.
Alexander, John.
Alexander, John, Assistant Forester, Benmore House, Greenock.
Alexander, William, Assistant Forester, Lochlinchart Lodge, Dingwall
Allan, Andrew, Rankeillor, Cupar, Fife.
*Allan, John, Forester, Dalmeny Park, Edinburgh.
Anderson, Alexander, Forester, St Fort, Newport, Dundee.
Anderson, Alexander, Assistant Forester, Darnaway Castle, Forres.
Anderson, Alexander, Gardener, Oxenford Castle, Dalkeith.
Anderson, Hugh, Assistant Forester, Hawkhead, Paisley.
Anderson, James, Bangholm Nursery, Edinburgh.
Anderson, James, Meadowbank, Uddingston.
Anderson, John, Newstead Abbey, Nottingham.
*Anderson, John, Nurseryman, Perth.
Annand, Charles Forester, Cromar Estates, Tarland, Aberdeenshire.
Annandale, Robert Burns, The Gardens, Fonthill, Tisbury Wilts.
Archer, James, Assistant Forester, Culzean Castle, Maybole.
Archer, John, Assistant Forester, Culzean Castle, Maybole.
*Archibald, Thomas, Forester, Virginia, Co. Cavan, Ireland.
Arnott, Alexander, Hedger, East Wemyss, Fife.
Ashdown, Samuel Harding, Land Agent, Uppington, Wellington, Salop.
Austin & M'Auslan, Messrs, Nursery and Seedsmen, Glasgow.

Baigrie, Andrew, Forester, Mote Park, Ballymurry, Co. Roscommon.
Baigrie, William, Forester, Echo Bank, Old Dalkeith Road, Edinburgh.
Baillie, William, Wood Manager, Cortachy, Kirriemuir.
Bainbridge, C. M., of Dissington Hall, Newcastle-on-Tyne.
Baird, Joseph, Assistant Forester, Drumpellier, Coatbridge.
Balden, James, Forester, Lennoxlove, Haddington.
Balden, Joseph, Overseer, Houghton Estate, Preston.
*Balden, Peter G., Forester, Vaenol Park, Bangor, North Wales.
*Balden, William, Appleby Castle, Appleby.
*Ballantyne & Son, Messrs John, Nursery and Seedsmen, Dalkeith.
Ballingall, Robert, Factor, Eallabus, Islay, by Greenock.
*Barrie, David, Forester, Durris, Aberdeen.
*Barrie, James, Forester, Stevenstone House, Torrington, Devonshire.
Barter, Frederick, Assistant Gardener.
Barton, James, Assistant Forester, Scone, Perth.
Baty, David, Forester, Lowther Castle, Penrith.
Baty, William, Forester, Netherby, Longtown.
Baxter, Robert, Forester, Dalkeith Park, Dalkeith.
Baxter, William, The Gardens, Riccarton, Currie.
*Bayne, Lewis, Forester, Kinmel Park, Abergele, North Wales.

Begg, John, jun., Factor, Durris, Aberdeenshire.
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Bell, James, Forester, Newcastleton, Carlisle.
Bell, Robert, Assistant Forester, Dunse Castle, Dunse.
Bennett, Alexander, Forester.
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Berry, Thomas Walter, Forester, Brynkinalt, Chirk, N. Wales.
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Birch, John, Assistant Gardener, Tinnchinch, Enniskerry, Co. Wicklow.
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Bissett, David, Land-Steward and Forester, Alva House, Stirling.
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Boa, Andrew, jun., Assistant Factor, Blackwood, Lesmahagow.
Boa, James S. M., Agent, Fettercairn, Fettercairn.
*Borthwick, William, Forester, Dunnichen, Forfar.
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*Brodie, James, Land-Steward, Glasslough, Armagh, Ireland.
Brough, James, Assistant Forester, Cluny Castle, Aberdeen.
Brough, Robert, Forester, Balnagowan, Tain, Ross-shire.
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Brown, James, LL. D., Nurseryman and Wood-Surveyor, Craigmill, Stirling.
Brown, James, Carnwath House, Carnwath.
Brown, John E., Craigmill, Stirling.
Brown, William, Land Valuator and Estate Agent (N. America).
Brown, William, Nursery and Seedsman, Stamford, Lincolnshire.
*Bruce, Peter.
Bruce, T. R., of Slogarie, Lauriestown, Castle-Douglas.
Bryan, F. G. D., Factor, Drumpellier, Coatbridge.
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Buchan, George, Forester, Bakewell, Derbyshire.
Buchanan, Robert R., Forester, Dunse Castle, Dunse.
Burnett, James, Assistant Forester, Durris, Aberdeenshire.

Calder, Frederick, Forester, Brucklay Castle, Aberdeenshire.
Calloghin, John, Assistant Forester, Houston, Paisley.
Cameron, Alexander, Forester, Countlich Lodge, Ballinluig, Perthshire.
Cameron, Angus, Assistant Forester, Altyre, Forres.

CAMERON, Henry, Assistant Forester, Linkwood, Elgin.
CAMERON, Hugh, Assistant Forester, Novar, Evanton Ross-shire.
*CAMERON, John, Assistant Forester, Fowlis Wester, Crieff, Perthshire
CAMERON, Robert, Forester, Galtie Castle, Mitchelstown, Tipperary.
CAMPBELL, Alexander, Forester, Gray House, Liff, Dundee.
*CAMPBELL, James, of Tillichewan Castle, Dumbartonshire.
CAMPBELL, John, Forester, Aboyne Castle, Aberdeenshire.
CAMPBELL, Peter, Assistant Forester, Invereshie, Kingussie.
CAIRNDUFF, Andrew, Forester, Abbeyleix, Queen's Co., Ireland.
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CHALMERS, James, Duchal, Port-Glasgow.
CHAMBERS, William, of Haford, Aberystwith, Wales.
CHAPLAIN, George, Assistant Forester, Glamis Castle, Glamis, Forfarshire.
CHAPMAN, James, Assistant Forester, Grinkle Park, Saltburn-by-the-Sea, Yorkshire.
CHAPPLOW, John, Glencoin Cottage, Patterdale, Penrith.
CHRISTIE, A. D., Foreman, Heaton Park Gardens, Manchester.
CHRISTIE, David, Forester, Abington House, Lanarkshire.
*CHURNSIDE, Francis, Forester, Ladykirk, Berwickshire.
CHURNSIDE, Robert, Forester, Edlingham, Alnwick.
CLARK, David, Assistant Forester, Ury House, Stonehaven.
CLARK, George, Liberton, Edinburgh.
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CLARK, James, Forester, Balvaird Cottage, Strathmiglo, Fife.
CLARK, John, The Nurseries, Cupar, Fife.
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CLARK, Thomas, Beechwood Gardens, Bortly, Hants.
CLARK, William, Assistant Forester, Hawkhead, Paisley.
CLEETON, Edward, Curator, Albert Park, Middlesboro'.
*CLEGHORN, William, Forester, Ayton Castle, Ayton.
CLERK, Sir George D., Bart., Penicuik House, Penicuik.
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COCKBURN, William, Forester, Coats, Penicuik.
COCKER, James, Nurseryman, Aberdeen.
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CORBET, James, Forester, Underley Hall, Kirkby Lonsdale, Westmoreland.
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COWAN, Robert, Forester, Park, near Paisley.
COWE, John, Luffness, Drem.
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Craig, Richard, Forester and Gardener, Carlowrie, Kirkliston.
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*Darling, John, Forester, St Martins, Perthshire.
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Davidson, James, Coonoor, Neilgherries, S. India.
*Davidson, John, Forester, Aldbar, Brechin.
Davidson, John, Forester, Firth, Roslin.
*Davidson, John, Overseer and Architect, Belmont Castle, Meigle.
Davidson, Richard, Scottish Colour Works, Leith.
Davidson, W., Leager House, Chuseburn Grange, Newcastle-on-Tyne.
Dawson, James, Forester, Kilmun, Argyleshire.
*Dawson, John, Messrs J. & J. Dawson, Alloa.
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Dempsey, Charles, Assistant Forester, Powerscourt, Enniskerry.
Dick, Joseph, Assistant Forester, Scone, Perth.
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Dickson & Sons, Messrs James, Nursery and Seedsmen, Chester.
*Dickson & Sons, Messrs James, Nursery and Seedsmen, Edinburgh.
Dickson, Thomas, Nursery and Seedsman, Chester.
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Don, John, Assistant Forester, Ardgowan, Greenock.
Donald, Alexander, Forester, Woodhall House, Airdrie.
Donaldson, J., Forester, Brechin Castle, Brechin.
Douglas, J., Gardener, Kilkea Castle, Mageney, Co. Kildare.

*Dow, Thomas, Forester, Idvies, Forfar.
*Downie & Laird, Messrs, Nursery and Seedsmen, Edinburgh.
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Drummond Brothers, Messrs, Nursery and Seedsmen, Edinburgh.
Drummond & Sons, Messrs William, Nurserymen, Stirling.
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*Duff, James, Melgund, Aberlemno, Forfar.
Duff, James, Wood Manager, Bayham Abbey, Tunbridge Wells.
Dugan, Charles, Assistant Forester, Cally House, Gatehouse.
Duncan, Charles, of Woodend, Rothesay.
Duncan, John, Forester, Blanepant, Llandyssil.
Duncan, Thomas, Assistant Forester, Meldrum House, Old Meldrum.
Duncan, William, Forester, Ardgowan, Greenock.
Dunlop, Alexander, Factor, Luffness, Drem.
Dunn, David, The Gardens, Heaton Park, Manchester.
*Dunn, Malcolm, The Gardens, Dalkeith Park, Dalkeith.
Durward, Robert, Manager, Blelack, Aberdeenshire.
Dykes, John, Nursery and Seedsman, Kilmarnock.
Dykes, Thomas, Factor, Maybole, Ayrshire.

Earnshaw, L., Forester.
Eden, The Hon. R. Henley, Estate Agent, The Coigne, Minchinghampton.
Edgar, Thomas, Forester, Torry, Fife.
Elibank, Right Hon. Lord, Darnhall, Eddlestone, Peebles.
Elliot, Robert, Forester, Blairquhan, Maybole, Ayrshire.
Ewing, David, Assistant Forester, Urie House, Stonehaven.

Fairbairn, William, Land Steward, Manderston, Dunse.
Ferguson, A., Gosfield Hall, Hallstead, Essex.
Ferguson, James, Forester, Benmore and Kilmun Estates, Greenock.
Ferguson, John, Forest Department, Madras.
Ferguson, Joseph, Assistant Forester, Lambton Park, Fence Houses.
Fernie, Robert, Forester, Balcarres, Colinsburgh, Fife.
Fettes, Francis, Assistant Hedger, Ury House, Stonehaven.
Fingland, J., Forester, Drumlanrig, Thornhill, Dumfriesshire.
Finn, P. W., Forester, Borris House, Borris, Co. Carlow.
Fisher, William, Forester, Wentworth Castle, Barnsley, Yorkshire.
*Forbes, Andrew, Forester, Stracathro, Brechin.
Forbes, William, Assistant Forester, Castlecary, Denny.
Forgan, James, Wellwood Cottage, Kinnoull, Perth.
Forrest, William, Melfort Cottage, Lochgilphead.
Foulis, Robert, M.D., Cairnie Lodge, Cupar, Fife.
Foulis, Robert, Forester, Fordel, Inverkeithing, Fife.
Fowler, Archibald, The Gardens, Castle Kennedy, Stranraer.
France, Charles, Forester, Culzean Castle, Maybole, Ayrshire.

*France, C. S., Overseer, Penicuik House, Penicuik.
*France, George, Overseer, Glenelg, Lochalsh.
France, James, Assistant Forester, Culzean Castle, Maybole, Ayrshire.
Fraser, Archibald, Forester, Skipness Castle, Tarbert, Greenock.
*Fraser, Duncan, Forester.
Fraser, James, Forester, Cabairdy, Huntly.
Fraser, James, Assistant Forester, Drumpellier, Coatbridge.
Fraser, P. Neill, Canonmills Lodge, Edinburgh.
Fraser, Hugh, Stanwell Nursery, Edinburgh.
Fraser, Simon, Forester, Haddo House, Aberdeenshire.
*Fraser, Thomas, Forester, Oriel Temple, County Louth.
Freeman, Timothy.
Frost, Philip, Gardener, Dropmore, Maidenhead.

Galloway, George, Park Hall, Oswestry, Shropshire.
*Gardiner, R., Wenalt House, Crosswood, Aberystwith, South Wales.
Gardiner, James, Forester, Hawkstone Park, Salop.
Gargan, James, Land Steward, Kells, Moynally, Co. Meath, Ireland.
Garner, John, Assistant Gardener, Cantley Hall, Doncaster, Yorkshire.
Geikie, P. M., Factor, Cortachy, Kirriemuir.
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*Gilchrist, William, Forester, Cluny Castle, Aberdeen.
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Goodier, George, Assistant Gardener.
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Gordon, John, Forester, 17 Bon-Accord Street, Aberdeen.
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*Gorrie, William, Rait Lodge, Trinity, Edinburgh.
*Gossip, James, The Nurseries, Inverness.
Gow, James, Forester, Camperdown, Dundee.
Gow, John L., Factor, Raith, Kirkcaldy.
Gow, John, jun., Assistant Agent, Grinkle Park, Saltburn-by-the-Sea.
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Grant, James, Assistant Forester, Abernethy, Strathspey.
Grant, John, Assistant Forester, Abernethy, Strathspey.

GREEN, Alexander, Assistant Forester, Culzean Castle, Maybole.
GREEN, William, Assistant Forester, Charleston, Malmesbury, Wilts.
GREER, Robert, Assistant Forester, Ardgowan, Greenock.
*GREIG, Gavin, Forester, Parkhill, Aberdeen.
GRIEVE, George, Gardener, Dalkeith.
GRIEVE, James, Messrs Dickson and Co., Nurseries, Leith Walk, Edinburgh.
*GRIGOR, John, Nurseryman, Forres.
GUTHRIE, Colonel, Carlogie House, Carnoustie.

*HALL, Peter, Forester, Huntly Lodge, Huntly.
HAMILTON, David, Forester.
HAMILTON, John B. Baillie, of Arnprior, Cambusmore, Callander.
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HARDIE, A., Manager, Monboddo, Fordoun.
*HARDIE, Walter, Forester, The Hall, Norwell, Newark, Notts.
*HARLEY, Andrew, Penybout, Radnorshire.
HARROLD, George, Gardener, Mount Henrie, Queen's Co., Ireland.
HARROWER, William, Forester, Glenapp, Ballantrae, Ayrshire.
HART, Thomas, Assistant Forester, Yester, Haddington.
HARTLAND, Richard, The Lough Nurseries, Cork.
HAVELOCK, Thomas, Forester, Raby Park, Staindrop, Co. Durham.
HAVELOCK, William, Forester, Dilston, Corbridge, Newcastle-on-Tyne.
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HELMAN, George, Assistant Gardener.
HELMAN, William, Gardener.
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*HENDERSON, Archibald, Forester, Clonad Cottage, Tullamore, King's County.
HENDERSON, John, Land Steward, Knockdrin Castle, Mullingar.
HENDERSON, John, Forester, Cardoness, Gate-House, Kirkcudbrightshire.
HENDERSON, Robert, Assistant Forester, Dalmeny Park, Edinburgh.
HENDRY, David, Bangholm Nurseries, Edinburgh.
HEPBURN, James, Forester.
*HEPBURN, William, Assistant Forester, Altyre, Forres.
HERMISTON, James, Assistant Forester, Floors Castle, Kelso.
HETHERTON, Walter, Forester, Heanton, Satchville, Bedworth, N. Devon.
HILL, John, Land Steward, Whitehill, Lasswade.
HILSON, John, Assistant Forester, Floors Castle, Kelso.
*HOGARTH, James, Forester, Duthill, Strathspey.
HOGG, Thomas, Forester, Hampton Court, Leominster, Hereford.
HOOD, James, Assistant Forester, Langlee, Jedburgh.
HODD, William, Gardener, Glasslough, Ireland.
HOME, Edward, Assistant Forester, Dunse Castle, Dunse.
HOME, George, Assistant Forester, Drumlanrig, Thornhill.
HORSBURGH, James, Forester, Yester, Haddington.

HOWIE, Charles, Eden Cottage, Largo, Fife.
HUBBARD, Egerton, M.P., of Addington Manor, Winslow, Bucks.
HUME, Andrew, Forester, Wansford, Peterborough.
*HUNTER, Patrick, Overseer, Glenarm Castle, Larne, Ireland.
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JOHNSTON, James.
JOHNSTON, William, Fencer, Lee, Lanark.
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JOHNSTONE, Alexander, Forester, Lee Castle, Lanark.
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*KEDZIE, Walter, Forester, Arundel Castle, Arundel, Sussex.
KEIR, David, Forester, Blair Athole, Perthshire.
*KEMP, John, Assistant Forester, Midmar, Aberdeenshire.
KENMARE, The Right Hon. the Earl of, Killarney House, Killarney.
KENNEDY, Duncan, Assistant Forester, Underley, Kirkby, Lonsdale.
KENNEDY, G. G. Allan, Assistant Forester, Gothic House, Morden, Surrey.
KENNEDY, John, Forester and Ground Officer, Glen Urquhart, Drumnadrochit.
KENNEDY, William, Overseer, Carradale, Greenock.
KIDD, James, Assistant Forester, Morden Park, Surrey, S.W.
*KINGHORN, Adam, Forester, Rochsoles, Airdrie.
KINGHORN, James, Assistant Forester, Dunse Castle, Dunse.

LAING, James, Assistant Forester, Penicuik House, Penicuik.
LAMBERTON, Hugh, Forester, Orwell Park, Bucklesham, Ipswich.
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LEISHMAN, Richard, Forester, Muncaster Castle, Ravenglass, Cumberland.

LEMON, Thomas, The Gardens, Convamore, Ballyhoolly, Ireland.
LENOX, William, Forester, Keir, Dunblane.
LESLIE, The Hon. George Waldegrave, Leslie House, Leslie, Fife.
LIDDELL, Rev. J. R., The Manse, Kirkliston.
LINKSTONE, James, Assistant Forester, Dalmeny Park, Edinburgh.
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M'ALISTER, Alexander, Rossie Priory, Dundee.
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M'CORQUODALE, D. A., Assistant Factor, Panmure, Forfarshire.
*M'CORQUODALE, William, Forester and General Wood Surveyor, Jeanie Bank, Perth.
M'CREATH, Hugh, Assistant Forester, Culzean, Maybole, Ayrshire.
M'CUTCHEON, Robert, Assistant Forester, Cawdor Castle, Nairn.
M'DONALD, Alexander, Forester, Drumpellier, Coatbridge.
M'DONALD, Charles, Superintendent, Phœnix Park, Dublin.
M'DONALD, Donald, Assistant Forester.
M'FADYEN, Duncan, Forester, Dunmore, Stirling.
M'GRATH, Patrick, Assistant Forester, Galtie Castle, Mitchelstown, Co. Tipperary.
M'GREGOR, Archibald, Assistant Forester.
M'HARDY, Charles, Forester, Castle Newe, Strathdon.
M'HATTIE, John, Seedsman, Northgate, Chester.
M'INTOSH, Angus, Forester.
MACKAY, John, West Dean Estate, Chichester.
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M'KEITH, Archibald, West Coates Nursery, Edinburgh.
MACKENZIE, Alexander, Warriston Nurseries, Edinburgh.
M'KENZIE, Donald F., Forester, Meldrum House, Aberdeenshire.
MACKENZIE, James, 1 George IV. Bridge, Edinburgh.
MACKENZIE, J. Ord, W.S., of Dolphinton, 7 Royal Circus, Edinburgh—*Auditor.*
M'KENZIE, K. Stewart, of Brahan Castle, Dingwall.
MACKIE, John, Assistant Forester, Ballogie, Aboyne.
MACKINTOSH, R. T., Nursery and Seedsman, Edinburgh.
M'LAGAN, John, Forester, The Cairnies, Methven, Perthshire.

*M'Laren, Hugh.
M'Laren, John, Ballencrieff, Drem.
*M'Laren, John, Forester, Hopetoun House, South Queensferry.
*M'Laren, John, Forester, Darnhall, Eddlestone, Peebles.
M'Laren, Peter, Forester, Lilleshall, Newport, Salop.
*M'Laren, Peter, Sub-Agent, Sittenham, York.
M'Lean, Andrew, Assistant Forester, Rutherford, Kelso.
M'Lean, John, Forester, Swainston, near Newport, Isle of Wight.
M'Lean, Malcolm, The Gardens, Gosford, Drem.
M'Lean, William, Forester, Eglinton Castle, Irvine.
M'Leay, William, The Gardens, Eaglehurst, Fawley, Southampton.
M'Lellan, Duncan, Superintendent of Parks, Glasgow.
M'Leod, Alexander, Forester, Gosford, Drem.
M'Leod, Angus, The Gardens, Newbattle Abbey, Dalkeith.
M'Leod, J., Nurseryman, Crieff, Perthshire.
M'Millan, Samuel, Assistant Forester, Dunse Castle, Dunse.
M'Nab, Malcolm, of 59 North Hanover Street, Edinburgh.
Macnaughton, Alexander, S.S.C., Arranmore Villa, Stanley Road, Edinburgh.
M'Naughton, Archibald, Forester, Williamwood, Cathcart, Glasgow.
M'Neill, D., Timber Agent, Kirriemuir.
M'Neill, James, Forester, Abercairney, Crieff.
M'Neill, James, Forester.
M'Rae, John, Forester, Coplawhill Nursery, Glasgow.
M'Rae, Robert, Assistant Forester, Cullen House, Cullen.
M'Ritchie, T. E., W.S., 4 Gayfield Square, Edinburgh.
Main, John, Forester, Bryan Hall, Ferrybridge, Yorkshire.
Main & Co., Messrs A. & J., Wire Fence Manufacturers, 7 Renfield Street, Glasgow.
Maitland, Sir A. C. R., Bart, M.P., Cliftonhall, Ratho.
Maitland, Wiliam, Assistant Forester, Keith Hall, Aberdeenshire.
Malcolm, George, Bangholm Nursery, Edinburgh.
Manson, Robert, The Nurseries, Kelso.
Manton, William, Assistant Forester, Dunse Castle, Dunse.
Marr, John, Assistant Forester, Darnaway Castle, Forres.
*Marshall, J., Forester, Lambton Park, Fence Houses, Durham.
Marshall, James, Forester, Preston, Dunse.
Marshall, James, Assistant Forester, Scone, Perth.
Marshall, Robert, Forester, Horton Manor, near Epsom.
Marshall, Robert, Assistant Forester, Ardgowan, Greenock.
Martin, George, Forester, Dunecht House, Aberdeen.
Martin & Sons, Messrs, Nurserymen, Cottingham, Hull.
Mathieson, Donald, Meikleour, Perth.
Maxton, Robert, Forester, Strathallan Castle, Auchterarder.
Melrose, John, Wood Merchant.

MELROSE, William, Forester, Byram Hall, South Mitford.
MENZIES, George, Agent, Trentham, Stoke-on-Trent.
MENZIES, William, Forester, Craigton Cottage, Causewayhead, by Stirling.
METHVEN, John, Nursery and Seedsman, Edinburgh.
*MICHIE, Christopher Young, Forester, Cullen House, Cullen, Banffshire.
*MICHIE, James, Forester, Wemyss Castle, Kirkcaldy.
MIDDLEMASS, Archibald, Forester, Dunans House, Colintraive, Greenock.
MILNE, James, Forester, Glenmuick, by Ballater.
*MILLER, John, Forester, Ochtertyre, Stirling.
*MITCHELL, David, Nurseryman, Edinburgh.
MITCHELL, Forbes, of Thainstone, Kintore.
MITCHELL, Garlies, Nurseryman, Stranraer.
MITCHELL, James, Aldie, Kinross.
MITCHELL, James, Forester, Knossington Grange, Oakham, Leicestershire.
MOFFAT, Adam, Forester, Hindlip Hall, Worcester.
MOFFAT, Henry, Forester, Monkray, Whitehaven, Cumberland.
MOFFAT, James, Forester, Newbattle Abbey, Dalkeith.
MOFFAT, John, Forester, Kimmerghame, Dunse.
MORRISON, John, Coney Park Nursery, Stirling.
MORRISON, R., Nurseryman, Elgin.
MUIR, William, of Inistrynich, Inveraray, Argyleshire.
*MUIRHEAD, John, Forester, Bicton, Budleigh, Salterton, Devonshire.
MUNRO, James, Forester, Invermorriston, Inverness-shire.
MUNRO, James, Assistant Forester, Darnaway Castle, Forres.
MUNRO, John, Assistant Forester, Cluny Castle, Aberdeen.
MURRAY, David, Forester, Dunira, Perthshire.
MYLES, James, Forester, Portmore, Eddlestone, Peebles.

NEIL, Archibald, Forester, West Grange, Culross.
NEWBIGGING, Alexander T., Nurseryman, Dumfries.
NICOL, W., Assistant Forester, Loudon Castle, Galston.
NICOL, William, Forester, Pitcaple, Aberdeenshire.
NICOLL, Alexander, The Gardens, Clova, by Lumsden, Aberdeenshire.
NOTMAN, David, Nursery Foreman, Dean Park Nurseries, Edinburgh.

*OGILVY, David, Assistant Forester, Cortachy, Forfar.
O'NEILL, Richard, Auctioneer, Old Castle, Co. Meath.
OLLIER, John Clement, of Beauchamp House, Enfield, Middlesex.
*ORMISTON & RENWICK, Messrs, Nursery and Seedsmen, Melrose.

*PALMER & SON, Messrs John, Nurserymen, Annan.
*PARKER, James, Forester, Belvoir Castle, Grantham.
PARKER, Robert A., Nursery and Seedsman, Lanark.
*PATERSON, Andrew, Surveyor, Exton, Oakham, Rutland.
PATERSON, Charles, Factor, Castle Menzies, Aberfeldy, Perthshire.

PEEBLES, Andrew, Highclere Castle, Newbury, Berks.
PENDER, John, M.P., of Minard Castle, Argyllshire.
PENDREIGH, John, Assistant Forester, Port Bannatyne, Rothesay.
PHILIP, John, Wood Merchant, Bonnyrigg, Lasswade.
*PHILIP, Robert, Minsterley, Shrewsbury.
PIERSON, Joshua, Forester, Old Shields, Airdrie.
PIRIE, John, Forester, Blackhall, Aberdeenshire.
PLATT, Major, Langairfechan, near Bangor.
POWERSCOURT, The Lord Viscount, Powerscourt, Enniskerry, Co. Wicklow.
POWNER, George, Forester, Willey Hall, Broseley, Shropshire.
POWNER, Thomas, British Workman's Rooms, Wellington, Shropshire.
PRESSLEY, D., Gardener, Knockmaroon, Chapelizod, Dublin.
PRICE, J., Forester, Garnstone Castle, Hereford.

RAIT, James, Forester, Castle Forbes, Whitehouse, Aberdeen.
RAMSDEN, Sir J., Bart., Buckden, Skipton, York.
RANKINE, Thomas, Nurseryman, Hamilton.
RATTRAY, Thomas, Forester, Westonbilt House, Tetbury, Gloucestershire
*RAVENSCROFT, Edward, "Farmer" Office, India Buildings, Edinburgh.
RAWLENCE, James, of Bulbridge, Wilton.
REA, Archibald Henry, Assistant Forester, Ury House, Stonehaven.
*REID, George, Nursery and Seedsman, Aberdeen.
REID, James, Assistant Forester, Dalkeith Park, Dalkeith.
RENTON, James, Forester and Land-Steward, Cleghorn, Lanark.
RICHARDSON, Adam, Assistant Forester, Arniston, Gorebridge.
*RICHARDSON, Alexander, Land-Steward, Arniston, Gorebridge.
RIGHY, William, Messrs King & Co., 45 Pall Mall, London.
RINTOUL, Henry, The Gardens, Hawick Hall, Alnwick.
RITCHIE, Henry, Eridge Castle, Tunbridge Wells.
*RITCHIE, Walter, Forester, Dinnas Mawddwy, Shrewsbury, N. Wales.
ROBERTSON, D., Albert Hotel, Hanover Street, Edinburgh.
ROBERTSON, David, Estate Manager, Curraghmore, Portlaw, Waterford.
ROBERTSON, George, Forester, Benmore, Kilmun, Greenock.
ROBERTSON, George, jun., Assistant Forester, Thirlstane Castle, Lauder.
ROBERTSON, James.
ROBERTSON, James, Forester, Drummond Castle, Crieff.
ROBERTSON, John.
ROBERTSON, John, Forester, Minto House, Hawick.
ROBERTSON, John, Assistant Forester.
ROBERTSON, Robert, Forester, Markree Castle, Collooney, Co. Sligo.
ROBERTSON, Peter, Gordon Castle, Fochabers, Morayshire.
ROBERTSON, P. S., Nursery and Seedsman, Edinburgh.
ROBERTSON, Thomas, Forester.
ROBERTSON, William W., Forester, Blinkbonny, Earlston.
*ROBSON, Alexander, Duchfour Woods, Lochend, Inverness.

Robson, David, Assistant Forester, Arthur Stone, by Meigle.
Robson, John, Forester, 15 Supple Street, Bishopfields, Chestrie.
Robson, Ralph, Nursery and Seedsman, Hexham.
Rodger, Hugh, Factor, Cleland, Motherwell.
Ross, Archibald, Overseer, Skipton Castle, Skipton-in-Craven, Yorkshire.
Rule, John, Forester, Monymusk, Aberdeenshire.
*Russell, John, Craigie, Ayr.
Russell, Robert, Forester, Mostyn, Holywell, N. Wales.
Rust, Joseph, The Gardens, Eridge Castle, Tunbridge Wells, Kent.
*Rutherford, Andrew, Forester, Bowmont Forest, Kelso.
*Rutherford, James, Forester, Linthaugh, Jedburgh.
*Rutherford, James, Agent, Kirkleatham, Redcar, Yorkshire.
Rutherford, John, Assistant Forester, Linthaugh, Jedburgh.
Rutherford, Robert, Manager, Invershie, Kingussie.
Rutherford, Thomas, Hothfield, Ashford, Kent.

*Sadler, John, F.R.Ph.S., Experimental Cottage, Edinburgh—*Secretary.*
*Samson, John, Forester, Abernethy, Strathspey.
*Sandbach, Henry R., Hafodunos, Llanrwst, Denbighshire.
Scarth, T. W., Land Agent, Keverstone, Staindrop, Darlington.
Scott, Adam, Forester, Southwick Park, Fareham, Hants.
Scott, Andrew, Assistant Forester.
*Scott, D., Wood Manager, Darnaway Castle, Forres.
*Scott, David, Forester and Land-Steward, Broadford, Limerick.
Scott, John, Forester.
*Scott, John W., Delgany, County Wicklow, Ireland.
Scott, Walter, Forester, Oxnam, Jedburgh.
Scrimgeor, James, Under Forester, Altyre, Forres.
Seaton, Allan, Assistant Forester, Curraghmore, Portlaw, Co. Waterford.
Sedgwick, A. O., of 38 High Street, Watford, Herts.
Service, George, Assistant Forester, Dunse Castle, Dunse.
Service, James, Assistant Forester, Dunse Castle, Dunse.
Service, Robert, Assistant Forester, Dunse Castle, Dunse.
Shand, James, Gardener, Meldrum House, Aberdeenshire.
Shanks, John, Forester, Kildrummy Castle, by Mossat.
Sheppard, John, Tweedside Cottage, Roehampton, Surrey.
Sim, William, Nurseryman, Forres.
Sime, John, Timber Merchant, Rafford, Forres.
*Simpson, J., Forester, Alloa Park, Alloa.
Simpson, Peter, Assistant Forester, Daughty Mill, Kirkcaldy.
*Simpson, Thomas, Forester, Glenferness, Nairnshire.
Sinton, David, Assistant Forester, Charlton, Malmesbury, Wilts.
Sinton, J., Forester, Stourhead, Bath.
Sinton, John, Forester, Charlton, Malmesbury, Wilts.
Skeldon, John, Assistant Forester, Dunse Castle, Dunse.

SKIRVING, Archibald, Forester, Duncombe Park, Helmesley, York.
SKIRVING, John Finlay, Assistant Forester, Duncombe Park, Helmesley.
SKIRVING, William, Nursery and Seedsman, Liverpool.
*SLATER, Andrew, Forester, Loftus, Saltburn-by-the-Sea, Yorkshire.
SLATER, Andrew, jun., Forester, Penicuik House, Penicuik.
*SMART, A. H.
SMITH, A., Factor, Douglas Castle, Lanarkshire.
SMITH, G. B., Wire Fence Manufacturer, 56 West Regent St., Glasgow.
*SMITH, James, Forester, Donibristle, Aberdour, Fife.
SMITH, James, The Gardens, Mentmore, Leighton-Buzzard, Buckinghamshire.
SMYTH, John B., Forester, Melville, Ladybank, Fife.
SMITH, John Crombie, Assistant Forester, Drummond Castle, Crieff.
SMITH, Thomas, Nurseryman, Stranraer.
SMITH, W. Baxter, Messrs Little & Ballantyne, Nursery and Seedsmen, Carlisle.
SMITH & SIMMONS, Messrs, Nursery and Seedsmen, Howard St., Glasgow.
*SMITH & SON, Messrs William, Nursery and Seedsmen, Aberdeen.
SOLLY, Professor Edward, F.R.S., Parkstone, near Poole.
SPENCE, Charles, Assistant Forester, Drumpellier, Coatbridge.
STALKER, Donald, Assistant Forester.
STAPYLTON, Major, Myton Hall, Borobridge, Yorkshire.
STARK, John, Assistant Forester, Woodhall, Airdrie.
STEELE, David, Forester, Skene House, Aberdeen.
STEPHEN, James, Forester, Dochfour, Inverness.
STEPHEN, John, jun., Assistant Forester, Cluny Castle, Aberdeen.
STEVENSON, Alexander, Forester, Cahir Estates, Co. Tipperary.
STEVENSON, David, Forester, Kelly, Wemyss Bay, Greenock.
*STEVENSON, James, Forester, Cobham Park, Surrey.
STEWART, Alexander, Edinburgh.
STEWART, Alexander, Forester, Gringle Park, Saltburn-by-the-Sea, Yorkshire.
STEWART, D., Manager, Dalnavart, Aviemore.
STEWART, James, Assistant Forester, Drumpellier, Coatbridge.
STEWART, John, Forester, Blair Athole, Perthshire.
STEWART, John, Forester, Castlecary, Denny.
STEWART, Peter, Gardener and Forester, Castle Wellan, Co. Down.
STEWART, William, Land-Steward, Dalhousie Castle, Lasswade.
STEWART, William, Nurserymen, Dundee.
STEWART, William, Assistant Forester, Underley Hall, Kirkby.
STEWART, William, Assistant Forester, Logie Almond, Perth.
STRACHAN, W. B., Manager, Dalkeith Nurseries, Dalkeith.
STRANG, Alexander, Forester, Rendlesham Hall, Woodbridge, Suffolk.
STRANG, William, Assistant Forester, New Scone, Perth.
STUART, John, Forester, Castle Grant, Strathspey.

STUART, Lewis A. G., Forester, Netherdale House, Turriff.
*STUART, William, Forester.
STUART & MEIN, Messrs, Nurserymen, Kelso.
SUTTIE, James, Evington, Ashford, Kent.
SWAN, R. G., Auctioneer, Dunse.
SWINTON, A. Campbell, LL.D., F.R.S.E., of Kimmerghame, Dunse.
SYME, David, 1 George IV. Bridge, Edinburgh.
SYMON, John, Forester, Cawdor Castle, Nairn.
SYMON, Peter, Forester, Forres.

TAIT, David, Forester, Owston Park, Doncaster, Yorkshire.
TAIT, Walter, Seedsman, 45 Chapel Street, Dublin.
TAYLOR, David, Barskimming, Mauchline.
TAYLOR, George, Forester, Monymusk, Aberdeenshire.
TAYLOR, George, Nursery and Seedsman, Inverurie.
THOMSON, James Scott, Strathallan Castle, Auchterarder.
THOMSON, Lockhart, S.S.C., 22 Coates Crescent, Edinburgh.
THOMSON, Thomas, Forester, Penicuik House, Penicuik.
THORNTON, Thomas, Heatherside, Frimley, Surrey.
TIVENDALE, William, Forester, Houston, near Paisley.
TOMLINSON, J., Brocklesby Park, Ulceby.
TOMLINSON, Wilson, Assistant Forester, Belvoir Castle, Grantham.
TURNBULL, James, Nurseryman, Hawick.
TURNBULL, William, Assistant Forester, Bowmont Forest, Kelso.
·TURNER, James, Assistant Gardener, Blithefield Hall, Rugeley, Staffordshire.
TWEEDIE, John, Forester, Dunglass, Cockburnspath, Berwickshire.

VEITCH, John, Nurseryman, Falkirk.
VEITCH, William, Hedger, Arniston, Gorebridge.
WADDINGTON, David, Crosshouse, Airdrie.
WADDS, Phillip, Gardener, Moore Abbey, Co. Kildare.
WALKER, George, Forester, Collessie, Ladybank, Fife.
WALKER, William, Assistant Forester, Penicuik House, Penicuik.
WALL, G. Y., jun., Exchequer Office, Durham.
WALLACE, Andrew, Assistant Forester, Drumpellier, Coatbridge.
*WARD, James, Forester, Hawkhead Abbey, Paisley.
WATERER, Anthony, Nurseryman, Knaphill, Surrey.
WATERS, Denis, Forester, Kelburn Castle, Largs.
WATERSON, A., Wood Manager, Glenark Castle, Arklow, Co. Wicklow.
WATSON, John, Gardener, Stravithy, St Andrews.
WATSON, William, Assistant Forester, Peth, Longtown, Cumberland.
WATSON, W. J., Nursery and Seedsman, Newcastle-on-Tyne.
WATT, James, Messrs Little and Ballantyne, Nurserymen, Carlisle.
WATT, William, Forester, Nisbet House, Dunse.

WEBSTER, Angus, D., Assistant Forester, Penicuik House, Penicuik.
WEBSTER, David, Bangholm, Edinburgh.
WEBSTER, J., The Gardens, Gordon Castle, Fochabers.
WEBSTER, John Blaikie, Verner's Bridge, Moy, Ireland.
WELSH, Duncan, Gardener, Mount Merrion, Dublin.
*WELSH, James, Nursery and Seedsman, Edinburgh.
*WELSH, William M., Nursery and Seedsman, Edinburgh.
WEST, Charles Elis, Land-Steward, Cartoon, Maynooth.
WHILLIS, Alexander, Assistant Forester, Penicuik House, Penicuik.
WHITE, George, Seedsman, Paisley.
*WHITEFORD, Robert, Assistant Hedger, Bute Estate, Rothesay.
WILLIAMS, B. S., Paradise Nursery, Upper Holloway, London, N.
WILLIAMS, Robert, of Bodelwyddn, St Asaph, North Wales.
WILSON, John, Land-Steward and Forester, Borthwickbrae, Hawick.
WILSON, John, Forester, Greystoke Castle, Penrith.
WILSON, John, Forester, Auchendolly, Castle-Douglas.
WILSON, John, Assistant Forester, Arniston, Gorebridge.
WILSON, John, Forester, Sudbourn Hall, Wickham Market, Suffolk.
WILSON, Peter, Forester, Whitehill, Lasswade.
*WILSON, Robert, Forester, Pewsey, Wilts.
WILSON, Stephen, 132 Union Street, Aberdeen.
WOOD, James, Factor, Haigh Hall, Lancashire.
WOOD, John, Gardener, Hatton Castle, Aberdeenshire.
WORMALD, J. D., W.S., 93 Princes Street, Edinburgh.
WYLIE, James, Assistant Forester, Douglaston, Milngavie, Glasgow.
*WYLLIE, George, Estate Overseer, Ballogie, Aboyne.

YELLOWLEES, George, Wood Merchant, St Boswells.
YOUNG, James, of Durris, by Aberdeen.
YOUNG, John, Messrs Imrie & Son's Nurseries, Ayr.

SUBJECTS OFFERED FOR COMPETITION DURING 1874–75.

I. For the best and approved Essay on the Pruning of Timber-trees, considered physiologically, and in relation to the production of the greatest value. (Prize of Five Guineas offered by George Reid, Nursery and Seedsman, Aberdeen.)

II. For a full and complete account, from published descriptions (with authorities distinctly quoted), personal observation and experiment, of the history and present state of the cultivation in Great Britain and Ireland of *Cedrus Deodara* (*C. Libani*, and *C. atlantica*, all now classed as one species). (Special Medal, value Three Guineas, offered by Dr Cleghorn.)

III. For the best and approved Report on the most extensive, complete, and judiciously arranged Arboretum. (*A Medal.*)

The Arboretums reported on in 1872 are excluded.

IV. For the best and approved Essay on the present state and future prospects of Arboriculture in the county in which the competitor resides. (*A Medal.*)

Yorkshire, Hampshire, and Aberdeenshire are excluded, having been reported on.

V. For the best and approved Report on the Old and Remarkable Trees on the estate on which the competitor resides; correct measurements of the circumference of the trunks, at 1 foot and 5 feet from the ground, must be given; also height of tree, spread of branches, &c. Photographs are desirable. (*A Medal.*)

VI. On the Economic Value of the Effects of the Gale of October 21, 1874, upon Trees of Position, and Woods in Scotland, with Statistics of the details of these Losses. (*A Medal.*)

VII. For the best and approved collection of Cones exhibited from and grown in the county in which the competitor resides. (*A Medal.*)

Each cone (or series of cones of one species) must be accompanied by a label giving the name of the species, the estate and county where produced, and the year grown. The Prize collection to become the property of the Society.

Wigtownshire is excluded, having been reported in 1873.

VIII. For the best and approved collection of prepared sections of different kinds of Wood grown in the county in which the competitor resides. (*A Medal.*)

Each section must have a label attached, bearing the name of the wood and the estate and county where grown. The Prize collection to become the property of the Society. The successful competitors for woods in 1872 cannot compete.

IX. For the best and approved series of Geological Specimens illustrating the different rocks and formations on which Forest Trees and Shrubs grow in the county in which the competitor resides. The specimens to be accompanied by a Report. (*A Medal.*)

The successful collection to be the property of the Society. Buteshire, having already been reported on, is excluded.

X. For the best and approved Report on the distances apart at which Forest Trees, of different species, should be planted in different soils, altitudes, and situations. (*A Medal.*)

XI. For an approved Report on the Plantations of which the competitor is Forester. (*Three Medals.*) One to be awarded for the best Report from each of the countries—England, Scotland, and Ireland—and competition to be confined to each country respectively. Reporters must state the extent of plantations under their charge, the kind of timber grown, soil, situation, management, age, &c.

The counties already reported on are excluded.

XII. For an approved Report on the management of Forests in Germany, France, or other places on the Continent. (*A Medal.*)

Special reference to be made to any appliances or modes of culture and treatment not generally adopted in this country, but followed in such arboricultural schools as those of Nancy and Hanover, and elsewhere abroad. Foreigners are specially invited to compete.

XIII. For an approved Report on the different Ages at which the various sorts of Timber Trees usually grown in Scotland may be most profitably felled in different soils and situations. (*A Medal.*)

XIV. For an approved Report on the Diseases most incidental to Forest Trees, including those that affect the roots as well as the bark, branches, and foliage. (*A Medal.*)

XV. For an approved Report on the results obtained by experience of Seedlings of Coniferæ, being the produce of trees grown in Britain, as compared with plants obtained from foreign-ripened seed. (*A Medal.*)

XVI. To any Member of the Society who shall send to the Secretary from abroad, cones or seeds of Forest Trees of new or rare species or varieties, capable of germination and of thriving in this country. (*A Medal.*)

To be awarded when fifty of any sort, or fifty plants in all, have been successfully raised. These plants to be the property of the

Society, and to be balloted for amongst Members intimating their desire to have them. The packages to be delivered free of cost to the Society at any British port.

XVII. For an approved Essay or Report on any subject connected with Arboriculture. (*A Medal.*)

XVIII. For any marked advantageous improvement on any of the Implements used in Forestry. (Models or Implements to be accompanied by a Report.) (*A Medal.*)

For conditions of Competition, see *Proceedings* of Annual General Meeting of 4th November 1875.

All Essays and Reports intended for Competition must be given in to the Secretary not later than 25th September, and all Collections of Cones, Woods, and Geological Specimens not later than 25th October 1875—*each bearing a motto, and being accompanied by a separate sealed envelope bearing the same motto outside, and containing a card with the name and address of the Author.*

Abstract of the Laws of the Scottish Arboricultural Society, as amended to November 1874.

I. The object of the Society shall be the promotion of the science of Arboriculture in all its branches, by periodical meetings of the Members for the reading of Papers; by offering Prizes for Essays and Reports on the Practical operations of Forestry, and publication of the same; and by such other means as may be found advisable.

II. The Society shall consist of the following classes of Members: —1. Proprietors, Factors, Nurserymen, and others, paying an annual subscription of Half-a-Guinea; 2. Head-Foresters, and others, paying an annual subscription of Five Shillings; 3. Assistant Foresters, and others paying an annual subscription of Three Shillings.

III. Any Member may become a Life Member by compounding for his annual subscriptions by a single payment—those of the First Class paying Five Guineas; and those of the Second and Third Classes, Three Guineas.

IV. The Society shall elect a limited number of Honorary Members, —gentlemen who have acquired eminence in the Science of Arboriculture, or who are otherwise deemed worthy.

V. All annual subscriptions shall be payable in advance, at the Annual General Meeting in November.

VI. In addition to the annual subscriptions above stipulated, the Society shall receive, from those friendly to its objects, Donations of larger or smaller amount.

VII. A Candidate for admission into the Society must be recommended by at least one Member, and shall, on payment of his annual subscription, be immediately admitted a Member of the Society, subject to the revision of the first General Meeting thereafter. Any Member of the Society introducing a New Member shall be held responsible for the first year's subscription of such party.

VIII. The affairs of the Society shall be conducted by a President, five Vice-Presidents, Secretary, Treasurer, Auditor, and fifteen Councillors—these office-bearers to be elected annually at the General Meeting in November; the three Councillors at the top of the list to go out annually, but one to be eligible for re-election.

IX. A General Meeting of the Members shall be held on the first Wednesday and Thursday of November annually, for the election of New Members, the appointment of Office-Bearers, awarding of Prizes, the reading of Papers, Discussion on selected subjects, &c.

JOHN SADLER,
Secretary.

OFFICE-BEARERS FOR 1874-75.

PRESIDENT.

JOHN HUTTON BALFOUR, M.D., M.A., F.R.SS.L. and E., Professor of Botany in the University of Edinburgh.

VICE-PRESIDENTS.

The Right Hon. W. P. ADAM, of Blairadam, M.P.
HUGH CLEGHORN, M.D., F.R.S.E., of Stravithy, St Andrews.
WELLWOOD H. MAXWELL, of Munches, Dalbeattie.
ROBERT HUTCHISON, F.R.S.E., of Carlowrie, Kirkliston.
JOHN GRANT THOMSON, Wood Manager, Grantown.

COUNCIL.

JOHN M'LAREN, Forester, Hopetoun, South Queensferry.
HUGH FRASER, Stanwell Nursery, Edinburgh.
DAVID MITCHELL, Nurseryman, Edinburgh.
JOHN M'GREGOR, Forester, Ladywell, Dunkeld.
ALEXANDER RICHARDSON, Land Steward, Arniston, Gorebridge.
JAMES MOFFAT, Forester, Newbattle Abbey, Dalkeith.
JAMES SMITH, Forester, Donibristle, Fife.
WILLIAM M'CORQUODALE, Forester and General Wood Surveyor, Jeanie Bank, Perth.
WILLIAM THOMSON, Deputy-Surveyor, H.M. Chopwell Woods (*deceased*).
JOHN ALLAN, Forester, Dalmeny Park, Edinburgh.
JAMES MICHIE, Forester, Wemyss Castle, Kirkcaldy.
THOMAS METHVEN, Nursery and Seedsman, Edinburgh.
CHARLES S. FRANCE, Overseer, Penicuik House, Penicuik.
D. SCOTT, Wood Manager, Darnaway Castle, Forres.
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TRANSACTIONS

OF THE

SCOTTISH ARBORICULTURAL SOCIETY.

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EDITOR AND SECRETARY

JOHN SADLER, F.R.P.S.,

LECTURER ON BOTANY IN THE ROYAL HIGH SCHOOL, AND ASSISTANT TO THE REGIUS PROFESSOR OF MEDICINE AND BOTANY, UNIVERSITY OF EDINBURGH.

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JOHN SADLER, F.R.Ph.S.,

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OF THE

SCOTTISH ARBORICULTURAL SOCIETY.

I. *Address delivered at the Twenty-second Annual Meeting.* By JOHN HUTTON BALFOUR, M.D., M.A., F.R.SS.L. and E., Professor of Botany in the University of Edinburgh.

I AM deeply sensible of the honour which you have conferred upon me, in electing me President of the Scottish Arboricultural Society, and I shall now endeavour to discharge a part of the duties of that office, by giving you a short address, at the commencement of another Session.

Since we last met we have to record the death of one of our oldest Members, who may be called the father of the Society, William Thomson, Chopwell. He was born in Fifeshire, on the estate of the Earl of Moray, in 1828. When he was quite young the family removed to Inverness-shire, where his father acted as Forester on the estate of Petty till the year 1843. During this time William attended school at Ballochy, where he obtained the rudiments of his education. In 1843, his father, having been appointed Forester to the Earl of Stair, removed to Wigtonshire. Here the son acquired his first knowledge of forestry. Lord Stair's woods and plantations in Galloway are very extensive and varied, and afford ample opportunities for acquiring a knowledge of arboriculture. Thomson's father was a thorough practical forester, and gave excellent instruction to his son, who, after serving his apprenticeship, went to Cally and acted as journeyman. When twenty years of age William accepted the superintendence of the woods of the Marquis of Londonderry at Wynyard Park, and remained there till 1851. After filling various situations with credit and efficiency, Mr Thomson was, on the recommendation of Mr Brown, appointed in 1853 to the surveyorship of the Chopwell Woods, which office became vacant about that time. At Chopwell he carried out plans, previously suggested by Mr Brown, and he did so to the entire satisfaction of the Crown. His work there is well known to all foresters, and need not be dwelt upon. He was the founder of this Society, and took a deep interest in its proceedings and its prosperity. He died suddenly from heart-disease, leaving a widow and five children.

Our Society has now fully attained its majority—having existed twenty-one years—and the number of its Members has largely increased. Good work has been done by associating together Scottish arboriculturists and others interested in forestry, by holding an annual meeting for the reading of papers and for discussion, as well as by the publication of "Transactions," which now amount to seven volumes, and embrace papers on many important questions connected with the cultivation and preservation of forests. The reputation of the Society has been widely extended, and we have Members from all parts of the United Kingdom, as well as from foreign countries.

Many landowners have joined our ranks, and I trust that ere long we shall number on our list a larger number of proprietors in Scotland. The subject of forestry is of great importance, whether we regard the landscape, the climate, or the resources and productions of a country. Our object is to encourage this department, to see that our foresters are properly instructed; that our woods are judiciously managed; and that thus the prosperity of our country is advanced.

The effects of trees on the climate of a country were long ago noticed by Humboldt, who showed that, by the rash cutting down of trees and the denudation of countries, the water supply of large districts had been seriously injured, and the character of the climate changed for the worse, while, at the same time, the means of procuring timber and fuel were destroyed. The great function of the leaves of trees is the evolution of oxygen gas, by means of which the purity of the atmosphere is maintained. This function of plants is antagonistic in its results to animal respiration, for while the latter takes oxygen from the atmosphere and replaces it by carbonic acid, the former remove carbonic acid, fix carbon, and give out oxygen. The processes of respiration and combustion are pouring into the atmosphere a large quantity of carbonic acid gas, while the leaves of plants are constantly removing it, and under the action of light substituting oxygen. The life of man and animals is thus intimately connected with the vegetable productions of the globe, not merely as regards the materials for their food, but also in reference to the air they breathe. "How interesting," says Johnston, "is it to contemplate the relations, at once wise and beautiful, by which dead organic matter, intelligent man, and living plants are all bound together! The dead tree and the fossil coal lie almost useless things, in reference to animal and vegetable life; man employs them in a thousand ways as ministers to his wants, his comforts, or his dominion over Nature; and in so doing he himself directly, though unconsciously, ministers to the wants of those vegetable races, which seem but to live and grow for his use and maintenance."

When forests are destroyed, as they are everywhere in America by the European settlers, with an imprudent precipitation, the springs are entirely dried up, or become less abundant. In those mountains of Greece, which have been deprived of their forests, the streams have disappeared. The inconsiderate felling of woods, or the neglect to maintain them, has changed regions noted for fertility into scenes of sterility. The sultry atmosphere and the droughts of the Cape de Verd Islands are attributed to the destruction of forests. In large districts of India the climate and rainfall have deteriorated from a similar cause, and the Government are now using means to avert and remedy the mischief. In wooded countries, where the rains are excessive, as in Rio Janeiro, the climate has been improved by the diminution of the trees. Gardner says, that since the axe has been laid on the dense forests surrounding the city of Rio Janeiro, the climate has become dry. In fact, so much was the quantity of rain diminished, that the Brazilian Government was obliged to pass a law prohibiting the felling of trees in the Corcovado Range. Müller states that the cultivation of grain, which has so completely transformed one part of the wilderness of Australia, has already exercised a most beneficial influence on the increase of rain.

The conservation of forests is unquestionably a subject of great importance. It is now occupying the attention of the Government of India, and of many other Governments, and it will sooner or later engage that of all our colonies. The physical history of every country proves incontestably that a moderate extent of forests, especially on mountain slopes and elevated rocky ground, where tillage is impracticable, promotes in a high degree both the agricultural and manufacturing interests of individuals, as well as the physical soundness and productive resources of extensive countries. It appears that the influence of forests in a physical, economical, and hygienic point of view, is deserving of a more complete investigation than it has yet received. By felling trees which cover the tops and sides of mountains, men in every climate prepare, at once, two calamities for future generations—the want of fuel, and the scarcity of water.

In reference to the climate of Malta, and the want of trees in the island, Mr Milne Home has written to me as follows :—

"Having been a couple of months in Malta, and seen the evils arising from want of water, I wrote a paper on the subject, which appeared in the Transactions of the Scottish Meteorological Society. Copies of this paper having been sent to Malta, the Governor and Legislative Assembly appointed a Commission of scientific men to take my paper into consideration. The Commission reported in favour of my views. In order to carry them out, the Governor (Sir Patrick Grant) sent a message to the Assembly to recommend £1000 a year to be appropriated for ten years, to carry out the scheme of planting the island. The Assembly agreed to vote £800 a year for ten years.

"The scheme was begun to be put in operation in 1873, so that there has been scarcely time to have many plantations made, and still less to judge of the effects. But I have received written reports mentioning the places where plantations are being formed, and specifying the kinds of trees planted. There is, as you will understand, no possibility of getting young trees from any other country. It is only by seed got from other countries, and grown in the island, that young trees can be raised, in order to be formed into plantations. I can only say, further, that the scheme is in progress, though, of course, many years will elapse before any good effects can become visible."

Mr Milne Home's plan, you will thus perceive, has been taken up in earnest by the authorities of Malta. His proposals have been favourably noticed in foreign journals, and reprinted by the Austrian Meteorological Society.

In the last part of our Transactions (p. 285), there is a report by Mr Buchan on the Meteorological Observations made at Carnwath, Lanarkshire, on the influence of forests on climate, particularly as connected with rainfall. The observations have been carried on for some time by Mr Currie at Winterlaw and Gallowhill, Lanarkshire, kindly placed at the disposal of the committee by Mr Maclean, Carnwath. The results are interesting, and are given in a tabular manner in the Transactions (vol. vii., p. 285). They are, however, still imperfect. It will require a series of years to bring out satisfactory results. It is, therefore, of importance that the committee should continue the work, and that Mr Currie, who is an excellent observer, should be engaged to carry on the observations. The work requires some extra expenditure in the way of instruments, etc., for which the sum of £8 or £10 will be required. If the investigation is carried on, the committee will be able to report to the British Association meeting at Glasgow in September.

Forests may thus be regarded as influencing, in a marked degree, the climate of a country. They are also necessary for the production of timber; and, in this point of view, it is of great importance that trees should be properly planted, and that their roots and branches should have free scope.

If we wish trees to be firmly rooted, we must allow the branches to spread freely. When they are so planted that the branches and leaves of contiguous trees do not interfere with each other, and thus all parts are exposed to air and light equally, the roots spread vigorously and extensively, so as to fix the plants in the soil, and to draw up copious supplies of nourishment. But in crowded plantations, where the branches are not allowed freedom of growth and exposure, the leaf-buds are either arrested or feebly developed and the roots are of necessity injured. They do not spread, and the trees are liable to be blown over by the wind; they exhaust the soil in their vicinity, circumscribed by the roots of the trees around; their functions become languid, and thus they react on the stem and branches, so that the additions to the wood are small, and the timber is of inferior quality. In such a plantation there is a marked difference between the trees on the outside and those in the centre; the former, having their branches and leaves fully exposed on one side, grow with comparative vigour, and form excellent timber on that side of the stem where light and air are admitted; while the latter, hemmed in on all sides, are drawn up like bare poles, and produce a small amount of ill-conditioned wood. A crowded plantation, in which the trees are allowed to increase in size until they interfere with each other, cannot be easily reclaimed; for every attempt at thinning in this advanced stage of growth is accompanied with the risk of exposure to the blast, which speedily levels trees having no firm hold of the soil.

Forests, in some countries, are the chief source whence fuel can be obtained, and it becomes necessary to guard the plantations, to see that the trees are properly cultivated for the purpose, and that the stock of fuel is kept up by constant renewed planting.

Dr Cleghorn, our late President, so far back as 1851 called attention to the need of commencing a system of forest conservancy in India, with a view to securing a permanent supply of timber and fuel, and he pointed out the danger of their exhaustion unless proper means were taken for the protection of the forests. I understand that the organisation of the Indian Forest Department is steadily progressing, and that there are now about seventy trained officers distributed over the numerous provinces of that vast empire. An Annual Report on the valuation surveys, and the progress of the work in all the districts, is published, and may be consulted in the library attached to the Edinburgh Botanic Garden. It is worthy of notice that a Forest Conference was held at Simla on 4th October. Dr Brandis, President, and thirty-four officers were present. This is the third annual gathering for considering difficult questions of forest administration. The first number of a monthly periodical called *The Indian Forester*, edited by Mr Schlich, was published at Calcutta in July. It is intended to supply a medium for the interchange of ideas among forest officers, and for the record of observations and experiments.

In his late address, Sir John Hawkshaw, at Bristol, pointed out the importance of economy in fuel, the enormous consumption of it at the present day, and the risk of exhaustion of our coal beds. His remarks on the expediency of economising fuel apply even more strongly to those countries in which the chief supply is furnished by the forests.

The conservation of forests in many countries thus becomes a very important matter, and nowhere is this more necessary than in our Indian possessions. It is essential, therefore, that a proper staff of officers and men should be employed in the department of forestry in India. Such a staff can only be obtained by the proper *training* of men for the purpose. In Continental countries, especially in France and Germany, forestry is taught as a regular system, practical instruction and lectures being given in the forests, the extent of which gives large scope for the training of young foresters. There can be no doubt that forest schools might be established in this country, which would fulfil all the important conditions required for the student.

There are certain matters connected with forest management which may be best illustrated on a large scale, but there seems to be no reason why our students of forestry should be sent to the Continent for their training. There ought to be sufficient means in Britain for imparting practical instruction in the management of forests.

The Secretary of State for India has adopted the plan of sending the students abroad. By so doing, the students are compelled to study the language of these countries in the first instance, for it is impossible to understand lectures and demonstrations without a thorough knowledge of the language in which they are given, and especially with the peculiar technical language used (and which cannot be got in books). Much time is thus spent, which might be better employed in studying some of the languages of India, so as to fit the forester for his employment in that country.

I am disposed to think that the education of foresters should be conducted on some such plan as the following:—

In the first place, we must suppose that students have had a fair education in English, arithmetic, writing, and composition. Instruction should next be given in the elements of natural sciences, especially botany, with its bearings on arboriculture, the nature of soils, and their adaptation for different kinds of trees, along with a knowledge of elementary chemistry. In studying botany, the young forester should attend to the mode in which plants are nourished, the functions of the root, stem, and leaves, the structure of the wood, the effects of vegetation on climate, rainfall, etc., the diseases to which trees are liable, and the mode of prevention and cure. The necessary information in regard to the elementary sciences can now be acquired at many of our schools. A certain amount of knowledge of Latin is valuable for the names of trees. The instruction given in science should not be merely from books, but should be by practical demonstration, and by teaching the principles of forest cultivation. Schools for practical forestry might be established in the vicinity of well-wooded districts, where draining, planting, thinning, pruning, felling, drying, and transportation could be practised, and the remedies for diseases tested.

I believe that the requisite instruction for candidates for the forest departments in India and our colonies could be acquired in this country if Government took up the matter, and called in the aid of the Scottish Arboricultural Society. If the student acquires a thorough knowledge of the principles and practice of Arboriculture in this country, he could easily get the additional information required for such countries as India in the way of forest management and rules. These details must be acquired on the spot, as they vary in different places.

The Highland and Agricultural Society is now offering bursaries for youths who prosecute natural science studies in schools, especially such departments as botany, physical geography, chemistry, and geology. The announcements are as follows :—

1. That the Society shall grant annually ten bursaries of £20 each, and five of £10 each, to be competed for by pupils, at schools to be approved of by the Directors, which include, or are willing to introduce, the teaching of chemistry, and the following branches of natural science—physical geography, botany, and geology, into their curriculum.

2. That the £20 bursaries shall be tenable for one year at the University of Edinburgh for the purpose of enabling the holders to take the classes necessary to qualify for the Society's Certificate or Diploma; and the £10 bursaries to be tenable for the same period, to enable the holders to receive another year's preparation at the schools.

3. That the bursaries shall be determined by examination held in Edinburgh by the Society's examiners.

For instruction in arboricultural principles botanic gardens in this country offer many facilities. There is at Kew an excellent arboretum, illustrating all the most important trees now cultivated in this country. Dr Hooker has done excellent service in this respect, following in the footsteps of his distinguished father.

We have, in the Botanic Garden here, a very good collection of forest trees, but the space is far too limited for the purpose of arboricultural study; and, hence I have requested Government to purchase grounds, lying in the vicinity of the Garden, for an Arboretum. There is now an opportunity of acquiring Inverleith grounds, on the west of the Garden, and I hope that Government will not lose the opportunity now offered of acquiring them, from the trustees of Fettes College. These grounds have been recently visited by many eminent arboriculturists and landed proprietors, and all agree in the importance of securing them. The difficulty, on the part of the Treasury, is the purchase money.

I hope that this may be removed by the indefatigable exertions of our Lord Provost, so that this addition may be made to the Botanic Garden, and may be supported by an annual Government grant.

The following is the proposal made in a recent document entitled The Edinburgh Municipal Police Amendment Act:—"That the Magistrates and Council be empowered to acquire by agreement, or, failing such agreement, compulsorily, under the Lands' Clauses Consolidation (Scotland) Acts, for the purpose of enlarging the Royal Botanic Garden in Inverleith Row, all or so much of the lands of Inverleith, situated to the west of the said Royal Botanic Garden, as may be considered necessary."

I may here express my obligations to Lord Provost Falshaw, the Duke of Buccleuch, the Lord Justice-General, the Right Honourable W. P. Adam, M.P., Sir James Elphinstone, Sir Robert Christison, and Dr Lyon Playfair, for the warm interest they have taken in the matter.

The grounds now proposed to be incorporated with the Botanic Garden are well situated, have a varied surface, a fine exposure, and are enclosed to a considerable extent.

Our Society has supported the scheme, and last year memorialised Government on the subject. The matter is an urgent one, and will be again brought under the notice of Government; and I hope that the Members of our Society who are also Members of Parliament, will give their support.

Sir Robert Christison, in his opening address to the Botanical Society last session, entered fully into the importance of acquiring the Inverleith grounds for an Arboretum. The address is published in the Transactions of the Society for 1875.

Various important publications on Arboriculture have been recently issued; among others, I may mention a work by Messrs Dupont and De la Grye, on the "Physiology, Culture, Productive Quality, Industrial, and Commercial Uses of Indigenous European and Foreign Woods," which contains ample details on all these subjects. The work is drawn up by a naval architect and a conservator of forests. It is hoped that it may be translated into English. The authors commence with the physiology of plants, and make remarks on the effects of climate, elevation, moisture, and dryness on the cultivation of trees. Next, they treat of cultivation in a commercial point of view. The forest statistics of various countries are then noticed; and remarks are made on the working of forests and the production of charcoal; on the quality of timber and its defects; the mode of desiccation and the quantity of water existing in wood at different seasons; the felling of timber and the machinery to be used in its manipulation.

The attention of our colonies also has been directed, of late years, to the conservation of forests and the cultivation of trees fitted for various economical purposes. I would especially allude to reports on the durability of New Zealand timber in constructive work, etc., recently published in that colony.* One of these is by Mr T. Kirk, who points out the differences observed in the durability of timber in different localities, arising chiefly from the following causes:—

1st. Trees having been felled during the growing season.

2d. Timber having been used immediately after being felled.

3d. Trees having been felled before the heart-wood was sufficiently matured.

4th. The use of defective timber, whether shaky, worm-eaten, or soft, from having been grown in unsuitable situations.

5th. Defective workmanship. No care having been taken to exclude rain from imperfect joints, exposed hewn beams left with a concave upper surface, so as to retain rain, etc.

6th. The application of paint and tar, etc., to the surface when the timber is in an unseasoned condition.

Mr Kirk also states that it is important that timber for public works should be selected in the forest by some competent person, so that unsuitable timber, whether defective from having grown in situations not naturally adapted for the particular kind required, or from not having arrived at maturity, might be rejected at the outset. The seasoning of timber also requires special attention. Mr Kirk alludes to the various attempts made to increase the durability of timber by the absorption of mineral solutions.

Mr Kirk has given a list of the more important trees in Australia, with their qualities. A report has also been given by Mr J. M. Balfour, engineer at Dunedin, on the strength of the New Zealand woods, and by Captain E. W. Ward on their capability of bearing pressure.

In Vol. VII. of the Transactions of the New Zealand Institution, edited by Dr Hector, issued July 1875, there is a valuable paper on Forest Culture by Mr F. C. Firth. In this article the author speaks of the effects of forests on the landscape, as a shelter for birds which devour insects, as well as for timber and for

* See Article in *Edinburgh Review* for October 1875.

fuel. He dwells specially on the destruction of forests, and makes the following remarks :—

"The effect of the destruction of forests is the result of the persistent and reckless disregard of a plain natural law. To strip a semi-tropical country of its forests is to convert it into an arid desert. In more temperate countries denudation of timber produces barrenness of soil, increases insect life, creates drought, diminishes rain, accelerates evaporation, causes floods and untimely frost, lessens the production of food, diminishes population, and finally degrades a nation. The glory of many an ancient empire has departed with its forests. To-day Persia and Spain present sad but warning spectacles of desolation and degradation, which, though partially due to various causes, have been intensified by the destruction of their forests."

Mr Firth points out the necessity for conservation of forests in New Zealand, otherwise some of the best trees, such as the Kauri, will be doomed to extinction. He maintains that Government should not sell for cultivation any forest land. The forest lands in the hands of natives ought to be purchased by Government as quickly as possible.

Mr Firth points out that forestry, as practised in Europe, can only apply to the cutting of timber in New Zealand in its general principles because the trees there are much larger than in European forests. The Kauri (*Dammara australis*), and many other forest trees, vary from 3 feet to 9 or 10 feet in diameter, and grow on the sides of valleys or gullies more or less precipitous. It is not easy to know how trees of this diameter, and running up to 70 or 80 feet without a branch, can be felled without inflicting much damage on the surrounding young timber.

Baron von Mueller, director of the State Garden, Melbourne, has published a pamphlet on Australian Vegetation. In speaking of the baron's exertions, the Marquis de Beauvin, in his "Voyage Round the World, 1866-68," says :—

"Besides the charming public gardens at Melbourne, there is a Botanical Garden situated on a verdant hill. This is the little kingdom of Dr Mueller. The misfortune of Australia is the want of water. Dr Mueller wishes to remedy this; he is succeeding. He distributes over the interior of the country thousands of shrubs and young trees reared in his nurseries. Little streams form rapidly round the young woods. The results are splendid already; and each year confirms this. On barren plains he has created woods and streams in more than a hundred places."

Recent reports have also been given on the Bavarian forests, and Professor Ebermeyer has written a work on the study of the Physical Influence of Forests on the air and soil, their effect on the climate, and their hygienic importance.

The following is an extract from a letter by Mr M'Vean, Japan:—

"YOKOHAMA, *10th August* 1875.

"The other day the Minister of Public Works called and asked if I could help him to get some Indian tree seeds. For some years back in this country the people have been using up all the timber to make charcoal, and have neglected to plant new trees, so now they are nearly out altogether, and some of the mines cannot be worked for want of coal and charcoal. What is wanted specially are some quick growing trees suitable for the making of charcoal, also some of the best hardwood trees of different kinds, and generally the seeds of useful trees, and especially hard woods."

The *New York Times* declares that the reckless destruction of the American forests is fast producing a condition in which there will be occasion for real alarm. In the whole United States, we are told, there is left but one really great tract of timber. It lies in the far extremity of the country, and consists of about one-half of Washington Territory, and one-third of Oregon. California has perhaps about 500,000 acres. In New York there is no considerable forest left, except the Adirondach Region.

Railroads have been the means of levelling at least 150,000 acres of trees annually for ties, of which there are 60,000,000 yearly required. Farmers are also enormous consumers of trees. The extravagant waste of timber, caused by the felling of forests and burning of the trees to bring the land under cultivation, goes on still at a fearful rate. From 1860 to 1870 no less than 12,000,000 acres of forests were thus wantonly destroyed. For fuel, also, vast tracts are cleared. It took 10,000 acres of forest to supply Chicago with fuel for one year, 1871. The necessity for a Commission of Forestry, and the need of efficient law for the preservation of forests in all the United States, needs no further argument than these facts.

Another important question is the growing of trees in our towns and cities. This is most important not merely as regards amenity and landscape beauty, but also in reference to hygiene. The Birmingham Town Council has voted £1000 for the purpose of planting trees in the open spaces of that town, and protecting them with guards. It is difficult for trees to grow well in the midst of dwelling-houses, unless space is allowed, and unless means are taken for consuming smoke, especially in the case of mills and manufactories; and of preventing the issue of noxious vapours, such as sulphurous acid and hydrochloric acid. The injury done to trees by alkali works is very great. This subject was investigated many years ago by Sir Robert Christison and Professor Turner of London, and they found that a very small amount of these gases in the atmosphere, even so little as $\frac{1}{9000}$ part, injured the leaves of trees, and made them fall off.

A subject of great importance, and which must necessarily engage the attention of foresters, is the causes of disease and decay in forest trees. This subject has been strongly brought under notice by the falling off in the *Larch*, and other forest trees. The most common causes of disease are,—improper soil, ungenial climate, frosts, long-continued rains, great drought, violent storms, parasitic plants, insects and worms.

The diseases of plants may be divided in the following way:—1. Diseases which are caused by an excess or deficiency of those agents which are necessary for the vigorous growth of plants; such as soil, light, heat, air, and moisture. 2. Those which are either originally caused, or, at all events, aggravated and modified by the attacks of parasites, more particularly belonging to the natural order Fungi. 3. Those due to the action of poisons, either taken up from the soil or from the atmosphere. 4. Those caused by mechanical injuries of different kinds, as by the attacks of animals, more particularly insects. Diseases caused by changes in the atmosphere are often epidemic, and spread over extensive districts of country. Those which are due to parasitic fungi are propagated by contagion—the minute spores being carried by the winds. Exciting causes operate with great intensity in cases where plants are previously predisposed to disease. Thus, if a plant is in an enfeebled or weak condition, it is very liable to suffer both from epidemic and contagious diseases.

The cryptogamic diseases of plants must be considered contagious, since they are produced by the contact of one portion of organic matter with another. The contact of diseased cells produces disease in healthy cells. The action is analogous to what takes place with ferment when introduced into a saccharine liquid.

The liability of the plant to the development of epidemic disease is produced by the state of the atmosphere as regards moisture, the prevalence of hot or cold weather, the amount of light, and probably the electrical condition of the air and earth. The natural decay of plants also renders them liable to attacks of fungi, etc. Thus leaves, before they fall, are often affected. The trunk and branches of a tree become most frequently gangrenous when they have attained maturity. Most epidemic diseases may be averted by keeping plants properly exposed to light, air, and moisture.

The influence of the sea breeze, carrying with it saline matter, is prejudicial to most plants. Plantations are frequently injured from this cause. A good illustration is seen at Gosford, near Edinburgh, where the trees, on reaching the top of a wall, are stopped in their growth by the sea breeze, and their tops form an inclined plane proceeding inwards from the wall as a base. Some plants withstand this influence better than others.* The following trees, shrubs, and herbs have been recommended as withstanding the sea air :—

Acer Pseudo-Platanus.	Hippophae conferta.
Pinus Strobus.	Tamarix gallica.
—— Pinea.	—— germanica.
—— Cembra.	Pyrus japonica.
—— Pinaster.	Leycesteria formosa.
Quercus Ilex.	Spiræa salicifolia.
Pyrus Aria.	Colutea cruenta.
Hippophae rhamnoides.	Sambucus racemosa.

The attacks of parasitic fungi cause extensive injury and disease in trees. Some think that the spores of fungi coming into contact with the plant act both as the predisposing and exciting cause of disease; others, perhaps more correctly, think that some change is first produced in the cells, which enables the spores to find a nidus, and then the disease goes on rapidly, assuming a peculiar type on account of the presence of the fungus.

Dry rot is a disease to which the wood of trees is liable. It may be traced, in the first instance, to some alteration in the woody tissue produced by moisture or other causes, and the subsequent development of a fungus which spreads its mycelium through the texture, and produces rapid disorganisation. Trees

* See two Papers by Mr William Gilchrist and Mr C. Y. Michie, in vol. v. of the Transactions of the Society.

growing in wet and ill-drained soil are subject to rot. The more abundant the alburnum or sap-wood, the more liable are trees to decay. The disease which has recently attacked the larch is attributed by some to the roots reaching ungenial soil, and to the production of dry rot. This rot in the larch begins in the heart-wood, near the root, and it spreads outwards; layer after layer crumbling like saw-dust. Among the crumbling mass is to be found, in abundance, the mycelium of some fungus. When the rot has reached the alburnum a thick leathery white formation appears between the bark and wood, which formation is identical with the appearances connected with dry rot. In dry rot the decay takes place, in the first instance, in the contents of the woody tubes, and thus a suitable soil is supplied for the spores of fungi, such as *Merulius lacrymans* or *vastator*, and *Polyporus destructor*. When these plants begin to grow, they spread their mycelium with great rapidity. If air is allowed to circulate freely around wood, dry rot does not attack it. But if it is placed in a damp situation, without a circulation of air, then decay takes place. The spawn of the dry-rot fungus deprives the woody tubes of their contents, for the purpose of getting the nourishment it requires, and the wood loses its consistency and toughness, the walls of the tubes becoming brittle, and ruptured.

The great cause of decay in wood is moisture. Wood in a dry state may be preserved for a long time, as may be seen in the case of wood in some old buildings, as Westminster Hall. Saw-dust is wood in small pieces; when wet it soon rots, but when dried thoroughly it may be kept for an indefinite period. To have timber in the driest state, it ought to be felled between the fall of the leaf and the spring, the nearer the former time the better. The timber of some trees is much more subject to decay than that of others. The wood of the cypress is very durable. A great error in building is painting wood early, and thus enclosing within it the elements of decay, by not allowing the escape of moisture. In olden times the wood was left bare, and exposed to currents of air which kept it dry. Hence its durability. Such is the case with the roof of Westminster Hall, which dates from the time of Richard the Second, and still is sound. So also the wooden roof of York Minster, constructed in the thirteenth and fourteenth centuries; also the timber of the Hospitium, constructed about the same period, in the garden of the Yorkshire Philosophical Society. Old doors and ancient pews in village churches owe their durability to the same causes, namely, thorough drying by exposure to air, without being covered with paint or plaster.

Various means have been adopted for preventing timber from being attacked by dry rot. Boucherie's method was to cause growing trees to absorb fluids of different kinds, which he considered as acting on the contents of the woody tubes, in such a way as to render them less liable to disease. The solutions he employed were acetate of lead, pyrolignite of iron, and corrosive sublimate. He also found that trees, immediately after being cut down, when their extremities were immersed in these solutions, absorbed them with rapidity. A tree having been sawn near the root, is placed in a horizontal position, and a cap of leather or waterproof cloth is tied firmly over the lower end, leaving a sufficient space for the solution. This is introduced by a flexible tube luted to the leathern cap, and communicating with a barrel, placed at some height above the timber, so as to give the pressure of a column of six or eight feet. The liquid is put into the barrel. In this way twenty or forty gallons of the solution of acetate of lead may be made to filter through the pores of the wood. Mr Hyett adopted Boucherie's method, and has given colours to timber, by making the wood absorb in succession fluids (such as solutions of ferrocyanuret of potassium and sulphate of iron), which, by their combination, produced a coloured compound.

Timber, after being cut, has been subjected to various processes for the purposes of rendering it durable. Kyanising is performed by subjecting the wood to the action of corrosive sublimate, by means of which it is probable that the albuminous matter is coagulated, fermentation is prevented, and hence the wood is rendered less liable to decay and to the attacks of fungi. Kyan's solution is made to pass rapidly through wood *in vacuo*. Sir William Burnett found that the application of chloride of zinc to vegetable matters, such as wood and canvas, had the property of effectually guarding them against all the ordinary causes of destruction, without communicating any bad property to the substance prepared from it. Canvas so acted on was kept long in damp cellars, and exposed to various vicissitudes, without being injured, while ordinary canvas, in similar circumstances, became rotten. The process has received the name of Burnettising. Burnett's antiseptic solution, of one pound of chloride of zinc to five gallons of water, has been tried in Woolwich Dockyard with success.

Mr Bethell uses creasote for the preservation of wood. The creasote acts by coagulating the albumen, and preventing putrefactive decomposition. Along with the creasote there are other products of the distillation of coal-tar, especially bituminous oils, which enter into the cells, and, by surrounding the woody fibres, prevent the action of water and air. There are two methods pursued: 1. By placing the wood in a strong iron cylinder, exhausting the air from it by an air-pump, until a vacuum is produced equal to about 12 lbs. on the square inch; then the creasote is allowed to flow into the cylinder, and afterwards pressure is put on the creasote, by a force-pump, equal to about 150 lbs. on a square inch. The timber is then taken out fit for use. 2. By placing the timber in a drying-house, and passing the products of the combustion of coal-tar through it. Thus the timber is dried rapidly, and impregnated, to a certain extent, with oily matter, and with the creasote given off from the fuel used to heat the house. The timber is then taken out, and immersed in hot creasote in an open tank. A load of fir timber will absorb 40 gallons; close-grained woods less. A cubic foot of beech usually weighs 8 lbs. heavier after being so prepared. Creasote is said to prevent the decay of wood, and to stop the attacks of *Teredo navalis.*

Many of our plantations have suffered severely from the devastation of insects of various kinds. Some of them feed on the plants; others form habitations for themselves in the buds, leaves, and flowers.

The species of spruce (*Abies*) are liable to a peculiar disease produced by the attacks of an insect called *Adelges abietis.* This disease is recognised by an alteration in the colour and form of the leaves, which are aggregated together in the shape of cone-like excrescences. Mr Hardy, in describing the insect and its mode of attack, says:—"The original matriarch lives outside the gall, remaining all winter in a dwarf state at the root of a bud. As soon as the bud swells, she revives likewise, and speedily becoming enlarged with the juice imbibed, she lays some hundreds of eggs. The bud, meanwhile, instead of growing in length, becomes fleshy, and this fleshiness is communicated to the leaves. The consequence is an arrested bud, into the recesses of which the young, issuing from the cluster of ova on the outside of it beneath, betake themselves, and become soon closed in by the increased irritation occasioned by their presence in its interior."

The remedies proposed for the attacks of insects are numerous.

Quick-lime, sulphur, turpentine, and tobacco, have all been recommended. Carbolic acid has also been suggested as a remedy for the attacks both of fungi and insects.

The cause of disease in trees, and the mode of cure, should be carefully studied by foresters. Much is still to be done in this department; and the Members of our Society will do well to direct attention to the subject, and to interchange any experience they may gain.

It will thus be seen that a forester requires to study various departments of science, in order to be able to practise his profession in a satisfactory and intelligent manner. The information, however, from books or lectures is not enough. The student of forestry must enter practically into the subject. He must have experience in planting, thinning, pruning, felling, and transplanting of trees, as well as in draining.

I believe that in the present day there is a great improvement in the study of forestry, more especially in Scotland. We have a great number of able and intelligent men in this department, and our Scottish Arboricultural Society is well calculated to encourage forestry, and to train up men well qualified for undertaking the duties connected with the growth of timber, both in this country and abroad.

II. *Experiments in Planting Sand-hills.* By James Hutton, Forester, Moy.

In 1869 I came to Moy as forester under the late Mr John Sinclair, Inverness, then factor on the estates of Glenmoriston and Moy.

The estate of Moy is situated in the united parishes of Dyke and Moy, and lies in the north-west part of Morayshire, between the River Findhorn and the Moray Firth. It may be said to be all under cultivation, the lands being amongst the richest in the county. Between this and the sea is the barony of Culbin, or Cowbin, formerly a separate estate, but united to Moy at the succession of James Murray Grant, Esq. of Glenmoriston, in 1822.

The property of Culbin, which extends nearly four miles along the southern shore of the Moray Firth, comprises an area of about 3500 acres, of which 1700 acres are composed of a continuous range of sand-hills, almost destitute of vegetation. The largest of these sand-hills probably covers an area of from 80 to 120 acres, and varies in height from 80 to 100 feet above the sea-level. The sand is readily lifted by the wind, and the prevailing winds being from the west, it drifts towards the east, where a portion is annually lodged in the sea opposite the town of Findhorn.

Some are of opinion that the sand is carried back by a westerly tidal current, and thrown on the beach, thus making an endless circuit of sand. During my residence, I have not seen the least sign of the sand performing this circuitous voyage, but the opposite, as I have observed that several acres have been cleared of these sands within the last few years, which, I know, were before covered with from 20 to 30 feet of sand in depth; and the spaces are now being rapidly covered with natural sown Scotch fir. The hills have also been considerably flattened. About 50 to 60 yards in width, at the west end of these hills, are being cleared annually; and the spring of 1874 being very stormy, even a greater change took place than before.

On the outer margin of the larger ones are smaller sand-hills, ranging from 10 to 40 feet high, and these are partially covered with bent, *Ammophila arundinacea*, and sand sedge, *Carex arenaria*.

They probably cover an area of 1800 acres, of which 900 acres are under wood, and 900 are bare. The latter having, at one time, been very much broken up by the influence of the winds, an idea became prevalent amongst proprietors that the pulling of bent was injurious to its growth, and that considerable damage had been done by pulling it. The consequence was, that they petitioned Parliament to pass an Act against the pulling of bent. The bent was used for thatching purposes, and people came from far and near for it.

An Act of Parliament was passed, and the people were prohibited from pulling bent, but the result was very different from what was expected, as it soon became apparent that it was dying out. Many knolls, which before had been covered with luxuriant bent where it had been pulled, became bare from want of pulling, and were broken and carried away by the prevailing winds in spring and autumn.

To convince myself more fully of this, I chose a small knoll or part of these hills where I found the bent very short—not over 8 inches long—and having pulled it, went the following season and found the crop of bent much stronger than that of last year. I pulled it again the second year, and on the following season I found that the crop could scarcely be improved, as it stood about 2 to $2\frac{1}{2}$ feet high. Thus I satisfied myself that the more bent was pulled the more certain the crop would stand out. The best time to pull it is about the end of March.

I have also planted bent with considerable advantage for preventing the drifting of the sand; but as I refer to this afterwards, I shall first remark on the portion of the Culbin Estate now under plantations.

1. *Planted Ground.*

The possibility of successfully planting these benty knolls or margins had been frequently discussed, but to no practical purpose, till the year 1837, when Robert Grant, Esq. of Kincorth, planted with Scotch fir and larch a narrow strip along the margin of his property (Trans. Highland Soc., 3d Ser., iii. 73).

The planting having proved a success, James Murray Grant, Esq. of Glenmoriston and Moy, commenced to plant in the year 1840 with more zeal and confidence, and in 1842 finished about 300 acres with Scotch fir and larch. Mr Grigor, nurseryman, Forres, refers particularly to the expense, growth, and value of these plantations up to 1866, in his work on "Arboriculture,"

p. 101; as I only report on these woods so far as my experience has made me acquainted with them, I recommend any one who wishes further information to consult Mr Grigor's book. These woods now cover about 900 acres, of which 300 acres were planted by the end of 1842, and 600 acres are of natural growth.

On my first visit, I was struck with the closeness with which the trees were growing. They stood from 4 to 4½ feet distant, while their height was about 30 feet. It was evident they were much neglected in point of thinning. On the outside of this plantation the trees were larger, and not standing so close; this place being more convenient for getting wood for home purposes, it was more resorted to, and showed the beneficial results of thinning in time. I found also, in this place, that the trees were growing in moss. To examine it more fully, I dug a pit 5 feet deep, and found that the sand had been blown across a mossy surface. There were 2 feet of sand above 3 feet of moss, and below the moss a shingly bottom, such as is generally met with in swampy grounds; and along the surface of the sand I found the roots of the trees interwoven with one another, and especially on sandy knolls. I pulled up a root, measuring over 30 feet long, while the tree stood only 6 feet high. The highest larches were 40 feet high, and the highest Scotch fir about 36 feet.

Much damage was done by squirrels to the Scotch firs. These animals gnaw the bark near the top of the stem; and as the trees grow they get ultimately top heavy, and the winds generally break them over at the place where the bark was eaten off. In 1869 I commenced to thin out all the under growing trees, along with those that were injured by squirrels. It was necessary to be very cautious in thinning, as the trees were so much drawn up, and the wood so close. I was not so much afraid of the trees being blown down as of the effects generally produced by the scourging winds upon such trees. These thinnings I did very moderately, and effected a sale generally once a year, and have only finished thinning this spring (1874).

The trees now stand about 9 feet apart, and the plantation contains about 540 trees to the acre. The tallest larches are about 45 feet high, and the tallest Scotch fir 43 feet, while the average of the plantation will probably be for height 35 feet, with a girth of 7 inches at 12 feet. The plantation cannot now be valued at less than £28 per acre, or altogether £8400. The cost of this plantation has been remarkably small, while upwards of £1000 have already been realised.

2. *Natural Wood.*

The natural grown wood extends from the planted ground seaward, and at some places runs near the sand-hills of Culbin, covers an area of about 600 acres, and stands from 10 to 20 feet in height.

It grows entirely on sand. Its success had been greatly aided in its early stage by the protection of heath and bent. A great part of the ground is covered in winter with water to a depth of about 2 feet, and would be much improved by a leading drain made along the centre of the wood running out to the sea at the west end, and discharged through a self-acting sluice, which would keep back the tide, and at low water discharge its contents from the wood.

This wood, as far as practicable, has been thinned, and about £200 realised. Much of the brushwood was used for covering the sand-hills between this and the sea, with a view to prevent the drifting of the sand, which I now proceed to describe.

3. *Culbin Sand-hills.*

In 1869 I commenced to cover one of these sand-hills, with the view of trying an experiment for planting them, so that these barren wastes might be made to yield something useful.

There were ample proofs of sufficient nutriment in the sand to grow useful timber, as in certain hollows which had lain for many years undisturbed trees were growing luxuriantly; but the great risk lay in the drifting of the sand, and the desideratum was to fall upon an inexpensive and effectual mode of preventing it from moving.

The hill operated upon was partly covered with growing bent, the greater part was destitute of any vegetation or covering; and to prevent the sand rising with the wind, I carted a large quantity of the small trees thinned out of the woods, and pulled a great many loads of heather from the natural woods, and spread it on the surface thinly, then laying on the brush and young trees like thatch. The following was the mode of procedure:—One party sowed as much broom seed as could be covered in a day, another followed with the brush and young trees, while a third was employed in the wood providing brushwood, and pulling heather, to keep the carts going. The covering being finished, planting commenced with one and two years transplanted Scotch fir, and in this way 80 acres of sand were reclaimed.

Rabbits did great damage to the plants at first, and I had repeatedly to beat it up; but three years ago a trapper was put on, and now every plant nibbled by rabbits has come away, and the trees stand 18 inches to 2 feet apart, have good leaders, and are from 18 inches to $2\frac{1}{2}$ feet high.

The broom in some places is 4 to 5 feet high, and forms good shelter to the plants. The hill, which before was bare, is now green with vegetation.

Bent has grown in the parts most bare of broom, and heather is making its appearance, probably from seed fallen while heather was used for covering the surface. The expense of this experiment cost about £4 per acre; but some places were covered with growing bent, and required no brush covering; all was sown with broom.

4. *Binsness.*

In 1874 I had a hill to cover for Major Chadwick at Binsness. The area is about 30 acres, and almost destitute of vegetation, except to the south, which was partly covered with bent. There was no brushwood or young trees to cover with; but there was broom, which was carted, and laid along the bottom of the hill until there was enough to give a good start. Bent was then pulled out by the root, and planted about 1 foot apart over all the face of the sand. This was done so as to be two days ahead of the other workers. Broom seed was then sown, and then broom-stalks laid on, pushing the ends of the broom into the sand. About 20 acres were covered with broom, and about 10 acres with growing bent. The plants have grown considerably for the first year, and all look fresh and healthy. The planted bent has grown well through the covering of broom and carried seed this year; and next year, I have no doubt, it will be one mass of bent and broom, forming excellent shelter to the young plants. The broom that was sown, along with the planting of the bent, has also made good progress, being from 6 to 8 inches long.

This procedure will doubtless fix the sands, and allow the plants to grow.

From this experiment I am of opinion that planted bent is very serviceable for keeping the sand from shifting without other cover ing; but trees cannot be planted till two years after, as the bent is not established before that time.

The bent should be planted out at 6 inches apart. It is only necessary to put in one stalk with at least three joints, and it will grow freely. Broom seed may be sown at the time the trees are planted, as the planters naturally mark the sands with their feet, and the seed blown into the tracks secures itself. The cost of covering the hill in this way is about 35s. per acre, the pulling of the bent being the most expensive part of the work.

Note.—For the state of Binsness in 1865, see Grigor's "Arboriculture," p. 99.—Ed.

III. *On the Present State and Prospects of Arboriculture in Hampshire.* By ANDREW PEEBLES, Highclere Castle, Newbury.

Arboriculture in the south of England bears little resemblance in many of its primary operations to that prevailing in Scotland. This has been attributed to various causes, such as scarcity of fuel, and consequent value of firewood; the increasing demand for a peculiar description of sheep-hurdles; the easy access to hop-growing districts; the prevalence of brush, rake, and bobbin factories; and the home and continental trade in hoops and "small-ware." All these circumstances exert a powerful influence on the local demand for the produce required in each case. In the vicinity of brush, rake, or bobbin factories, it pays better to grow underwood, required for these purposes, than to produce a crop involving considerable expensive transport to a favourable market. It serves no good purpose, however, to plant a particular kind of underwood, merely because there is a ready market, unless the soil and situation are calculated to produce a vigorous growth. The adaptation of the crop to surrounding circumstances is one of the chief points to be attended to by the forester. No mistake so certainly leads to unsatisfactory results as that of attempting to grow a particular crop under unfavourable conditions. In such cases, the only remedy is to grub up the whole crop and replant. The longer this is deferred the more apparent the mistake becomes, and the unhealthy symptoms are annually more strongly developed. Numerous instances of negligence in this matter have come under my observation, and one extreme case is worth relating.

In South Berkshire stood a very unpromising larch plantation, on a poor, thin soil, with a hard substratum of red gravel. At twenty-five years old, this enclosure was thinned for the first time, and many of the poles were already discoloured in the heart-wood or rotten in the core. After being thinned, the trees assumed a more unhealthy appearance, were prematurely loaded with cones, and it was considered advisable to clear the crop and replant. The larch poles being too small for general purposes, were sold at a sacrifice; the ground was trenched, and a local nurseryman consulted as to the future crop. The only trees he had in stock at the time were hazel and alder, and the proprietor did not encourage hazel-planting, on account of the depredations of trespassers in search of nuts. The contractor, therefore, was obliged either to buy trees from another nursery or recommend his own alder. He assured his employer that Mr S—— had disposed of 10 acres at £18 per acre, for eight years' growth, and that nothing would pay better than alder underwood. Ultimately his employer consented, and it is scarcely necessary to add that it proved a failure.

Though such extreme cases rarely occur, yet in rake-manufacturing districts alder underwood is often cultivated in ungenial situations. The demand is great, and, under favourable conditions, such large profits are realised that even practical foresters occasionally err by planting it too extensively. We frequently find it in low marshy valleys, and, in such situations, the underwood is invariably of little value. This may appear strange to many who have seen large alders with their roots projecting in rivers or running brooks, and who may conclude that wet, low-lying valleys will produce a healthy crop ; this may be the case in South Hants, within the influence of the sea, but in North Hants, where severe spring frosts prevail, the result will be disappointing. Alder starts early into growth, and the tender shoots are easily affected by frost. Consequently the frosty air, settling in the valleys, destroys the succulent leader, and it often takes the whole season to recover. This not only retards the growth of the crop, but, by destroying the ascending shoots, each plant produces a succession of new leaders which renders the underwood comparatively worthless for rake-making.

Another mistake which prevails in many parts of Hampshire, is attempting to grow alder in oak plantations. The soil in such cases is either too wet for oak or too dry for alder. If too wet, the oaks soon give unmistakable symptoms of disease, and I would prefer to have the crop cleared, and the ground trenched and replanted. If, however, the soil is *not* too wet, and the oak-trees are healthy and vigorous, nothing pays better than the Scottish system of treating it exclusively as a timber plantation. The southern practice is to thin the oaks severely, and plant the vacant spaces with alder for underwood. This is a ruinous proceeding, for no description of underwood is so susceptible of injury from the drip and shade of other trees as alder ; and no crop depreciates so rapidly in value when grown under unfavourable conditions. Unless grown clean and straight, free from knots, joints, or double leaders, and with comparatively little taper in proportion to the length of stem, it is useless, except for charcoal or firewood. When planted in oak-timber plantations there is only a quantity of feeble, straggling bushes, which are periodically converted into "puffs" for bakers' ovens, instead of a valuable undergrowth.

Another mistake in alder culture is more prevalent. It is the plan of mixing various sorts of underwood with the idea that competition is thereby increased. I admit that miscellaneous lots bring together purchasers for each description of produce, but it does not follow that a mixture of hazel and alder will increase competition. The purchaser who converts hazel into sheep cages, hurdles, and thatching rods knows nothing of brush-head, handles, and rake-ware. Consequently he could not convert economically the alder he must purchase with his hazel.

When two trades are represented by one lot, the value is depreciated. It often happens that the whole enclosure is not adapted for the same crop. When this occurs, the forester should confine himself, if possible, to sorts which can be economically manufactured by one purchaser. Alder, willow, ash, and Spanish chestnut are used in one branch of industry, and are all admissible in the same enclosure. They ought, however, to be planted in masses, and not on the alternate system generally adopted for mixed plantations. If the enclosure is wet, and subject to spring frosts, willow will prove a more certain crop than alder; and if the elevated portions are too dry for alder, ash or Spanish chestnut may be substituted. The two latter are invariably selected for hoops, hop-poles, and crate-rods; and their conversion is managed by those who prepare brush and rake-ware for sale. These, therefore, may be disposed of separately or combined; but it would be injudicious to include hazel, oak, maple, or birch, which are required for a distinct branch of industry. These remarks do not apply if the enclosures are so extensive as to afford separate lots for each sort of underwood. When this is the case, the forester has only to consider which crop is the most remunerative, and best adapted to the situation. Ash is used for such a variety of purposes that it is valuable at all ages. As underwood, it is convertible into crate-rods, hurdle stakes, hoops, hop-poles, and sheep cages. It can be sold with almost any description of underwood without depreciating its value. It is a rapid grower, and luxuriates in deep, loamy soils, cool, but free from wet. It is not so much cultivated as it ought to be, especially in the south, where there is a continually increasing demand. We seldom find ash timber in quantity even in our largest plantations;

and, as underwood, it is only grown on the driest portions of alder gullies. One great obstacle to its successful cultivation in this thickly-wooded county is the prevalence of rabbits, whose depredations on young ash are ruinous. Year after year, the tender shoots are eaten off, which gradually weakens the vitality of the stools, and ultimately the whole crop is destroyed. Ash underwood, in favourable situations will pay a yearly rent of nearly £3 per acre, after deducting expenses. If grown in masses, as timber, considerably more may be realised. In Hampshire, underwood is generally preferred, as the returns are quicker and more certain than from timber plantations. The subsequent management of timber trees exerts a great influence on the receipts, which are necessarily more precarious than from coppice. I do not make these remarks because I am in favour of underwood; for even in this land of "gullies," "shaws," "withybeds," and coppices, I maintain that nothing pays better than timber plantations; and when forming new enclosures, I invariably recommend timber trees, unless there is some particular reason to the contrary.

Spanish chestnut is a valuable crop, planted extensively as coppice in many parts of Hampshire. It is used principally for hoops and hop-poles, but occasionally for sheep cages, hurdle stakes, and crate-rods. For the latter purposes, however, ash is always preferred, and is on the whole a more valuable crop. The Spanish chestnut delights in a deep sandy loam and sheltered situation. In elevated or exposed places, it assumes a bushy habit of growth, which depreciates its value. This also occurs if it is planted in tenacious soils, or wet valleys subject to spring frosts. As a timber tree, it is highly ornamental, and many gigantic specimens may be seen in different parts of the county. It is surprising that this picturesque and fast-growing tree is so seldom grown for timber. I am aware that it is often objected to on account of the supposed brittleness of its timber, and its tendency to ringshake in the heart-wood. Its timber has also the undesirable reputation of decreasing in durability as the tree advances in age. This remarkable peculiarity is opposed to the natural order of things, and may be attributed to prejudice. I have seen many large Spanish chestnuts converted, and my experience does not support this theory. Although not so hard, and a little more brittle than oak, it is a valuable timber, and very durable if not exposed to weather. I admit its tendency to become "ring-shaken," and to assume a dwarf habit under unfavourable conditions; but the same thing occurs to oak timber if the soil, etc., are unsuitable. I can point to large oak plantations on light sandy soils, with a hard substratum, where every alternate tree is "ring-shaken;" but I cannot accept this as evidence of the inferiority of oak timber. Several clumps of Turkey oaks planted in similar soils are so severely split in longitudinal fibre that they are only fit for firewood; but it would be wrong to assume from this that Turkey oak is useless for every purpose except for fuel. On the same principle, Spanish chestnut, grown under adverse conditions, will produce inferior timber, whereas, if grown in favourable situations, the timber will be sound and durable. It is admirably adapted for the interior of buildings; and we have abundant proof that it was formerly esteemed for this purpose. I am informed that the whole of the timber used in Westminster Hall is Spanish chestnut; that the workmanship of the roof cannot be excelled for magnificence, strength, and beauty; and that its durability is established by the fact that it has stood seven centuries, and shows no symptoms of decay. Many old farm buildings in Hampshire attest the fact that this timber was once largely used; and in most cases the old woodwork is in good preservation. These circumstances justify me in claiming for this tree more attention than it has hitherto received.

Alder underwood, under favourable conditions, occasionally realises a clear annual rent of £3 per acre for the time the crop has occupied the land. I have sold such underwood at £28, 7s. 6d. per acre for nine years' growth. Willow of the same age, and under favourable conditions, realises £18 to £20 per acre. In marshy places which cannot be drained effectually, willows can be successfully cultivated, if water does not stagnate about the roots. Alder enjoys a wet, loamy soil; but to grow a full crop, superfluous water should percolate freely to open drains made at from 10 to 30 yards apart. Draining, either for timber or underwood, is very important, but is often carelessly performed, or entirely neglected. In timber plantations, the efficacy of draining is not readily apparent; practical men see the increased vigour and healthy luxuriance of the trees, but the financial results can only be ascertained after many years. With underwood, the benefits accruing from draining are conclusively demonstrated at the first sale; and this may account for underwood draining being often attended to on large estates where plantation draining is ignored. Another reason is, that the wet portions of estates are invariably converted into "gullies," which must be drained to produce a healthy crop. Throughout the county, underwood draining receives fair attention, but timber plantations are often sadly neglected. Even where drains exist, they are often allowed to become receptacles for leaves and rubbish, until all traces of them are obliterated, while underwood drains are generally cleared each time the wood is cut. This branch of forestry seems, on the whole, to be imperfectly understood. The drains are often too shallow, too far apart, and unprovided with a sufficient outlet. It is not unusual to see lateral drains terminate at a green ride in the middle of the wood. The accumulated water then overflows the ride, and finds its way into shallow drains on the opposite side. Such a state of things is discreditable in the management of many plantations.'

In upland districts, where sheep-farming prevails, the principal coppice woods are hazel, oak, and ash, which are cut periodically, and converted into wicker hurdles and sheep cages. These undergrowths are invariably grown in oak coppice plantations where the timber consists exclusively of stock shoots allowed to remain when the underwood was cut. Here a question arises in regard to growing more than one crop at a time on the same land. Those adverse to this system contend that the two crops cannot be profitably grown together, as underwood prevents the healthy development of timber trees, which react and damage the undergrowth. They argue thus :—"During the first period of growth, the trees, being young, do little injury to the tender shoots. Consequently, these grow luxuriantly, exclude the sun's rays, and retard the circulation of air amongst the branches. In the beginning of winter, the whole of this underwood is cut and cleared, and the trees that were unduly sheltered are exposed at the coldest season of the year to a sudden change of temperature. In consequence, the health and vigour of the trees are destroyed, they become what foresters term 'hide-bound,' cease to increase in height, acquire a low spreading habit of growth, and are comparatively worthless as timber trees. In a short time the horizontal spread of the branches is out of all proportion to the length of the stems, and the drip and shade occasioned thereby do more damage to the succeeding crops of underwood than the timber itself is worth. Thus the crops act and react on each other until ultimately they become so much deteriorated in value that the only effectual treatment is to trench and replant." Such arguments are generally accepted by the Scottish forester, whose predilections are against double cropping. He prefers single crops in all cases, whether the produce is oak coppice or timber plantations. Underwood, as a crop, he ignores, except for ornament, or as cover for game. So far as Scotland is concerned, he is right, but in the south of England the surrounding circumstances differ so widely that there is practically no analogy between the two countries. In Scotland, it is a common practice to burn brushwood, which in England would be converted into bavins, puffs, or fagots, and realise a handsome profit. Everything in our woods is turned to account, even the roots and smallest twigs are disposed of.

In agricultural districts, the rural population cannot always find employment during winter; and it is not unusual for labourers to solicit permission to grub tree stools to sell for fuel. The roots they arrange in cords of 4 feet high, 4 feet wide, and 8 feet long, and sell them readily at 9s. per cord. When trenching by piece-work, we sell the firewood ourselves, and consequently can calculate on a considerable profit from this source, instead of paying for burning.

When a Scottish forester is entrusted with the management of plantations in England, his first impulse is to eradicate the undergrowth, and cultivate the oak alone as a coppice wood. Acting on this impression, he may do irreparable damage to a remunerative crop. Great changes should only be made after mature deliberation as to the financial result. He must consider whether the increased growth of the timber trees, consequent on the removal of the underwood, will compensate for the deficit caused by the destruction of a crop periodically contributing to the income. Oak-trees trained in an underwood coppice are purposely left at wider intervals than if intended solely for coppice timber, and consequently less lucrative as an independent crop. If a change is desirable, the best time for effecting it is when the whole of the timber and underwood is cleared. When oak stools predominate, he will have no difficulty in selecting a sufficient number of healthy shoots to constitute an oak coppice. In Somerset and Devonshire this system is occasionally adopted, but with unsatisfactory results. The whole of the shoots are allowed to grow together for eight, ten, or twelve years, as the case may be. It is then sold standing; and two or three of the best stems on each stool are reserved for the permanent crop. Previous to the sale, the forester goes through the coppice, and marks with paint all the stems that are to remain. Owing to the closeness of the shoots, it is difficult to penetrate the underwood, so that the selection is laborious, and much time is occupied in the process. After the reserved stems are marked, the remainder are sold subject to such conditions as will protect the vendor from damage, and insure the fagots being removed within a reasonable time. All this is avoided by the proprietor's own workmen cutting and converting the wood, which may be exposed for sale in lots by the side of the nearest roads. When this system is adopted, the best stems are left as the work proceeds; and any pruning required is attended to at the same time. The stems have another thinning at the end of the second period. In favourable soils and sheltered situations, this cycle will be three or four years shorter than if these conditions are reversed. In some cases, three, and even four, successive thinnings at earlier periods are preferred, but as a rule two are considered sufficient. Formerly, the usual custom was to thin in spring, for the sake of the bark, but since the price has fallen it has become a question whether or not this should be continued. The profit from bark is very small, and the increased growth of brushwood resulting from winter-cutting more than compensates for the loss of its price. The final cutting takes place at from thirty to forty years; and it is considered satisfactory if the crop pay an annual rent of £1 or £1, 10s. per acre. If we contrast this with the Scottish system of growing oak coppice, we find the financial results much alike; and the system of double cropping detailed in my previous report* compares favourably with either of them. This sort of produce on Highclere is paying an annual rental of upwards of £2, 10s. per acre on land not worth more than 15s. per acre for agricultural purposes.

In districts remote from railway communication, where fuel is dear, the chief consideration is often the production of firewood. Coppice shoots of oak, hazel, birch, sweet chestnut, maple, sycamore, ash, and hornbeam, are grown for this purpose, and cut periodically at twelve or thirteen years old. The cultivation of this crop is almost identical with that described for sheep cages and wicker hurdles. The main difference is, that the oak-trees in wicker-hurdle coppices are severely thinned to encourage the growth of straight continuous stems; whereas for firewood it matters not how crooked the stems are, provided a large quantity

* See vol. vii., p. 165.

is obtained in addition to the timber crop. Formerly, firewood was produced extensively from old pollards, but it is now known that the most productive crops are grown from stools near the ground.

In the upland districts to which I now refer, large quantities of *firewood* are derived from hedge-rows. These vary from 5 to 20 yards wide, and divide most of the fields in North Hants. Scottish agriculturists, who are accustomed to neatly-trimmed hedges and well-cultivated fields, consider wide hedge-rows an excessive waste of land. They are peculiarly adapted as breeding-places for pheasants and partridges, and add materially to the stock of game in the proprietor's preserves. They form excellent covers for hares and rabbits; and where farmers are prohibited from killing these, wide hedge-rows are a continual source of annoyance. In exposed situations, they shelter live stock and the adjacent fields; and where the climate is excessively dry, they retain and transmit moisture to the atmosphere where it is most required. The proximity of South Hants to the English Channel insures an abundance of showers which renders retention of moisture undesirable, and these wide-spreading hedge-rows are gradually disappearing. In North Hants, on the contrary, agriculture often suffers from extreme and long-continued drought, and such hedge-rows are considered essential to successful farming. I, however, prefer neatly-trimmed hedges, and planting systematically done, whether for shelter or for the retention of moisture. The fences generally throughout the county are in an unsatisfactory state; they are merely long, straggling rows of underwood, sometimes planted with a ditch and bank, but often without any preparation of the surface soil. They receive no trimming nor weeding, and are only cut and splashed once in nine years. They are, as a rule, full of gaps, unsightly, unsubstantial, little calculated to resist the encroachments of cattle, and are receptacles for weeds and rubbish. Where wide hedge-rows are disappearing, we occasionally see a quick hedge properly treated, and yearly becoming more compact and durable, as if to testify that Hampshire fences are a mistake. The advantages claimed for hedge-rows are briefly these:—Shelter for live stock and the leeward crops; production of stakes and wattles required for temporary fences; affording a supply of bavins for rick bottoms; and benefiting agriculture generally by contributing to the humidity of an arid atmosphere. I may state a case which illustrates, in a remarkable manner, the power of trees to absorb and retain moisture. Siddon Hill, the natural termination of the Hampshire downs, is 1000 feet above the sea-level, and the highest point of the county. It consists entirely of chalk, through which water percolates freely. The hill is clothed with timber, and on the summit a water pond has been constructed by excavating the earth, and puddling the chalk. From this pond the principal supply of water is derived for the stock of a farm of 1000 acres. In seasons of severe drought, when all the ponds on the lower grounds are exhausted, the farmer has, in this pond, an apparently inexhaustible supply. Although in continual requisition, the "oldest inhabitant" cannot remember seeing it empty, and yet it is fed exclusively from the atmosphere and the leaves of the surrounding trees.* This favours the growth of trees in districts where agriculture suffers from long-continued aridity.

In fertile plains, where hops are cultivated, large tracts of land are planted with larch, Spanish chestnut, and ash, which are cut at four, six, or eight years old, according to the rate of growth and the size of poles required. This description of produce is confined almost exclusively to East Hants, and is grown on the green sand or gault formation. It is generally produced in large enclosures without timber; but when a plantation is converted into a hop-pole coppice, few trees are allowed to remain. No planting for hop-poles is admissible under the shade or drip of timber trees. The system of growing this crop has changed considerably. Formerly, the custom was to depend entirely upon larch, which was planted in the same ground for an indefinite number of crops. Sometimes they were planted at 2 feet apart, and allowed to grow undisturbed until the whole was large enough to cut. The poles were then arranged in lots according to size, and exposed for sale. At other times they were planted closer, and the small poles thinned out from time to time as the state of the growing crop required. Whatever system was adopted, the ground was always trenched when the crop was cleared, and replanted with larch. This system no longer prevails in the hop-growing districts of the south. In many large woods, where hop-poles are cultivated, larch planting is discontinued. Trenching after each crop was found expensive; and unless the larches for replanting were well rooted and specially attended to, one year's growth was lost when they were transplanted to the open ground.

* Though we believe there is a spring, the argument in favour of trees is correct.—Ed.

In order to avoid this expense and waste of time, ash and Spanish chestnut were substituted, and found to answer as well as larch. Both are excellent coppice woods, and send up numerous strong shoots the first season after the crop is cut. They grow rapidly, and when treated as underwood, produce a crop of clean, straight poles, which command a good price and ready sale amongst hop-growers. Various ways of forming coppices of hop-poles are adopted in the south, but many of them I cannot recommend. The alternate system of planting ash and Spanish chestnut is objectionable; and when these sorts are mixed indiscriminately with larch, the succeeding shoots of the coppice stools are irregularly distributed over the ground. This necessitates a large amount of filling up (especially where larch predominates), after the first fall of poles. Another system I condemn is that of planting ash and Spanish chestnut in masses, at distances of only 2½ feet. This distance apart is perfectly legitimate for the first crop; but when that is cut, and each stool sends forth a number of shoots, the coppice becomes overcrowded. The following system is now adopted on many estates in Hants:—Ash or Spanish chestnut is planted at regular distances apart, and in sections, according to the nature of the soil. The whole ground is afterwards filled up with larch 2 or 2½ feet from plant to plant. If the soil and situation are best adapted for ash, the forester will plant these first in rows at a distance suitable for the particular size of poles required. He will afterwards alternate the ash with larch in the rows, and plant an intermediate row of larch between the rows of ash, at half the distance of those previously planted. If the ash is planted at 5 feet apart, and the same distance between the rows, 1440 plants will stand on an acre; and when the whole is finished as above described, there will be 5530 larches on every acre planted. This is a material increase of poles when the first crop is cleared; and as the larches do not shoot again, the permanent stools are at proper distances for coppice.

Before leaving this subject, I ought to state that various sorts of plantation produce are sold for hop-poles without being grown specially for that purpose. The first thinnings of larch, the nurses from oak or mixed hardwood plantations, and straight poles of every description, command good prices in hop districts. Small thinnings of Scotch and spruce firs are sometimes sold, but these never bring large prices.

Osiers, or basket willows, are cultivated extensively in South

Hants, and, under favourable conditions, are highly remunerative. On alluvial banks, or in marshy places that admit of draining, the ground is prepared in narrow flats, or "lazy beds," and planted with osiers. Growing basket rods is so simple, and requires so little skill on the part of the cultivator, that few remarks are necessary. Before planting the willows the ground should be thoroughly trenched to a depth of 2 feet, and drained with open ditches sufficiently deep to prevent water stagnating within reach of the roots. The ground should be carefully cleaned in trenching, and frequently hoed in the growing season. The crop is annually cut and tied into bundles according to the length of the shoots. In deep, moist, loamy soils, free from weeds and stagnant water, £10 per acre of net profit is occasionally realised.

The *timber plantations* of Hampshire may be divided into ornamental plantations and those grown for profit. In this paper I make no allusion to *arboreta* or decorative planting, but refer to the special characteristics of certain trees, and their general effect in landscape scenery.

The principal difference between ornamental planting and planting exclusively for profit is, that in the former the crop is subservient to general effects, in the latter the only consideration is the adaptation of the crop to surrounding circumstances. For instance, on the Hampshire hills, where great variety is desired, many trees suffer from being placed in positions unfavourable to their healthy development. On these chalk hills it is difficult, and sometimes impossible, to combine ornament with profit. No variety is pleasing if it is produced by sickly, stunted, unprofitable trees, whose dwarf, hide-bound stems testify to the struggle for existence. A more limited selection is preferable, if thereby a more vigorous and healthy crop can be secured. These remarks do not apply to old decaying trees, with shattered arms, drooping boughs, dead branches, stag-horned heads, or hollow trunks, features which are exceedingly picturesque. The blasted fir with shattered trunk records the history of some violent storm; the scathed and leafless oak, with dismantled head, proclaims the power of lightning's blast, and are both sublime appendages to a landscape scene. But those mutilated trunks, those remnants of decaying grandeur, those rugged monarchs of the forest, are ornaments in forest composition entirely distinct from anything that can be produced by planting trees in ungenial soils.

Planting on Chalk.—The two deciduous trees that succeed best, the beech and lime, are so like in general outline, as scarcely to be distinguishable in perspective. When planted together, either alternately or in masses, their characters are blended. As single specimens, the characteristics of each become fully developed, and the contrast is more distinct. The lime-tree is tall and graceful, with drooping spray hanging loosely and pleasingly. This is particularly the case in July and August, when its masses of beautiful white fragrant flowers, dependent from the leaves, help to distinguish it from the characteristic pointedness of the beech. This tree, on the contrary, forms a large, round, umbrageous head, with intertwining branches and formal outline. It is, however, a useful tree which we ought not to repudiate on account of its heavy luxuriance, in certain positions a desirable accompaniment. Neither ought we to ignore its autumnal hues of brown and orange, which are always beautiful. Both trees grow rapidly on chalk, and produce timber of larger dimensions in a given time than any other tree under similar circumstances.

Of evergreen or dark-foliaged trees, the common yew and the cedar of Lebanon rank first in regard to adaptability. Here again there is a similarity of outline and colour when seen in perspective. The cedar of Lebanon is indeed a characteristic tree where it has sufficient space to develop itself, but when confined in plantations, or planted in masses, it is easily mistaken for the common yew, especially in the earlier stages of its growth, when its massive boughs and umbrageous head are still undeveloped. Single specimens in parks or open vistas, with their noble, wide-spreading, and majestic outline, cannot be mistaken for any other tree. The various conifers requiring an elevated situation will not grow so rapidly as when planted in soils free from chalk or lime. *Picea cephalonica* and *P. pinsapo* make excellent specimens if protected from blasting winds. The latter is best adapted for lawns or pleasure grounds, where its symmetry is displayed to advantage. *Abies Orientalis* and *A. morinda* may be successfully grown if the soil is cool, and the chalk not near the surface. In warm and dry situations they are apt to become infested by red spider, and *A. morinda* will start into growth before the spring frosts are over. *Pinus Austriaca, insignis, cembra, hispanica,* and *monticola* may be planted in more exposed places without risk of failure. Several of these grow slowly when young, but make great progress when established. The Scotch fir in similar positions is remarkable for its slow growth, but it may be relied on for continuing in health until it arrives at timber size. The silver fir is not admissible, and the spruce, though frequently planted, is difficult to manage, and seldom produces handsome specimens or sound timber. Oak and larch are often planted, and where the chalk is not too near the surface they make considerable progress at first, but never develop into large majestic trees. Ash and sycamore assume a bushy, sickly habit of growth at an early stage, and seldom grow to useful timber. Spanish chestnuts, Turkey oaks, Oriental and Occidental planes are occasionally planted, but I have not seen any healthy specimen in soils superincumbent on chalk. Norway maples, horse-chestnuts, tulip trees, and evergreen oaks, grow tolerably, but require good soil and protection from blasting winds.

From these varieties which succeed on the chalk formation, we may select sufficient to produce pleasing effects, and secure, by careful adaptation, a healthy and profitable crop of timber. Yet how seldom do we find these combined? How often do we see those species planted which must inevitably result in failure. For certain positions a well-defined mass of dark-foliaged and spiral trees is required. In such a case the common silver and spruce firs are selected, and of all the trees enumerated, these are the least likely to succeed. The same effects might be obtained by planting *Abies Orientalis*, *A. morinda*, or *Picea cephalonica*, and the results, as regards the health of the trees, would be more satisfactory. For exposed situations the Scotch fir is generally preferred, yet *Pinus Austriaca* grows quicker, is better adapted for contrast, and superior for resisting prevailing winds. Where dark-foliaged or sombre trees are required, the common yew and cedar of Lebanon scarcely receive a passing thought; yet these are not only admirably adapted for ornament, but develop on the Hampshire hills into magnificent trees which can seldom be surpassed. These hints indicate how desirable it is to select with care trees for the chalk formation, and how seldom adaptation is considered in ornamental planting.*

Hedge-row timber throughout Hampshire consists principally of oak and English elm. Collectively the hedge-rows are beautiful and effective, but individually they are deformities. In almost every case the trees are lopped and trimmed in a barbarous fashion, and their health and vigour thereby destroyed. Unfortunately this reprehensible practice is not confined to Hampshire, but prevails

* Planting on chalk soils is well treated by Mr Salter in *Gard. Chron.*, 1875, pp. 391, 582, 743.

throughout Britain. It is strange that a practice which destroys every characteristic of our noblest trees, and prevents their healthy development, should be so generally adopted. I am aware that hedge-row trees are detested by farmers. In arable fields their ramifying roots cause inconvenience, and occasionally break agricultural implements. Their spreading heads injure valuable crops, and destroy live fences where these exist. Consequently the farmer's aversion to trees in arable fields is natural, and when they cannot be removed a severe lopping is always appreciated. He knows the more limbs that are severed from the parent stem the less damage his crops will suffer, and he cares not whether the trees are injured or benefited. Lopping, however severe, does not remove the evil complained of, and where this cannot be done without removing the offending trees, it is better to fell them at once, as thereby the crops have the full benefit of light and air, and the trees are converted into money instead of cumbering the ground without increasing in size or value. From Weyhill to Salisbury Plain numerous shaws (belts or strips in Scotland) are planted on the rising grounds, and give the county a clothed appearance. The same system prevails on all the prominent positions between Whitchurch and Winchester. These shaws consist almost exclusively of spruce, Scotch and silver firs, and the contrast with hedge-rows of deciduous trees is pleasing and effective. They vary in width from twenty to over one hundred yards, and have been planted for the double purpose of ornament and shelter. In the majority of cases the wrong trees have been selected in the first instance, and these have been rendered defective for shelter by overcrowding. No error in cultivating shaws is so prevalent as neglecting to thin. The more limited they are in width, the more reluctant the owner is to cut, and the sooner the ruin resulting from overcrowding is completed. Few trees suffer more from straightened quarters than the spruce and silver firs, and as these are extensively planted in shaws, the mischief is the more apparent. Shaws of a superior description may be produced by planting *Pinus Austriaca, P. sylvestris* (Scotch fir), *Abies morinda,* and *Picea cephalonica,* in widths of not less than sixty or eighty yards. All the trees should be induced to feather well to the ground, and care taken to keep the trees intact, by preventing the lateral branches from injuring each other. Every lateral branch that is destroyed detracts from the beauty and symmetry of the trees individually, and renders them less effective for shelter.

It is therefore important that thinning receive early attention, and that overcrowding be avoided.

From Christchurch to Southampton, *Pinus insignis* occupies many prominent positions near the sea. Here again I cannot concur with this selection for shaws or shelter belts on the coast. The name *P. insignis,* or remarkable pine, is appropriately applied to this tree when planted in sandy soils and exposed to the pernicious influences of the sea-breeze. The ragged head, dwarf habit, and distorted ramification, make it a remarkable curiosity. It is difficult to conceive that these trees will ever increase in size or beauty. I am aware that *P. insignis* is often recommended for planting near the coast. Indeed, many contend that no other tree is so valuable for forming screens from prevailing winds. *Pinus maritima* grows more vigorously, continues longer in health, and is superior both for ornament and shelter. Then the evergreen oak (*Quercus Ilex*) is a slow-growing tree, but exceedingly beautiful, and well adapted for shelter. It is invariably well clothed with lateral branches, continues to grow for a great number of years, luxuriates in the sea-breeze, and where it has been planted, forms ornamental screens which cannot easily be surpassed. I might also mention *Pinus pinaster, P. Austriaca, P. laricio,* the common yew and holly, and various sorts of shrubs.

Plantations of larch, Scotch and spruce firs, are common throughout Hampshire. Much damage is occasioned in enclosures of this description by neglect of thinning. I attribute the reluctance to operate on large plantations to the small profits from thinnings. Hampshire is inadequately intersected by railways, and has no direct communication with large mining districts, consequently the demand for pit props is limited; and when the expense of haulage is heavy, most of the profit is absorbed in transporting the props to the collieries. On many estates, however, the thinnings are now sold to railway contractors for sleepers and fencing. Scotch and spruce firs steeped in solution of corrosive sublimate are found durable for these purposes. Still the prices received are far from satisfactory, and the usual custom is to thin sparingly at first, and reserve as many trees as possible for timber size. To reserve the largest number of trees compatible with healthy development, requires great discretion, both while the plantations are young, and after they are convertible into material for estate purposes. At the first thinning the forester merely removes the worst trees, and any that show symptoms of disease. At each successive thinning he leaves as many trees as possible, but is careful that the best specimens are not injured by those of an inferior description. If the plantation consists principally of silver or spruce firs, more space is required at each stage of growth than for Scotch fir of the same age. When the trees have arrived at timber size, and can be used for estate purposes, they command a ready sale at from 9d. to 1s. per cubic foot. Then it is, that plantations previously well managed are often irretrievably ruined. Up to this stage the thinnings were of little value, and now that the trees can be sold at remunerative prices, the temptation to have a large sale is sometimes irresistible. Even when the trees have not been unduly confined, the most disastrous results often follow an injudicious thinning. Good management suggests the propriety of giving the trees space for full development, but cautiously and gradually, so as to avoid checking their growth, or having valuable trees uprooted by storms of wind. When a plantation of this description is judiciously managed it will clear an annual rent of from £2 to £3 per acre for the time the crop has occupied the land.

In many parts of Hampshire, larch is planted as a nurse for oak and mixed hardwood plantations. It is admirably adapted for this purpose, both on account of its light and airy nature, and the value of the thinnings at all ages. No other tree requires so little attention, or does so little damage to the permanent crop, and no thinnings except ash exceed them in value. Ash, however, is inadmissible as a nurse for hardwoods, but is occasionally interspersed in plantations of oak and larch. I have seen an oak plantation with ash nurses, but the ash soon overtopped the oaks, and in stormy weather lashed them severely. The demand for larch poles and larch timber of all dimensions is good, and the crop in favourable soils highly remunerative. In the northern parts of the county, however, larch is uncertain, unless where the chalk is a considerable distance from the surface. Throughout the county larch is sparingly cultivated, and even in suitable localities it is seldom planted for timber. This, I believe, is greatly owing to the increasing demand for all sorts of underwood. Timber plantations are invariably at a discount in districts where coppice shoots realise a net annual profit of £2 per acre. Still, in the majority of cases, the returns from a larch plantation will more than double those from our best alder gullies. Why, then, it may be asked, are alder gullies preferred? One reason is that the planter can look forward to reaping the fruits of his labour, whereas in the other case posterity derives the greatest benefit. To illustrate this point, I append a statement of the approximate income at fixed periods from each source. This is based on actual profits, after deducting the cost of management :—

Acre of Alder Gully.							Acre of Larch Plantation.			
At 11 years old,	1st cutting,		£18	0	0		1st thinning, .	*Nil.*		
,, 20 ,,	2d	,,	23	0	0		2d and 3d ,, .	£15	0	0
,, 29 ,,	3d	,,	23	0	0		4th and 5th ,, .	25	0	0
,, 38 ,,	4th	,,	21	0	0		6th and 7th ,, .	50	0	0
,, 47 ,,	5th	,,	20	0	0		8th and 9th ,, .	75	0	0
,, 56 ,,	6th	,,	18	0	0		10th ,, .	85	0	0
,, 65 ,,	7th	,,	17	0	0		Final cutting, .	170	0	0
			£140	0	0			£420	0	0

By these figures it will be seen that the profits from underwood during the early periods of growth are much in excess of larch plantations. Thirty-eight years after planting, the returns are nearly equal, but from that date the larch profits are far in excess of those accruing from alder gullies. Perhaps a more equitable comparison might have been made with hop-wood, hurdle-rods, or hop-poles, all of which are grown in soil suitable for larch. None, however, except hop-poles, give so large or so quick a return as alder gullies. Hop-poles under careful supervision would be a little in excess, but no coppice wood can compare with larch plantations, which yield larger returns in a given time than any other crop.

In Berks and Oxon innumerable willow pollards adorn the banks of the Thames. The principal produce of these pollards is firewood, and the returns are often meagre and unsatisfactory. In Hampshire they are not so numerous, but frequently occur in the water meadows, and by the sides of rippling brooks and streams. What an improvement it would be to introduce the black poplar in these positions—a valuable tree almost unknown in the south, but superior to willow pollards, both in remuneration and scenic effect. In its young state it is not so valuable as the larch, but this is more than compensated by its rapid growth. Black poplar matures timber of large dimensions sooner than any other tree. In forty years from planting the final cutting may take place, so that the planter may often realise the profits in his lifetime. The following statement shows the approximate *profits*, exclusive of expenses, of an acre of black poplar, at fixed periods of five years :—

STATEMENT SHOWING THE *Proceeds* OF AN ACRE OF BLACK POPLAR IN FORTY YEARS.

At 10	years old,	1st thinning,	. . .	*Nil.*		
,, 15	,,	2d ,,	. . .	*Nil.*		
,, 20	,,	3d ,,	. . .	£5	0	0
,, 25	,,	4th ,,	. . .	10	0	0
,, 30	,,	5th ,,	. . .	25	0	0
,, 35	,,	6th ,,	. . .	60	0	0
,, 40	,,	final cutting,	. . .	170	0	0
				£270	0	0

From this it appears that an acre of black poplar may realise a clear profit of £270 in forty years, or an annual rental of £6, 15s. for the time the crop has occupied the land. This will appear large to those who cut from time to time without keeping a record of their transactions. They will be astonished to see such profits from a crop of which the first and second thinnings are quoted as "nil." But the black poplar, comparatively worthless when young, is one of our most profitable timber trees, well adapted for planting on tracts of wet, cool soil, of little value for agriculture.

The Lombardy poplar is better known, and frequently planted adjacent to farmhouses and villa residences, for ornamental purposes. The timber is of little value, but is of rapid growth, and the tall conical heads, towering like church spires, are excellent landmarks, and break the monotony of level masses of trees. Their extreme height renders them more susceptible of motion than other trees, and the least blast makes them wave from top to bottom. They form a natural and beautiful accompaniment to buildings, and small clumps are more effective than single specimens. These and the aspen poplar are the only two varieties well known in the south. The tremulous motion of the leaves of the aspen is curious, and has occasionally given rise to superstitious notions. The long, grey, horizontal branches are not devoid of beauty, but as an ornamental tree it will never take a prominent position. Its wide-spreading roots ramify beneath the surface, and produce numerous suckers which render it unsuitable for lawns or pleasure grounds. When the trees attain a large size, they are invariably hollow in the centre; but even when the timber is sound, it is short-grained and of little value. It is curious that the two poplars best known and most cultivated in the south, are those of least value for timber. The Abele tree, or great white poplar, produces timber superior to either of the preceding, grows rapidly, and is more ornamental, but like the black poplar it is practically unknown in Hants. It makes a tall and graceful specimen, with smooth, silvery bark, spreading head, and beautiful white woolly leaves. Its silvery appearance, especially when agitated by the wind, contrasts well with trees of a glossy green or sombre hue. It would prove a great acquisition to English parks and pleasure grounds, and yet it rarely occurs in our most picturesque landscape scenes. It delights in a moist loam and sheltered situation, but does not succeed if exposed to prevailing winds. The timber is of good quality, makes excellent flooring, and, in common with all varieties of poplars, has the commendable advantage of being peculiarly uninflammable.

In treating of mixed hardwood plantations, I give precedence to the oak, because it is more extensively cultivated than any other tree. The oak is indeed the "monarch of the forest," and stands unrivalled for majestic grandeur and picturesque effect. Its principal characteristics are the great firmness, power, and strength with which it takes a secure hold of the ground, stoutness of limbs, twisting of branches, short elbows, abrupt twigs, horizontal arms, expansive head, and bold irregularly swelling outline. Other remarkable characteristics might be mentioned, such as extreme longevity, extraordinary dimensions, hardness, and durability (what Shakespeare terms the unwedgeable and gnarled oak). It has been termed the bulwark of Old England, the keystone of her "wooden walls," and the mainstay of her navy. The bark also is extolled as a useful article of commerce, and an unfailing source of profit. In regard, however, to the "wooden walls" alluded to, and the large profits from bark, these are things of the past. Iron ships are rapidly superseding those wooden walls, and there is no longer the great demand for oak timber of large dimensions. Those knees and elbows that foresters were once so careful to preserve intact, have not the fictitious value which once prevailed. The time has passed for reserving low, crooked, staghorned oaks for Government contractors, and stripping Spanish chestnut of large dimensions to send to the dockyards instead of oak, is also obsolete. Oak bark, which formerly sold readily for £12 or £13 per ton, is now difficult to dispose of at one-third the amount; still the oak continues a favourite tree, and is cultivated extensively not only as coppice timber, but in forming new plantations from acorns or transplanted trees. It is very accommodating in regard to soil and situation, but luxuriates in a deep heavy loam resting on a substratum, through which water percolates freely. When the roots meet with obstructions in passing through the strata, the stem and large limbs pursue a similar deviating course, which produces those knees and elbows once so valuable, and still so picturesque. This character is most distinctly seen when the oak is planted in a heavy soil superincumbent on chalk. While the roots remain in the surface soil, the tree grows rapidly and erect; but as the roots approach the chalk the vigour decreases, and it acquires a bushy habit of growth. This peculiarity is strongly marked in several enclosures of the New Forest; not from the roots coming in contact with chalk, but from being planted in poor, gravelly soils, equally unsuited to their healthy development. The New Forest, on the whole, is well adapted for oak, but there are extensive tracts of light, gravelly moorland, which can never produce oak of large size. To plant such tracts with oak-trees and Scotch fir would be injudicious. All soils capable of producing a healthy crop of oaks will grow larch firs, the best nurses for hardwoods. They occupy less space than Scotch firs, are more valuable at all ages, do not overtop the permanent trees so soon, require less attention to prevent damage to the main crop, promote a better circulation of air, and are decidedly the most appropriate nurse trees. When Scotch fir and oaks are planted together, one or other of the crops is out of place. If the land is not good enough to grow larch of useful size, oaks are certainly not admissible; and if it is capable of producing healthy oaks, Scotch firs should be discarded for a better nurse, and more profitable tree. When oaks are planted in poor moorland soil, a large proportion never start into growth, and those that become established take such devious paths in search of food, that they soon exhibit the same peculiarity as those planted on the chalk formation of North Hants. Such a case, however, would not be a fair example of the capabilities of the New Forest to produce navy timber. In former times, some of the finest oak timber sent to our Government dockyards was supplied from it, and it still boasts of many magnificent trees, containing three to four loads of timber each. The New Forest is in the southern division of the county, and its geological formation is London clay, or plastic clay sand and marl. An imaginary line, from Liphook in the east to Winchester and Salisbury in the west, divides the county into two large divisions. Geologically, these consist of chalk and chalk marl in the north, and London clay and plastic clay sands in the south. These London clays are cold and retentive; but if not too wet, and the superincumbent soil of an adhesive nature, they produce magnificent oaks and excellent timber. Light, sandy, or gravelly soils on substratums of cold plastic clays have a tendency to grow oaks short of stem, with large bushy heads. This is caused by the roots ramifying rapidly in the light, warm surface soil, and producing masses of fibrous rootlets incapable of penetrating the impervious subsoil. If, on the contrary, the superincumbent soil is adhesive, the roots acquire a tapering and pointed form, with strong penetrating rootlets, which overcome almost any resistance. This propensity to produce fibrous rootlets in warm soils, and to become "carrotty rooted" in heavy soils, is common to all trees, but is more marked in some species. Every forester has probably observed that shallow roots produce short stems, and that twisted grotesque heads indicate the same general formation of roots. This explains why the oaks planted in the New Forest gravels are never likely to make noble specimens, or produce valuable timber.

Hardwood Plantations are advantageously treated as a whole, as it seems undesirable to classify the several varieties. The term mixed hardwoods is indefinite, and may include few or many sorts, planted alternately, massed according to the number of varieties, or indiscriminately mixed. The sorts generally planted in the south are oak, ash, birch, beech, and lime-tree. The English elm (*Ulmus campestris*) is grown extensively in hedge-rows but seldom in enclosures, and the Spanish chestnut, sycamore, and plane trees, are rarely planted except for ornament. The varieties enumerated are placed according to the frequency in which they occur in our woods. The ash frequently occurs in mixed hardwood plantations and is a useful and profitable acquisition. In them it is difficult to define its value as a crop, but when planted in masses it affords more certain data. In deep loamy soils and sheltered situations the ash is a profitable tree. It is a rapid grower, can be closer confined than most hardwoods, and is valuable at all ages. In the south 3500 trees may be planted to an acre, and as the smallest thinnings can be disposed of at remunerative prices, we may calculate on selling 2700 at a profit. This, however, can only be expected in favourable situations, and where hares and rabbits do not prevail. It is disputed among practical foresters whether the ash or the larch is the most profitable crop in a given number of years. Some uphold the ash, others the larch, and others maintain that a combination of the two gives the best results. Much depends on the nature and condition of the soil. Cool, moist, loamy soil, in which ash luxuriates, is not suited for a healthy crop of larch, and *vice versâ*. If the crops in each case are equally adapted to the surrounding circumstance, then the *locality* in which they are grown will exert a controlling influence on the final results. A larch crop under favourable conditions is undoubtedly the most profitable in Scotland, yet in the south of England the case is occasionally reversed. Larch commands a ready sale in this county, but prices are not so well sustained where the local demand is limited, as where there is easy access to collieries. If large consumers are distant from the plantations, the expense of transit limits competition, and depreciates the value of the timber. Consequently larch, though easily disposed of, does not command such prices as in the mining districts of the north. Again, ash thinnings are put to more varied uses in England than in Scotland. The suitability of ash to various industries causes a continually increasing demand at advancing prices. During the past five years the price has advanced 5d. per cubic foot, and the value of small thinnings in a proportionate ratio. In the same period the price of larch has only advanced 2d. per foot, and small poles have not altered in value. Thus we must consider the locality in which the crop is to be grown when deciding these respective crops. The following statement shows the approximate value of an acre of ash in Hampshire in seventy years. We suppose the trees are planted at $3\frac{1}{2}$ feet apart, and allowing for 800 casualties, we have 2700 for thinnings.

ACRE OF ASH PLANTATION.

At 6 years thin out 700 trees at 5s. per 100, .	£1 15 0	
Deduct expenses of thinning, etc., . .	1 0 0	
		£0 15 0
At 10 years thin out 600 trees at 10s. per 100, .	3 0 0	
Deduct expenses, etc., . . .	1 10 0	
		1 10 0
At 14 years thin out 400 trees at 25s. per 100, .	6 0 0	
Deduct expenses, etc., . . .	2 0 0	
		4 0 0
At 18 years thin out 250 trees at 6d. each, . .	6 5 0	
Deduct expenses, etc., . . .	2 0 0	
		4 5 0
At 22 years thin out 150 trees at 1s. each, . .	7 10 0	
Deduct expenses, etc., . . .	2 10 0	
		5 0 0
At 26 years thin out 120 trees at 1s. 8d. each, .	10 0 0	
Deduct expenses, etc., . . .	3 0 0	
		7 0 0
At 30 years thin out 100 trees at 3s. 6d. each, .	17 10 0	
Deduct expenses, etc., . . .	3 10 0	
		14 0 0
At 35 years thin out 80 trees at 5s. each, . .	20 0 0	
Deduct expenses, etc., . . .	4 0 0	
		16 0 0
At 40 years thin out 60 trees at 10s. each, . .	30 0 0	
Deduct expenses, etc., . . .	5 0 0	
		25 0 0
At 45 years thin out 60 trees at 25s. each, . .	75 0 0	
Deduct expenses, etc., . . .	7 0 0	
		68 0 0
At 50 years thin out 50 trees at 30s. each, . .	75 0 0	
Deduct expenses, etc., . . .	7 0 0	
		68 0 0
At 55 years thin out 40 trees at 40s. each, . .	80 0 0	
Deduct expenses, etc., . . .	8 0 0	
		72 0 0
At 60 years thin out 40 trees at 50s. each, . .	100 0 0	
Deduct expenses, etc., . . .	9 10 0	
		90 10 0
At 70 years, final cutting, 50 trees at 60s. each, .	150 0 0	
Deduct expenses, etc., . . .	12 0 0	
		138 0 0
		514 0 0
Expenses of sales and original planting, . .	26 0 0	
Trenching and making good the ground, . .	8 0 0	
		34 0 0
Net proceeds of an acre of ash in seventy years, . .		£480 0 0

We have thus a clear profit of £480 for seventy years, or an annual rent of £6, 17s. per acre. This seems large, and yet I believe that under favourable conditions the actual receipts will exceed the preceding quotations. I avoid retaining an excessive number of trees towards the end of the periodical thinnings. I have also valued the trees under, rather than over, their value. For instance, at sixty years old forty trees are cut, which are entered at 50s. each, certainly not an extravagant value. If ash trees are planted in deep loam and sheltered situations, no one will consider 30 feet an unusual growth for sixty years. The selling price of growing ash is 2s. per foot, so that trees containing 30 feet of timber should be valued at 60s. each, clear of expenses. It will further be observed that I only cut ninety trees after they are fifty-five years old, whereas it is not unusual to retain that number after the last thinning.

Birch is a valuable underwood, but unprofitable as a timber tree. It rarely acquires large dimensions, and its timber is of little value. It prefers a dry, warm position, but succeeds tolerably well in cool moist soils, provided water does not stagnate at the roots. It grows rapidly when young, but its rate of growth decreases as the tree increases in size. It is a graceful tree, with long, slender, drooping spray. After rain, the leaves emit a delicious odour, which makes birches desirable specimens for lawns and pleasure grounds. In mixed hardwood plantations, their silvery bark, glittering among the stems of other trees, is peculiarly picturesque. They seldom occupy prominent places in mixed hardwood plantations, but frequently occur in Scotch fir enclosures on gravelly moors. They are accommodating in regard to soils, and often spring up spontaneously on moorland covered with heath and furze. In such soils they are sometimes considered more remunerative than Scotch firs, but in my opinion this is a fallacy. The early returns are superior; but at the end of sixty years, a Scotch fir plantation judiciously managed will realise 30 per cent. more than birch. The thinnings are valuable, because the whole of the spray is made into brooms, and the stems are utilised for brush or rake ware; whereas the Scotch fir thinnings are only fit for firewood or inferior fencing rails. The usual practice in birch plantations is to plant the trees 3½ feet apart, and to allow the whole to grow undisturbed for nine years. It is then sold standing; but previous to sale, about 500 trees per acre are marked and reserved for a permanent crop. The stems shoot again, and are recut after another period of nine years, and the trees are thinned as much as required at the same time. This is repeated from time to time until all the trees are cleared, and succeeded by stockshoots, which have been reserved in the same way as the previous crop.

Another system is to treat the whole as a plantation from the beginning, when the trees are thinned early and frequently, and the undergrowth is a secondary consideration. All the cut stems where the trees have been thinned are allowed to shoot, and the spray is invariably converted into brooms previous to each periodical thinning. Of the two systems I prefer the first, but both are open to objection, and not so profitable for gravelly, moorland soils, as a crop of Scotch firs. To mix birch with Scotch fir I consider to be a mistake.

Having referred to the beech and lime trees, little more requires to be said. Both occupy prominent positions in our parks and pleasure grounds, but not in our mixed plantations. Some sixty or eighty years ago, beech was extensively planted in North Hants for ornament, and probably also for profit. At that time large beech timber was valuable, but its value has depreciated, and is held in little repute. The beech is now only planted in exceptional cases, causing a scarcity in the country; and as the demand exceeds the supply, prices are again rapidly advancing. Within six years the price of beech has advanced from 10d. to 1s. 6d. per cubic foot; but in its young state it is still difficult to dispose of. At present rates, I consider it the most profitable tree for the chalk formations, in situations too exposed for the lime-tree. The reaction in regard to planting beech has not yet begun, but in a few years we may see it more extensively planted in North Hants than hitherto.

In sheltered positions, the lime-tree excels the beech for rapidity of growth, is more valuable when young, and when mature, sells readily for 2s. 3d. per cubic foot. Even the limbs and large branches are valuable; and if over six inches in diameter, can be disposed of at prices varying from 1s. 3d. to 1s. 9d. per cubic foot. It is not adapted for elevated positions; and if exposed to prevailing winds, assumes a stunted and unhealthy appearance. For avenues, and planting by the sides of roads, it is a general favourite. When planted in double rows, as is frequently done, it forms a spacious canopy, whose shade is an agreeable resort in the sultry summer months. In July and August it is pleasant and refreshing to walk under its umbrageous head, listening to the busy hum of myriads of bees, and enjoying the sweet perfume of its fragrant flowers. Like the beech, it has hitherto been cultivated principally in parks and pleasure grounds, but it is increasing in favour, and is now occasionally introduced in mixed hardwood plantations. It stands pre-eminent for profitable planting on soils superincumbent on chalk, and is worthy of more attention than it has hitherto received.

Future Prospects.

The intelligent forester will have gathered from the preceding remarks that the future prospects of the woods and plantations of Hampshire are, on the whole, unsatisfactory, particularly in districts where underwood is in good demand at remunerative prices. The area of underwood and coppice is steadily increasing, while that of timber plantations is gradually diminishing. Larch, Scotch and spruce fir enclosures, as they become matured, are generally succeeded by underwood, for which there is a demand in the neighbourhood. Occasionally a few mature trees are left to retain the wooded appearance of the district, but these are a poor substitute for a healthy crop of timber. Scotch and spruce firs are seldom planted in new enclosures, even where the soil is incapable of growing any other crop. Larch is more frequently planted, but the new plantations on private properties are not nearly equal to the areas annually cleared or converted into other crops. This deficiency, however, is more than compensated by the large enclosures periodically planted in the Government forests. Several of these are in Hampshire, the principal one being the New Forest, where there are large tracts of unproductive land, over which freeholders and proprietors of adjoining estates have certain rights. Freeholders' rights, however, do not preclude the Crown from planting any portion of these wastes so soon as the trees on an equal portion of the enclosed forest are out of danger from cattle, and thrown open in exchange. Thus large tracts are enclosed and planted from time to time. These are probably more than equivalent to the decrease of larch plantations on private properties. On soils suitable for larch, underwood is generally cultivated, and on soils only adapted for Scotch fir, larch is occasionally planted. This, I believe, is caused by the greater demand for larch poles than Scotch firs of the same age. The difference in value tempts people to plant larch in poor gravelly soils, and the result is a diseased and unprofitable crop. The prospects of arboriculture in Hants would be improved if larch was more planted in soils at present occupied with coppice; if Scotch fir was not so completely ignored where large tracts of land exist, incapable of growing any other crop; and if the various hardy coniferæ received a fair share of attention.

The cultivation of underwood has a more deteriorating influence on oak coppices than on any other sort of trees, as will be apparent from the following facts. The general practice is to reserve a number of stockshoots for permanent trees. These are afterwards severely thinned to encourage the growth of underwood, often the main consideration. Under any circumstances, they tend to produce short stems, with wide-spreading bushy heads, which damage the undergrowth. When severely thinned, this peculiarity is more marked, and the trees soon acquire a sickly and stunted appearance. The fewer trees left, the more money will each successive fall of underwood realise. By thinning severely, therefore, we increase the value of future crops of underwood, and augment the profits by the sale of the timber trees. This system gives excellent results so long as the timber trees last; but when these are cleared without a succession, the prospective value of the crop is seriously diminished. To prevent deterioration, a subsequent crop of trees must be planted to succeed the stockshoots which are removed. It is also requisite that the blanks occurring by the decay of old stools should be regularly filled up with young trees. Where planting is systematically neglected, the underwood rapidly deteriorates until it may be decided to trench the ground for agricultural purposes. One case may be cited near Andover, where an enclosure of over 1000 acres is at present being converted into an arable farm. The enclosure consisted chiefly of hazel underwood and oak timber. Both crops had been rendered permanently defective by neglecting to plant, and injudiciously clearing the oak timber. Such cases are the result of mismanagement. With careful attention and adequate planting, the prospects of our coppice woods might be much improved. On many well-regulated estates, where present profits are not the chief consideration, coppice woods are not only remunerative, but are increasing in value.

The prospects of plantations cultivated exclusively for timber are more encouraging. They are, on the whole, healthy and vigorous, and promise larger profits than can be derived from any other source, whether the plantation consists of Scotch firs, spruce, larch, oak, ash, lime-tree, or mixed hardwoods. If planted for timber, and judiciously managed, the result will be more satisfactory than striving to accomplish two things at once. When these are planted in favourable soils, and are afterwards thinned and regulated as they require, there can be little doubt as to the future results. The only cases where failure may be anticipated are when by due care the crop has not been adapted to surrounding circumstances. This occasionally occurs in mixed plantations, but more frequently where only one sort of tree is planted. The reason is obvious. Where various trees are intermixed, those that are misplaced can be removed in the usual course of thinning. If the forester has discretion to remove the worst and all unhealthy trees, those best suited to the soil and situation will soon predominate, and a healthy crop be secured. This is the best way of treating a plantation where trees have been planted in ungenial positions. The time, however, is approaching when such mistakes will be things of the past; when the ultimate result of planting a piece of land will be so correctly ascertained, and so clearly defined, that mistakes cannot occur; when particular trees will no longer be planted, because they are in demand, but because they are specially adapted for the geological formation and soil; when every arboriculturist will be as conversant with the physiology of trees, as the farmer is with the nature and habits of the animals under his care; and when practical foresters will be as cheerfully and liberally rewarded as their abilities and superior intelligence deserve. When this is the case, we will be able to report more favourably on the present state of our woodland, and the prospects of private properties will improve so rapidly that employers will be amply repaid for any encouragement they give to those in charge of their woods and plantations.

IV. *Pruning in relation to the Production of Timber.* By John B. Smyth, Forester, Duff House.

Arboriculture may be looked upon as the oldest of all sciences, and can be traced back to the earliest existence of man upon earth. Scriptural records inform us that in the past ages our ancestors laboured as we ourselves labour. In the remotest centuries we are told by oral tradition that planting and felling of timber formed subjects of legal enactment.

Need we wonder that a science so old and so useful, and which displays so beautifully the works of an all-wise Creator, has been extolled by the writers of ancient Greece and Rome, as well as by modern anthors? Evelyn, in his "Sylva," says—"Men seldom plant trees till they begin to grow wise, and that is when they grow old." But we are well aware that the science of Arboriculture is not in that stage of advancement which it justly deserves. Many engaged in the science at the present day have no fixed principles, their only theory being that their fathers before them did it. Doubtless, many things have been discovered by chance, while others have been the result of accident. However skilful a person may become by experience, more success is to be expected when he acts upon fixed rules, the soundness of which has been ascertained. At the present day, there is no want of empirical rules, based upon practice only, supposed to be successful; but our opinion is, that no man is capable of performing the operation of pruning until he be conversant with the laws of vegetable physiology.

In the first part of our subject, viz., pruning physiologically, we hold that every man should have a thorough knowledge of the growth of trees, so that his operations may be in harmony with the laws of vegetable physiology. In the second part, viz., "In relation to the production of the greatest value of timber," we are of opinion that this requires practical skill, combined with knowledge of the foregoing laws, in order that a wound may cause the least possible loss of blood. It is also essential to know whether the wound produced will be beneficial, or otherwise, to the plant operated upon.

In the art of pruning, we are convinced there is nothing more detrimental than extreme measures. It is essential to success, in this branch of forestry, that we act upon fixed principles. We are all aware that plants are living beings, although they have no power of locomotion, and are entirely destitute of sensation.

We propose to give a brief description of pruning, physiologically considered, in the form of a dialogue between a proprietor and his forester, and hope that it may tend to establish sound principles of practice.

Dialogue between my Lord Buchan and his forester:—

Lord Buchan—Having selected you to undertake the duties of forester on my property, I should like to hear your opinion upon pruning, the more so that you are a member of the Scottish Arboricultural Society. I am aware that pruning is a subject to which you have devoted great attention. You say that no man should attempt pruning unless he is acquainted with the laws of vegetable physiology. I shall therefore ask you several questions relative to these laws; and, first, What are plants?

Forester—Plants are organised bodies endowed with a principle of life, capable of being either starved to death or fattened by abundant matter; in fact, they are analogous to animals. Plants also consist of masses of tissue, both vascular and cellular, and woody fibre, each performing their various offices.

Lord Buchan—Let me hear what the root is, and what office it performs.

Forester—When a seed is deposited in the soil, and begins to grow, the root is that part that strikes into the earth, and continues to lengthen beneath the soil, sometimes to a considerable depth; but for the healthy execution of its functions there must be access of air. The office of the root is to fix the plant in the soil, and to absorb food, although not absorbing by all parts of its surface. The chief supply of the plant is from the extremities of the newly-formed roots; these are called spongioles, and are of the most delicate structure, and easily injured, therefore, in removing plants from one place to another, the greatest care is necessary for the preservation of these organs. The spongioles have no power in selecting food, but whatever the earth or air may contain, they suck up, provided it be fluid enough to pass into their mouths, or through the sides of their tissue, so that they are capable of absorbing that which is injurious as well as that which is suitable.

Lord Buchan—Now, tell me as to the stem—its structure and development.

Forester—The structure of stems in their earliest state is extremely simple, being merely a mass of cellular tissue, which is the first trace of the pith. The most vigorous stems are those that grow most erect, therefore the more a stem deviates from that position the less vigorous it is. Stems increase annually in diameter by the addition of new matter to the outside of the wood and inside of the bark. In the case of the oak, for instance, the duramen or heart-wood is hard, dark, and more durable than the alburnum or sap-wood. The duramen or heart-wood, when young, was simply alburnum or sap-wood, and afterwards became solidified by secretions peculiar to the species. Stems have also the power of propagating their own species by means of leaf buds; and they also form the channels through which the sap flows from the roots to the leaves.

Lord Buchan—What are leaves, and what office do they perform?

Forester—The leaves are the lungs of the plants; they are traversed by veins, and enclosed in a skin or epiderm, which protects them from great variations in temperature. It is in the leaves that all the secretions of plants are formed, and the more they are exposed to light and air, the more active will the vital powers be. This clearly explains why plants languish and die if deprived of their leaves and if crowded to the exclusion of solar light and heat. You will find the same effect from excessive pruning, for if you lop off branches with the leaves close to the trunk, you remove a number of its essential organs.

Lord Buchan—I shall now revert to our particular subject, and ask you—What effect pruning has upon plant life?

Forester—There are various methods of pruning, some of which are injurious to plant life. Close pruning is a system practised by many; this is doubtless very injurious and detrimental to the value of the timber. Another system of pruning, viz., foreshortening or disbudding, I consider to be beneficial for the future development of the tree. This system also produces the greatest quantity of sound timber, and consequently the greatest value.

Lord Buchan—How is close pruning injurious to plant life?

Forester—Trees, like most other plants, derive their nourishment from the soil, and their nutritive organs are the roots, the stem, and the leaves with the branches—the leaves acting as the lungs of the tree, or its breathing organs. In spring, when the ground is sufficiently warm, the spongioles absorb the nutritive fluid or sap, and pump it into the tree, after which it describes two courses, viz., an ascending and a descending one. The ascending sap is simply the water of the soil; but after it reaches the leaves it combines with the gases absorbed from the atmosphere, through the pores or hairs of the leaves; here it exhales the fluids not essential to vegetation, and is changed into the nutritive food of the plant. It is thus evident that to lop off a branch close by the stem is to divest the tree of a portion of its essential organs. You had an instance this year, on the 13th March, when you saw a number of men pruning on a neighbouring estate by the road-side, and asked my opinion as to the system practised. I said that the trees were individually weakened by the loss of so many of their nutritive organs. There was also nothing done to arrest the progress of contending leaders, nor of overstrong side branches —nearly as large as the trunk itself. The large wounds were likewise injurious to the value of the timber, for it is impossible for nature to heal them over without causing a defect in the bole. On the 20th of the same month, your lordship returned and examined the trees, and saw that they were all bleeding, especially the sycamore or plane tree, which was bleeding severely, and there was a hole in the earth as if made by water from a spout. Unquestionably such a loss must be injurious to plant life. You had also an example among your own oaks, which were taken out some years ago. These had been all close pruned, the result being that the quality of timber was greatly marred by the wounds not having healed; and from the water having got into the wound, the wood was materially damaged. I therefore maintain that close pruning is injurious, and should never be resorted to, especially after the plants have attained any size.

Lord Buchan—I am satisfied with your explanation. I remember looking at those large wounds referred to, and at my own oaks, and observing that the timber was damaged in both cases, evidently by the close pruning to which you object. I wish you now to prove that foreshortening or disbudding is beneficial to the quality of the timber, and, at the same time, not injurious to the trees.

Forester—In the operation of pruning, it is easy to overstep judicious limits, and the actual evils have arisen, no doubt, from abuse of the practice. It would be as unreasonable to suppose that the accumulation of timber should be increased by reducing the roots as by reducing the foliage, both being necessary, as we have shown. Foreshortening or disbudding the branches is beneficial to the timber in this way: If you reduce a branch by one-third of its original length, more sap or vigour is thrown into the main stem, and this branch does not appropriate too much of the food of the plant for its own support; and also those large wounds on the bole, so injurious to timber, are avoided—indeed, this system of foreshortening causes no injury to the tree. It cannot be injurious to plant life in this way, for although you have foreshortened the branch to about two-thirds of its original length, there are still as many leaves on the remaining portion as keep up a healthy action, which is all that is necessary. Again, supposing a tree to be possessed of several lateral branches, claiming to be the main stem or leader, by foreshortening or disbudding a number of these branches, in proportion as the case may be, but selecting or leaving the *best* for its future leader, by its having the terminal bud left, it will make a much larger growth than any of the others, and will soon gain a supremacy over them all. This method is beneficial to the timber, because it prevents those large wounds on the bole; and by reducing the branches indicated, it throws more vigour into the main stem. Again, although you have foreshortened or disbudded the branches, you have left as many branches and leaves on the tree as are essential for its future support. Further, by foreshortening or disbudding, you can even bring a tree of a branchy habit to a more formal appearance without injuring or weakening its system. Your lordship saw the effects of this system on your own young larches, some of which lost their leaders. By disbudding all the lateral branches save one, some of them made large growths the same season, while those left untouched in the same plantation did nothing. You will also recollect those hardwoods which we pruned this spring on April 15th by foreshortening, and that you were well pleased with the effects. On close examination, you admitted that it was impossible it could be injurious to plant life, or detrimental to the quality of the timber, because those large wounds on the bole were avoided that would have been inflicted by close pruning. You also saw that there was no bleeding. You are further aware of my having been in the Edinburgh Botanical Garden, and having examined the deodars pruned by Mr M'Nab by foreshortening. Then trying the same experiment on a few of our own, we found that the method tended to increase the growth of the main stem.

Lord Buchan—I am satisfied with your explanation, and can corroborate all you have said. From the fact of my having witnessed your operations, I confess that the evils of pruning have arisen from abuse of the practice. Now, then, as the second part of our subject is "Pruning in relation to the production of the greatest value of Timber," let me ask you—Suppose I wish a mixed hardwood plantation to produce the greatest value of timber, whether should I have recourse to pruning on the system suggested, or allow the trees to grow, so as to prune themselves?

Forester—By all means have recourse to pruning on the principles already laid down, so as to produce the greatest value of timber, and keep the trees from pruning themselves, *i.e.*, nature's pruning.

Lord Buchan—Why should I avoid nature's pruning?

Forester—If timber trees stand so close upon the ground, so that nature prunes them herself, the branch is amputated and the wound healed at the same time. This she does gradually but surely; but she heals also a portion of the decayed branch. By this method of pruning, you will often see on the timber, on its being sawn up, a defect in the bole, caused by these black knots so common in such cases. For example, you will recollect the sale of hardwood this year. The ash sold was tall and clean when growing; the plantation had never been attended to, the trees being allowed to prune themselves. These ashes, after being sawn into barrel-staves, were unsaleable, owing to the black knots, some of which went through the stave—in fact, two-thirds of the wood had to be burned. This is the general result of nature's pruning, upon hardwoods especially. But by "foreshortening or disbudding the branches," you prevent all this, for by gradually pinching in the branches, you prevent the growth of over strong side branches, thereby throwing more sap and vigour into the main stem.

Lord Buchan—I remember the circumstance you allude to. Then, suppose I was to grow a young plantation of Scotch pine, with a view to produce the greatest value of timber, would you advise close pruning, foreshortening, or nature's pruning?

Forester—In the pine or fir tribe there is a great amount of resin, which, if you apply close pruning, will doubtless bleed very much—in fact, some of the species, if severely cut, will bleed for years. Severe close pruning is injurious to all forest trees, but more especially to conifers. Foreshortening or disbudding is applicable to all classes, and in the pine tribe it may be more freely practised. If a pine loses its leader, you will assist the tree greatly in forming a leader, by foreshortening the upper tier of lateral branches but one, for that branch having its terminal bud left will unquestionably make the largest growth, and ultimately form the leader; if this plan was more freely adopted, there would be fewer trees with large bushy heads and wide-spreading arms in our plantations. In allowing pine woods to prune themselves, the system is no doubt abused. The trees are overdrawn by excessive crowding upon the ground; and after the timber attains size, then thinning is often too freely administered, so that the wind gets too ready access; and from the want of roots the trees are unable to withstand severe storms, especially in exposed situations. Early thinning, boldly, but systematically performed, when the plantations are young, is the only way to establish a good sound crop of timber, as well as timber of the largest dimensions, and consequently the greatest value.

Lord Buchan—You are still in favour of foreshortening; then how would you prune those small dead branches in that fir wood—would you saw them off or leave them as they are?

Forester—I would not advise sawing them off, because generally a piece of the dead branch is often left within the bark, and as the tree grows, it heals over it. I prefer breaking them off, for the branches will then break within the outer bark, leaving no dead wood to be enclosed. You thus assist nature in performing that operation, and she has nothing to do but commence the healing process.

V. *The Failures of the Larch.** By WILLIAM GORRIE, Rait Lodge, Trinity.

The failures of the larch, whether considered economically or scientifically, is the most important subject that now forces itself upon the attention of both forest-owners and foresters; for not only have failures of the larch involved vast pecuniary losses in many districts of Britain, but the diversity in appearance which the plague-stricken trees present under apparently similar, as well as very different influences, has led to the adoption and dissemination of many theories regarding their causes and prevention, most of which have not stood the tests of minute inquiry and careful experiment. Under such circumstances, I cannot expect that the opinions I now promulgate will entirely coincide with those of many members, so that ample room will be afforded for eliciting information on the important subject before us. And in regard to the opinions, or rather convictions, that I express, I may state that they are the results of long-continued as well as widely-extended practical observations.

The principal causes of larch failures I shall notice under three heads:—

I. *Heart-rot, dry-rot, or pumping.*

II. *Surface-rot, cancer, cankering, or blistering, and top-rot.*

III. *The larch bug, or blight* (*Adelgis laricis* of Vallot, and *Coccus laricis* of previous authors), which is also frequently designated the *Aphis disease.*

I. *Heart-rot, dry-rot, or pumping.*—The outward indications of fully-established heart-rot are—the tree becoming perceptibly thickened under about two feet from its base; the bark of both stem and branches assuming an unhealthy, dried, and more or less moss or lichen covered appearance—the length and abundance of such covering being in proportion to the atmospheric dampness of the situation; and the stunted, decreasing growth of the annual shoots and foliage, till the tree becomes partly and ultimately wholly dead. When cut down, the internal appearances are—first, unhealthy, darkish discoloration of the portions of the red or heart-wood, spreading and changing from

* Read by the author at the Twenty-Second Annual Meeting in opening a discussion on the Failures of the Larch.—ED.

dry rottenness to total decay and hollow-heartedness or pumping; the decrease in the width of the annual wood-layers being proportionate to the increase of rottenness till arrested by death. These symptoms occur at all ages, but are most frequent between ten and thirty-five to forty years, and are attributable to occasional droughts, as well as occasional over-saturation; to fungoid attacks on the roots such as emanate from decaying remains in ground previously occupied by Scotch fir; and by lopping off or otherwise destroying the roots. In fact, by anything that thoroughly checks or materially weakens the root action, that in those of the larch when once fully stopped, is incapable of resuming sap circulation, hence these must inevitably decay, when they first convey their rottenness to those parts of the stem that are in most direct communication with them, from whence it spreads with rapidity proportionally to the extent of the root injury. The correctness of these remarks being assumed, it follows that the only prevention of dry-rot is to avoid planting larch in places likely to produce it. The only remedial measures that can be adopted—for cure there is none—are cutting down the trees when it first appears, and replanting the ground with other more suitable kinds.

II. *Surface-rot, cancer, cankering* or *blistering,* and *top-rot* presents the appearance of a dark, flattish, thickish margined bruise or cancerous-like wound, from which more or less thickish resinous matter exudes. Frequently several of these exist on one stem, and they occasionally include the base of the branches, so as to deprive them of vitality. Sometimes they are also to be found on the branches themselves. Wherever they appear, the injury to the stem or branch has only been at first partial, a sufficient portion having been left sound to admit of the sap flowing beyond; and when only slightly affected, the tree often resumes and maintains a healthy growth, so as to nearly, if not entirely, obliterate all traces of the injury. If, on the other hand, the injury is of such an extent as to prevent the further ascent of the sap, all above speedily dies without presenting the appearance of blistering, but merely that of dead tops or top-rot.

Canker and top-rot are due to the effects of late spring frosts occurring after the sap-flow and growth is in full progress, and to early autumn frosts setting in before the growths of the season are fully matured. The late spring frosts are, however, those most generally productive of canker, from the facility with which they penetrate to the lower and earlier leaf-covered portions of the tree, when on its upper extremities the leafage is yet undeveloped, and the sap-flow comparatively limited as well as languid. On the other hand, late autumn frosts are those most productive of top-rot, from the upper extremities being the latest in maturing, as well as the least protected. And it may be here remarked that this most common form of top-rot, and that to which the name is most generally applied, is not to be confounded with the before-mentioned, which proceeds from internal decay or heart-rot; whereas in both the forms of failure (canker and top-rot) here associated, the heart timber remains comparatively sound, unless the trees have been affected with heart-rot prior to suffering from either early or late frosts, a by no means uncommon occurrence.

Canker and top-rot may be induced at all stages of larch growth, being occasionally observable in one-year-old plantations, but both, and especially the former, become comparatively scarce after from forty to fifty years of age. Cure for these injuries being out of the question, and cases of that recovery being very limited as well as uncertain, the best procedure is to clear them away, as recommended under the last head, and replant with other kinds suitable for the soil and situation. And the only prevention for the wide spread and heavy losses that occasionally arise from canker and top-rot lies in the judicious selection of soils and situations in which to plant young larches, avoiding warm southerly exposures that excite their too early spring growth, and more especially all low, flat, moist-surfaced districts, that are subject to cold ground fogs and hoar-frosts. These severe early and late frosts are not of frequent occurrence, but when they do happen they are occasionally very disastrous.

The following examples may be adduced in confirmation of the forestated conclusions regarding the cause of canker and top-rot in the larch:—

About the middle of May 1837, I left Huntly for Edinburgh, where I had been conducting planting operations on the Duke of Richmond's estates, the most extensive, I believe, that have ever been done within the same space of time. Proceeding by the "Defiance" coach to Aberdeen, continuous frost, with occasional snow showers, lasted throughout the day. At night the frost became much more intense; next morning a covering of snow concealed the ground surface and hung thickly on the trees, especially on the larches, which were then in full leaf. By the time we reached Laurencekirk, most of the snow had melted under the influence of bright, warm sunshine. As we proceeded, the sun heat became still more intense, and the larch leaves became more and more flaccid or flagged, till on nearing Forfar and onward they hung so pendant as to appear irrecoverably injured. In travelling through the same and other parts of Strathmore the following autumn, I found many of the larches entirely killed, and most of the rest more or less injured. These effects were specially marked in a fifteen to twenty year old low-lying plantation by the road side between Forfar and Cortachy, which was in course of being cut down, many of the trees having entirely succumbed, and among the others were innumerable examples of canker or blistering which only wanted more time to become transformed into the hard, swollen-edged, matter-discharging sores, to which the terms, canker or blistering, are applied. Again, I think in 1853, we had a cold late season, with an early and severe autumn frost, which effected much larch injury and destruction in the shape of blistering or canker, as well as in top-rot. The last became conspicuous next season in the district of Gala Water, as well as along other middle tributaries of the Tweed, the lower slopes of the Lammermoors, the Moorfoot and Pentland Hills, Peebleshire, etc.

At Prestonhall, where I then resided, many fine young Lombardy poplars, of from 15 to 25 feet in height, were entirely killed, none in fact escaping except such as were sheltered by plantations on their northerly and easterly sides, a decided proof of the severity of that early autumn frost, as well as of the unpreparedness of late-maturing plants for resisting it. As before mentioned, many of the larches that were only slightly injured recovered, and by cutting up these and counting the annular layers of wood that they have formed since the injury was sustained, the year in which that injury was produced can be ascertained with accuracy; and the dates of other like injuries in the same manner.

In 1835 there appeared in the *Quarterly Journal of Agriculture*, a paper on the native larch forests of Switzerland, by that most eminent vegetable physiologist M. de Candolle of Geneva, in which he mentions that although he had traversed these large larch forests in different situations, he and his "numerous correspondents can name the larch as the alpine tree which is less liable to disease than any other," although "sometimes it is seen having a wound or resinous cancer;" seemingly the same as that noticed under this heading. From his paper we further learn that these native larch forests predominate on the northern slopes of the mountains; that the larch is not particular about where it grows, and seems only to fear extremes. Marshy grounds are the only ones it essentially dreads, nor is it found on those that are often too dry. "What appears to be most necessary to the larch is, that it have its roots in a soil habitually but moderately damp, and its top exposed to the direct rays of the sun."

"Larches generally thrive on the declivities of our mountains, seldom on flat places; because on declivities there is always a little dampness in the earth, coming from the summit; and at the same time the trees, on account of the inequality of their bases, have more space at their tops and are better exposed to the light; whereas flat places are often too dry, and the trees being all of the same height, overshadow each other. Among declivities, these which are connected with summits covered with perpetual snow are those where larches grow best."

Those descriptions of the situations in which the native larches thrive best, are in conformity with the experiences of home planters; and were larches only planted in such, growers would have little to fear from either of the fore-mentioned injuries, nor would the larch bug become very hurtful, provided clean young plants were planted, and that the young plantations were sufficiently removed from old infested ones, to prevent contamination.

III. *The larch bug or blight* (*Adelgis laricis* of Vallot, and *Coccus laricis* of previous authors).—In the winter or leafless period of the year bug-infested larches are readily distinguished by the darkish colour of their bark, the somewhat reflexed or drooping appearance of their branches and branchlets, and notably, by the abbreviated as well as attenuated growths of the previous season. Microscopic examinations of the expanding buds in spring show them to be thickly covered with the so-called bugs and their eggs, the former emitting a honey dew-like discharge, which in the warmer portions of the day may often be fairly said to "wet with misty showers" the trees themselves, as well as the undergrowing herbage, and even the clothes of underwalkers, covering all with a hurtful, honeyed viscidity.

Unless checked by adverse weather or other causes, these insects go on breeding successively and abundantly throughout what may be termed the active growing season of the larch, the successive broods becoming winged in due time, and flying away to spread their kind after the most rapacious feeding period of their existence is past; while in summer and autumn they assume that white cottony or flaky appearance, by which their presence is most distinctly and unmistakably marked.

The larch bug infests trees of all ages, but in their nursery growth it is comparatively rare on what are termed "one-year seedlings;" while on "two-year seedlings," and "one-year seedlings one year transplanted," although seldom entirely absent, it is frequently nearly so. But on older plants it is generally much more evident, sometimes even to the extent of permanently withering their foliage, commencing with that of the lower branches and proceeding upwards. Hence nurseries that can produce "two-year seedlings, two-year transplanted larches," free, or nearly so from the bug, deserve favourable attention from intending planters. William Boutcher, a famous nurseryman at Comely Bank Garden, Edinburgh, who dedicated a treatise on forest trees to Henry, Duke of Buccleuch, in 1775, therein recommended that larches "intended for planting where beauty and shelter were immediately required" should have three nursery transplantings previously, and be "finally removed when ten to twelve feet high." Who would think of practising this nursery treatment of larches now? Or if it were attempted, assuredly the blight-stricken plants would neither be objects of beauty nor subjects for shelter. In plantations, the larch bug is most prevalent in low, hollow, and flattish, sheltered situations, more especially where timeous thinning has been neglected; in fact, just in such places as blistering or surface-rot is most likely to be produced; hence some have formed the erroneous opinion that it is the cause of that injury. M. de Candolle, in his treatise before referred to, leads us to infer that the bug is unknown as an injurious infectant of the larch in its native forests. Most probably it may there be associated with some other insect which preys upon it, and thus keeps it within harmless bounds. Many other plants have their health-destroying "mealy bugs," or white blights, such as the silver fir, beech, apple, etc.; but all these are essentially different from that of the larch, which I have never found feeding upon any other plants. This would favour the conclusion that it is not naturally indigenous to Britain, but that it has been introduced with the larch. In fact, that the latter has been brought to us with its bane, without the antidote, as were orange trees to the Cape of Good Hope, and nutmeg plants to Pulo-Pinang, where, in consequence of the absence of the latter, the former prevailed to such an extent that many plantations had to be abandoned before curatives were discovered.

In this country the larch bug seems to have first attracted notice in 1785, when it was observed in the plantations at Raith, in Fife, where it increased in an alarming manner in the three dry, warm summers of 1800, 1801, and 1802; but from 1806 it decreased, till by 1815 it had almost disappeared. Previous to 1795, it was noticed in the Athole forests, and then, and for eight to ten years afterwards, it materially retarded the growth of the larch, but thereafter became comparatively scarce and harmless. Observing that it did not appear at higher altitudes than 600 feet, the Duke of Athole transferred his planting of larch generally to higher elevations. In 1779, James Webster, who acted as gardener and forester at Munches for more than forty years, noticed the larch blight in that south-western district of Scotland; and writing thirty-six years after, he stated that he had since watched the disease carefully in all the plantations he was concerned with, and in others, and was satisfied that trees so infested did not make the progress in growth which those do that are not infected. And going to one of the best nurseries of the district in 1834 to select plants, he there discovered a number infected with the disease, which he "advised the nurseryman to destroy, and he did so." Turning now to the able comments on the diseases of the larch, in the second volume of our Transactions (1863), by Mr M'Corquodale, of Scone, it is therein stated that the ravages of the *Aphis* disease were fearfully abundant among young larch plantations in Scotland for the four years 1838-1842, but since then the insects had, comparatively speaking, ceased. This irregularly alternating great increase and decrease in the larch bug is in unison with the habits of many other plant insects, and although pretty correct ideas may be formed as to some of the causes, we are still quite in the dark as to others. Here, then, is much scope for investigation. And I fear that this disappearance or diminution of the larch bug noticed by Mr M'Corquodale, must only have been local, as during the period assigned for it, I found it injuriously prevalent in Midlothian, where I then resided, as well as throughout the lower parts of Lanarkshire and elsewhere. And that it has again returned to Perthshire in unwelcome abundance, is evident to passengers along the Highland Railway, where to practised eyes its abounding presence is observable in the adjoining plantations;

and notably in those at the Murthly station, where young blight-stricken larches are maintaining a hopeless struggle with Scotch firs.

It is now nearly forty years since my attention was attracted to a large break of two-year transplanted larches in the vicinity of Edinburgh, where nursery crops have long been supplanted by dwelling-houses. Early in the summer, two small circular patches appeared where the foliage presented a whitish tint. Both of these patches increased in size and whiteness, till the presence as well as the effects of larch bug was unmistakable, even when viewed from a considerable distance, each patch being whitest in the centre, and shaded off to clean, healthy green, at its circumference. In autumn the diminution in growth of the plants in both was proportionate to the whiteness, being shortest in the middle, and rising gradually to their junction with the surrounding uninfected plants. Just before the falling of the leaves, the centres presented a brownish, withered-like appearance; and throughout the winter a shaded-off blackness held the place of the former whiteness. In the succeeding summer those indications became much extended, as well as intensified, each of the patches widening to about 20 yards in diameter, while the plants in their centres made very short growth, and these around the circular margins remained clean and healthy. Since the period here indicated, continuous as well as extensive observations of nursery larch crops throughout the kingdom have still furnished me with more distinctive evidence than the above of the regular and rapidly progressive spread of the bug over previously healthy young larch plants. And these observations have further shown that while no nursery visited was entirely clear of this plague, its virulence among many of the older transplants showed that the fire was the only proper place for them.

After larches have suffered from late spring frosts, the bugs often become so conspicuously abundant as to induce the untenable notion that they have been produced by the frost; while that injuring agent may only be blamable for more fully exposing and concentrating them by its partial removal of their leafy covering, and limiting of their feeding ranges, by its restricting or stunting the growths of both the young shoots and foliage.

It is a very common notion that weak and unhealthy plants are the most susceptible of injury from insects. The insects are, however, much more frequently the cause than the effect of such unhealthiness, and this is specially evident in the case of the larch. Hence the importance of planting out only clean plants, more particularly in places so distant from previously existing plantations that the insect plague is not likely to be transmitted from them. And as nursery plants are seldom, if ever, entirely clean, it is highly desirable that a steep or other curative be found that will destroy any insects or their eggs which may be on plants intended for transplantation, without affecting the health of the latter. No better subject than this can be chosen by this Society for which to offer a high premium; and next to it would rank one for a detailed account of the transformations, propagation, and habits of the larch bug, founded on minute, careful, and frequently-repeated observation, extending over two or three years; for as yet little or almost nothing is definitely known of the natural history of this and other most troublesome members of the *Coccidæ* and the *Aphidæ*.

In conclusion, I have only to add that, while admitting that as in the case of the Scotch fir, a diminution in the size of larch trees may to some extent be induced by long continued collecting of the cones from the easiest got at plants, or dwarf sub-varieties; I have no belief in the often-advanced theories that degeneracy or weakness of constitution has been produced in the larch by rearing the young plants from seeds that have not been produced in its native climate; by collecting seeds from so-called diseased, but which are actually injured trees; by over-heating the seeds, in order to their more easy extraction from the cones, or other like untenable supposed causes; for if the seed is sufficiently matured and sound to produce healthy young plants, no bad results can follow from the trees on which it grew having been injured by drought, saturation, frost, insects, and other causes, or from the seeds being over-heated in the kiln-drying of the cones.

VI. *On the Age at which various Timber Trees in Scotland may be most Profitably Felled.* By D. F. M'Kenzie, Forester, Meldrum House.

The question discussed in this paper involves the consideration both of *bulk* and *quality*. It is the producer's interest to have the greatest possible bulk of timber in a given time. Any one who has given attention to arboriculture, knows that after a certain time most trees, though growing and apparently healthy, cease to produce sufficient timber to warrant their being left to occupy the ground. It is therefore the producer's interest to have the crop removed as soon as this is determined, and replaced by another crop. Were consumers of timber fully alive to their own interests, they would look more to good quality than they do; it would then pay the producer to let the crop stand till full maturity. Distance from market and places where large quantities of timber are consumed, has much to do with the time at which to fell timber to advantage, as for example, near mining districts; but this is the exception, not the rule, for generally when pit and spar wood fetch high prices, larger sizes also increase in value.

Ash (*Fraxinus excelsior*).—The ash is one of our most useful timber trees, and can be cut with profit from thirty years old and upwards. It luxuriates in a rich deep loam, well drained by the natural formation and position of the ground. It does not succeed on poor soil, especially in exposed situations. Though found in a natural state in some parts of the Highlands, it is only profitable when planted in good soil. In exposed situations the wood is brittle and almost useless for many purposes to which it is generally applied.

Alder (*Alnus glutinosa*). — The wood of the alder is more valuable now than many imagine. It is in great demand for herring-barrel staves and heads, and this season (1875) I received for alder the same price per thousand superficial feet, as for the best larch for the same purpose. In 1868 alder was scarcely worth felling, except for bobbins, powder works, etc.; this year it fetched 100s. per thousand superficial feet, 31 inches broad, by $\frac{5}{8}$ inch thick; free on rail, two miles from the saw-mill. It thrives best in damp soils along the margin of lakes and streams, and can be cut to advantage after a growth of thirty-five years.

Beech (*Fagus sylvatica*).—Beech timber is not valued so much, and is not so largely planted as it was a century ago. It is still used for wringing and mangling machines, lasts, carpenters' planes, and partially for bushes in machinery ; but lately, another market has opened up for beech in a manufactured state ; it is now used for mining purposes in blocks from 20 inches to 3 feet long, and from 4 to 8 inches square, to which is given the name *chocks.* I have disposed of many thousand chocks during the last few years, and have found them pay well. Beech thrives on most dry soils, but not on stiff clay, even though tolerably dry. Although a hardy tree growing on exposed places, it prefers a low sheltered situation, where it may be felled at about seventy years of age.

Birch (*Betula alba*). — The birch is very graceful, but of moderate size compared to many of our forest trees. Since the introduction of Norwegian birch for barrel staves and other purposes to which our birch was generally applied, it has been little asked for, except for bobbins and turnery ; but well-grown trees still fetch good prices. It is not particular as to soil or situation, and when cut down springs readily from the stool. It may be felled profitably every thirty years, and at present is in demand for bobbinwood, chocks, and burnwood.

Spanish Chestnut (*Castanea vesca*).—The sweet chestnut is a timber tree of the third class, and never attains large dimensions even in favourable situations. The wood is durable and useful for many purposes ; and the tree from its rapid growth is well adapted for planting among others which require longer time to mature, from among which it can be thinned out at twenty to thirty years of age. It is then fit for any purpose to which the timber is applicable. It answers well for barrel heads, and I frequently receive a good price for it. I have also found, on comparing the price of an acre of larch with an acre of sweet chestnut, taking larch to be mature at seventy years, and sweet chestnut at forty, that the annual value yielded by the sweet chestnut exceeded that yielded by the larch. In favourable situations this tree may be felled when about thirty-five years old.

Horse Chestnut (*Æsculus hippocastanum*). — This tree, like the foregoing, is a rapid grower, but of little use for timber. The wood is soft and not durable, and may be used like the willow and poplar for railway brakes, agricultural implements, saddlers' cutting-boards, patterns, etc. It can be recommended for lawns, avenues, roadsides in plantations, and solitary trees in parks: it requires good soil and sheltered situation. Though a hardy tree as regards cold, yet the young wood is so brittle as to break under ordinary storms. It can only be felled with profit when of large dimensions, which in good soil would be when about eighty years old.

Scotch Elm (*Ulmus montana*).—Next to the oak, the elm is the most useful of our deciduous timber trees. Its timber, which is of great strength and durability, is much used by coachbuilders, cartwrights, and cabinetmakers, and also for agricultural implements and cooper-work. To grow the elm well it must be planted in deep loam, resting on a dry porous subsoil, and it can only be cut down with profit when of large dimensions, which under ordinary circumstances it attains when about eighty years old. Thinnings of the elm 6 inches in diameter can be profitably disposed of, being used for barrel staves, drawing bars, etc.

English Elm (*Ulmus campestris*). — Generally speaking, the English elm furnishes better and larger timber than the Scotch, and is used for the same purposes. Its wood is usually more cross in the grain, and better adapted for wheel naves. It cannot be felled to advantage before ninety or one hundred years of age.

Oak (*Quercus robur var. pedunculata, and var. sessiliflora*).—Since iron has become the principal material for the construction of our navy and large trading vessels, large-sized oak is not so much in demand. It is used for constructing coasting vessels, agricultural buildings and implements, and in mining operations. The bark is also much used for tanning. In favourable situations it can be felled with profit when about one hundred years old.

Sycamore (*Acer pseudo-platanus*). — The sycamore is one of our hardiest timber trees, and grows well on most soils and situations. When of great age, if of fair quality, it commands a high price. Cabinetmakers give fabulous prices for some trees of large dimensions. It is largely used for veneers, and is stained in imitation of various woods. On account of this it is difficult to estimate the time at which it ought to be felled. I am aware, however, that it is profitable to cut it at any age over forty years. At this age it is suitable for barrel staves, and would exceed in value any crop of larch. It is also an excellent coppice wood, springing readily and rapidly from the stools, and in many cases growing 4 to 6 feet in length in one season. I have seen in good soil and sheltered situations shoots 20 feet long in four years, but this is exceptional. Considering the value of a cubic foot of old timber, we believe it to be most profitably felled when mature, which, in good soil and sheltered situation, it would be when about 120 years old; in inferior soil and exposed situation it should be cut down earlier when signs of maturity appear.

Willows and Poplars.—All the *timber* varieties of willows and poplars are fast growers, and are generally soon matured. Their timber is used for railway brakes, cutting-boards, agricultural implements, barrel staves and heading, and for patterns in most engineering departments. They succeed only in moist soils, and moderately sheltered situations, and can be profitably felled at thirty-five to forty years of age, after which they become stag-headed and unsightly, and liable to warp at the heart. In good soil and sheltered situation they grow to very large dimensions, and are longer of coming to maturity.

Larch (*Larix Europæa*).—This is the most useful and rapid growing pine cultivated in Scotland, and without doubt the most valuable. Of late years it has shown a great tendency to disease, especially heart-rot. When larches are planted in hardwood plantations as nurses, they may be thinned out with profit at twenty-five years of age. If well grown, they command a high price for mining operations, fence posts, etc. In soil suitable for this crop the time to remove it would be about sixty-five years old. On thin soil, however, it matures much sooner.

Scotch Fir (*Pinus sylvestris*).—None of our timber trees are more extensively cultivated than the Scotch fir, its timber being applied to almost all purposes to which common wood is applicable. This tree is not particular as regards soil or situation, and it can be cut down with profit at thirty-five years of age and upwards. I felled a large wood of Scotch fir on an estate in the North, on land worth less than 2s. 6d. per acre. The age of the plantation was thirty-five years, and the net return after manufacture was £33 per acre. The ground is again planted, and the crop, considering that the soil is thin and resting on rotten sandstone at two feet from the surface, promises to do well. The wood referred to showed signs of maturity, and ceased to grow. Many of the trees were dying. It may be stated, however, that the quality of the timber was inferior. It was sawn into staves and pit props, for which the same prices were obtained as though it were superior timber. The most profitable time to fell the Scotch fir is when about sixty years old.

Spruce (*Abies excelsa*).—The spruce fir is a very useful tree, its wood being largely used in the erection of agricultural buildings. Byres fitted up with spruce are admitted to be more durable than those fitted up with planted Scotch fir, and not inferior to those with natural grown pine. It is not affected by the cattle breath, nor liable to the attack of moths or beetles. It is also used for mining-poles and other pit wood, and for railway sleepers. It likes good moist soils, which may be considered too damp for other timber, willows and poplars excepted, provided there is no stagnant water near its roots. When this is the case, even on good soil, the tree dies prematurely. The most profitable time to fell this tree is when about sixty years of age; if, however, the soil is dry and hard, the tree will be ready for cutting when about forty or fifty years old. On deep moss it requires to stand longer—say from ninety to one hundred years. I felled a wood of spruce at 125 years. It grew on boggy moss, from 3 to 9 feet deep, resting on a bed of gravel mixed with blue clay and sand. On examining this wood, I found that taking all the crop, it averaged only 4 inches in diameter during the first twenty-five years of its growth. Those trees on the shallow parts of the moss grew double this diameter in the same time. The slowness of growth can only be accounted for by the want of *inorganic* matter in the soil. After the decomposition of the leaves of the trees and other vegetable matter which supplied the soil to a certain extent with inorganic and healthy *humus*, they grew rapidly. From seventy years of age to seventy-five they made 3 inches, when they diminished till about one hundred, after which they seemed to add little to their timber. A short distance from this wood was another spruce wood planted on a rather dry soil, on a hard gravelly bottom. It was only fifty years old, and most of the trees were decayed at the heart.

Silver Fir (*Picea pectinata*).—Till twenty years ago the silver fir was planted more for ornament than for its timber. It is now largely cultivated, and will be used for fitting and roofing farm buildings, for which it is well adapted, especially if grown in good soil, and in cold but sheltered situations. It grows rapidly after the plants are well established, and thrives best in deep, damp, loamy soils. It is not, however, particular with regard to soil, provided the situation is not very exposed. Seventy-five years of age may be the average time to fell the silver fir with profit.

It may be stated that wood, like most other crops, is sooner matured on light soils and moderately exposed situations, and has much less bulk than that grown in good soils and in sheltered situations.

Soils of the same class differ greatly; they are, however, estimated according to the proportion of clay, lime, humus, and sand, in a given number of parts; and are divided into seven or eight classes, and subdivided into sixty different species; but properly speaking, soil consists of two parts, *organic* and *inorganic* matter, the latter also consisting of two parts—the soluble and insoluble. To distinguish soils they require to be analysed, but the experienced eye knows pretty nearly by turning up the soil and examining it and the surrounding herbage.

Appended is a table giving an average of the age at which the timber trees referred to cease to grow profitably on different soils and situations.

This table, however, is imperfect, and I believe that no definite rule can be laid down. I have therefore given only the average ages at which I found, during eighteen years' experience in the management and manufacture of timber, the varieties mentioned could be most profitably felled in the different soils and situations, considering the producer's interest. My data were taken on the ground on which the timber grew, in eight counties, and over forty estates, a list of which is given below:

ABERDEEN.—Auchry, Ballater, Blelack, Byth, Meldrum, Midmar, Dunecht, Monymusk, and Delgaty Castle.

BANFF.—Auchlunkart, Auchanacie, Arndilly, and Rothiemay.

INVERNESS.—Aigas, Aldourie, Belladrum, Beaufort, Dochfour, Drumaglass, Erchless, Faraline, Foyers, Lentran, Newton, Rothiemurchus, Castle Grant, Duthel, Abernethy.

MORAY *and* NAIRN.—Altyre, Brodie, Cawdor, Darnaway, Dumphail and Kilravock.

ROSS *and* CROMARTY.—Ardross, Brahan, Conon, Coul, Balnagown, Culrossie, Highfield, Ord, Raddery, Flowerburn, Kilcoy, Redcastle.

PERTH.—Abercairney and Ochtertyre.

Situation.	Clay Soil.			Heavy Loam.			Light Loam.			Damp Loamy Soil.			Heathy soil on hard gravelly subsoil.			Sandy soil on deep porous subsoil.			Deep mossy soil on gravelly subsoil.			Remarks.
Name.	S.	E.	I.	S.	E.	I.	S.	E.	I.	S.	E.	I.	S.	E.	I.	S.	E.	I.	S.	E.	I.	Elevations from 5 to 1300 feet above sea-level.
Ash, . . .	50-60	70	65-70	70-75	80-90	80	60	80	70	80	90	85	Will not grow well			70	80	75	..	..	..	When old, the wood loses its toughness in exposed situations.
Alder, . .	40-50	35	40-50	60	40	50	Does not succeed well.			50	40	45	..	..	..	..	..	..	70-80	60	70	Thrives best in damp soils and on the margins of streams.
Beech, . .	90-95	70	80	90	70	80	80	60	75	70	60	65	..	..	..	80	60	70	..	..	..	
Birch, . .	60	50	55-60	60	50	65	50	70	60	40	45	40	50	40	45	50	40	40	30	30	30	Grows freely in most soils and situations.
Spanish Chestnut, .	70	50	65-70	70	65	65	80	60	75	60	50	55-60	..	..	..	80	60	75	..	..	..	
Horse Chestnut, . . .	80-85	70	80	80	65	75	70	60	70	95	85	90	..	..	..	60	50	60	..	..	..	Liable to be broken by winds.
Scotch Elm, .	90-100	70	80-90	90	70	85-90	100	90	90-100	70	60	65-70	..	..	..	80	75	80	..	..	..	
English Elm,	80-100	80	80-90	90	80	80-90	100	90	90-100	90	85	90-95	..	..	..	80	75	80	..	..	..	
Oak, . . .	120	100	100	90-100	90	90-100	100	90	90-100	100	90	100	..	..	..	90	80	90	..	..	..	Very hardy.
Sycamore, .	120	110	100	100	90	100	90	85	85	90	70	80	70	60	65	80	60	60	..	..	..	
Willows and Poplars, .	40	to	60	50	to	70	Do not grow well.			40	to	60	..	..	..	Poor specimens.			50	30	45	Requires moist soils and sheltered situations.
Larch, . .	50-65	50	60	75	60	70	70	60	75	80	70	75	45	40	40	70	65	70	100	80-90	100	Liable to heart-rot when growing in poor soil.
Scotch Fir, .	50-60	70	65	50	60	50	70	70	70	40	50	45	60	60	60	80	85	80	70	80	70	Grows well in almost all soils.
Norway Spruce, . .	70	50	60	75	70	70	40	35	35	50	45	50	..	..	..	Liable to heart-rot.			100	90	100	Grows best in damp soils containing large quantities of vegetable matter.
Silver Fir, .	80-85	70	80	90	90	90	70	60	65	90	85	85	..	..	..	Poor specimens.			..	..	..	Thrives in stiff loams and most deep soils.

N.B.—S., Sheltered. E., Exposed. I., Intermediate.

VII. *On the Distances at which Forest Trees should be planted on different Soils and Situations.* By Lewis Bayne, Forester, Kinmel Park, Abergele.

There is probably no point in forestry on which the opinion of practical men has undergone less change than as to the distances at which forest trees should be planted; and it is a matter of importance, as the first start of a plantation has much to do with its after progress—that is, whether it will turn out a profitable or a losing investment.

The nature and quality of the soil, the situation, and altitude at which trees are planted, will in great measure settle the question, as the better the soil, and the more sheltered the situation, the fewer plants will be required, and *vice versâ* on poor thin land and exposed situations.

In planting hardwood trees that are to form the ultimate crop, particular attention should be directed to the size they are likely to attain in the different soils and situations, so that after the plantation has been regularly thinned, those to be left may stand at proper distances apart, before arriving at timber size. In considering this, it should be borne in mind that in most cases larch and other coniferous trees are of more value when young than hardwood trees of the same age; and that accordingly in view of the after thinning, the former class, larch, etc., should be thickly planted, and the hardwoods as widely apart as the circumstances will admit of. It must, however, be carefully guarded against planting the latter too thinly, as the system of planting the exact number of hardwood trees required for the main crop, and filling in the remainder with quick-growing trees of more value when young, would be impracticable, because the hardwood varieties, in order to thrive, require an amount of sun, light, and air, which would be denied them by the great shade of the tall and faster-growing trees of the fir tribe.

The same objection is not applicable to close planting of coniferous trees, providing they are thinned in proper time, but by planting an unnecessary number per acre, extra expense is incurred in plants and labour, when it may be the labour is required elsewhere; for instance, the trees required to plant an acre at 3 feet apart exceed the number by over two thousand, if planted at 4 feet apart, which at 20s. per thousand (including carriage and labour), would make a difference in expense of over £2 per acre. On a large plantation this would amount to a considerable sum, which might be saved or expended to better advantage in draining the plantation, or other useful purposes.

Further, when trees are planted very close together, they are more liable to be drawn up by overcrowding, if not thinned at an early age. But while this is the result of too close planting, the opposite extreme should be avoided, for in the case of too thin planting, especially in exposed situations, the trees get one-sided, by the want of shelter to one another from prevailing winds, and become to a great extent starved and scrubby, and make but little progress.

From the small value of the early thinnings of plantations, it seems a pity that trees will not thrive if planted at such distances apart that the first thinnings might be of considerable size and value. If this were practicable, it would do away with close and thick planting, which ruins many young plantations that are left without timely thinning, with the view of the first thinnings becoming of the greatest possible value before being taken out.

When trees are planted in clumps or masses, they can be more regularly dispersed than when the mixing system is adopted, as some trees are of faster growth than others, have a greater spread of branches, and require more room. It is proposed, therefore, to consider the question of distance in regard to each variety of tree under the clump or massing system of planting. The *oak*, in favourable condition, grows to a great size, with considerable spread of branches; and as a good revenue may be derived from its bark and branches, for tanning and charcoal, etc., it should have room to develop itself. When it is planted in a good soil, low altitude, and moderately-sheltered situation, a distance of 20 feet from each tree, with the spaces filled in with Scotch fir, larch, or spruce as nurses, at 5 feet apart, will not be found too wide. In such favourable circumstances the plants will make rapid progress, taking their girth with ample branches and foliage, and laying a good foundation for after-growth, and these will be of more value at the first thinning than if planted close together. But when planted in less favourable soil, at higher altitude, and in an exposed situation, a distance of 12 feet apart, with the intervals filled in with Scotch fir or larch to $3\frac{1}{2}$ feet apart, will be wide enough, as neither the principals nor the nurses will make such progress as in good soil and sheltered situation.

Neither will the oaks grow to such a size, nor require so much room to mature. Moreover, after the first thinnings of the hardwoods, and the removal of the nurses, they will require little more thinning until they arrive at good size and value.

Ash requires to be grown more clean and lengthy than most timber trees, and should therefore be more closely planted than other hardwood kinds of large dimensions; and when the soil is good, altitude low, and situation moderately sheltered, 15 feet apart, intermixed with nurses at 5 feet, is a fair average distance. If the soil is of a thin and inferior quality, 9 feet apart, with nurses at 3 feet, will not be too close. From the ready sale of, and demand for, good clean ash of small dimensions, the thinnings are more valuable than most others of the hardwoods, which is in itself a good reason for not planting ash too widely apart.

Elm (*Scotch*) is of little value when young, and although a tree of great spread of branches when mature, it should not be planted too widely apart when grown for the market. In good dry loam and subsoil, 16 feet apart, with nurses to 4 feet, will be a suitable distance; but in less favourable soils, and more exposed situations, 12 feet apart, with nurses to 3 feet, will not be too close.

Elm (*English*) is a fast-growing tree, of an upright habit of growth, and, although of less spread of branches, is of larger size when grown in suitable soil and situation than the Scotch or Wych elm. On this account, therefore, and also because it is of little value when of small dimensions, it should be allowed ample room, and not planted too closely, as it is less liable than many hardwooded trees to be over-topped or shaded by firs or other nurses. When the soil is dry and good, and the situation sheltered, 20 feet apart, with nurses to 5 feet, will not be too wide; while in less suitable situations, 14 feet apart, with nurses to $3\frac{1}{2}$ feet, will be about the proper distance.

Beech is seldom planted in first-class soils for profit, but frequently for landscape effect; and in the case of a light, dry soil, and moderately sheltered position at a medium altitude, it may be planted at 16 feet apart, with nurses 4 feet apart; but in an exposed situation, 12 feet apart, and 3 feet for the nurses, will be sufficient.

Sycamore and *Norway Maple* may be planted in good dry soil, moderately sheltered, and medium altitude, at 16 feet apart, with nurses to 4 feet; and on thin and poor soil, and more exposed situation, 12 feet apart, and filled in with nurses to 3 feet.

Alder being a tree of smaller dimensions, and in most cases cut before arriving at old age, may be planted moderately close. In sheltered situations and dampish soil (free of stagnant water, however), it may be planted at 12 feet apart, with nurses to 4 feet apart; and on poor soil and high elevations, at 9 feet apart, and filled in with nurses to 3 feet apart; but when planted as coppice-wood, or in swampy places, a preferable course would be to plant the trees at from 5 to 6 feet apart, without nurses.

The *Birch* is a tree that does not require much room, for its spread of branches is not very wide, having an erect tendency of growth. It is often grown on poor soil and high elevations, in which position 9 feet apart, the spaces planted with nurses of Scotch fir to 3 feet apart, will not be too close; or the trees may be planted in masses at 4 feet apart, without nurses. When in low elevations and good soil, and moderately sheltered, the birch may be planted at 12 feet apart, with nurses to 4 feet.

The *Poplars* all grow rapidly to large dimensions, and require considerable room for their development, with the exception of the Lombardy poplar (*Populus fastigiata*), which is of upright growth, and requires little room. But it is seldom planted for profit in plantations, and 5 feet apart, without nurses, will be found suitable in favourable soils and situations. The other varieties of poplar, viz., Black Italian, Balsam, Ontario, Silver, etc., may be planted in good loam and sheltered situation, 6 feet apart, without nurses; but in less favourable situations and soils, at 9 to 10 feet apart, with larch and spruce nurses at 4½ to 5 feet apart. The same distance is equally applicable to the mountain poplar, filled in with Scotch fir, or other nurses, to 3½ feet apart.

Willows are fast growing trees, and require plenty of room; when planted in good and rather moist soil, and sheltered situations, without nurses, 6 feet apart will be close enough.

Chestnut (*Spanish*) luxuriates well with the oak; and the same distances, in the same varieties of soil, altitude, and situation, will be suitable for its growth.

Chestnut (*Horse*) being principally grown for ornament, should be planted widely, so as to allow abundance of room to expand its branches; and when the soil is good, and the position well sheltered, 18 feet apart, with nurses to 4½ feet, will be a suitable distance.

The *Lime*, although a valuable timber tree, is more frequently planted for ornament than for profit, and requires considerable room for its growth. It may be planted at distances ranging from 16 to 18 feet apart, with nurses from 4 to $4\frac{1}{2}$ feet apart.

Coniferous trees grown by themselves require to be planted much more closely than hardwoods, as they constitute both principals and nurses.

When the *Scotch fir* is planted in good soil, at a moderate elevation, and in a sheltered position, $4\frac{1}{2}$ feet apart will be found close enough; but when the elevation is high, and the soil poor, 3 feet apart will not be found too close. Although the Scotch fir is one of our hardiest forest trees, if planted widely apart on poor, thin ground, and exposed situations, it becomes scrubby and branchy, especially when the ground slopes towards the exposed or windy side; but on level ground they may be planted at wider distances towards the interior of the plantation, having the margin more close to break the prevailing winds.

The *Larch* is a tree of fast growth, and in favourable soils and situations soon outreaches the Scotch fir. Planted in moderately sheltered situations, 5 feet apart, and in more exposed positions, higher elevations, and less favourable soils, $3\frac{1}{2}$ feet, are suitable distances; but being less hardy than the Scotch fir, Austrian and Corsican pines, it is preferable to substitute some of these, or to mix them with larch, rather than to plant larch alone at a closer distance in poor and exposed situations—the latter to be removed at the early thinnings.

Spruce should never be planted alone, in exposed situations, nor in high altitudes, but in favourable soils and situations it may be planted at 4 feet apart, and in less favourable places at $3\frac{1}{2}$ feet.

Austrian pine being of fast and strong growth, and thick, dark foliage, should not be planted too close, on account of the amount of shade it produces, thereby depriving one another of the necessary amount of sunlight. It is particularly adapted for exposed margins of plantations, and when so placed, should never be planted closer than $4\frac{1}{2}$ feet apart, except in very exposed situations, where $3\frac{1}{2}$ feet will be a good distance.

The *Corsican pine* is of more upright growth, and less shady and spreading in its habit than the Austrian pine, and although a rapid grower, it requires less room. It should seldom be planted wider than $4\frac{1}{2}$ feet, nor closer than $3\frac{1}{2}$ feet.

The *Cluster pine* (*Pinus pinaster*), when planted in dry or gravelly soil, may be placed at the same distance apart as the Corsican pine.

The *Douglas pine* has a little of the habit of the common or

Norway spruce, and may be planted at the same distance apart, or at 8 to 9 feet apart, with common spruce or larch as nurses. This latter course is recommended on account of the superior quality of the Douglas pine timber, and the expense of the plants over the spruce fir, thus placing it in the same position as a hardwood tree, using the others as nurses.

Silver fir being more hardy than the common spruce, may be extended to more exposed situations, and planted at a distance of $3\frac{1}{2}$ feet apart; in good soils and sheltered situations at $4\frac{1}{2}$ feet apart.

The writer's experience in growing other varieties of coniferous trees is too limited to warrant his remarking upon them specifically, or at any length, as he has done with the more common varieties. Most of those which have been planted in this country are principally confined to the Pinetum, or pleasure ground, or as ornamental specimens in plantations. In few instances have they, to any great extent, been planted for profit, but rather as a trial of their hardiness in standing the winters and climate of Great Britain, and to prove whether they are worthy of being ranked amongst first-class timber trees.

Only one or two general observations fall now to be made. When planted in a moderate soil and sheltered situation, the Corsican pine (*Pinus laricio*) is one of the best conifers for attaining, from its erect habit and fast growth, a good size before thinning; but the larch is most valuable when young in this country, in consequence, perhaps, of the quality of its timber being better known than that of the Corsican pine.

Poplars, without nurses of the fir tribe, may, from their fastness of growth, be planted at a greater distance apart, and be more remunerative, from their first thinnings, than any of our hardwood trees.

In planting hardwood trees, it is preferable to place them at as wide distances apart as the circumstances of the case will allow, and to fill in the spaces with coniferous trees; for when hardwooded trees are cut down, in the case of thinning, their roots send forth numerous shoots in the shape of underwood, while the roots themselves continue to grow, and draw the nourishment from the soil, thus impoverishing the trees left growing.

The following schedule shows, in a detailed tabular form, the distances apart at which the various kinds of trees referred to may be planted in certain circumstances. The altitudes are distinguished as follows: low, 300 feet and under; medium, 300 feet to 700 feet; and high, above 700 feet:

TABLE, showing the Distances apart at which Forest Trees may be Planted in different Soils, Situations, and Altitudes.

Names of Trees.	Good clay soil or heavy loam.	Strong loam and gravel subsoil.	Light loam and gravel subsoil.	Light loam, resting on sandy clay.	Strong sandy loam and dry bottom.	Light loam and moist subsoil.	Poor, thin, sandy soil and dry bottom.	Rich alluvial loam and dampish subsoil.	Dampish clay or loam, with open bottom.	Strong loam and dampish subsoil.	Dry sandy soil and dry bottom.	Gravelly loam on slate or granite.	Gravelly loam on limestone.	Remarks.
	Sheltered.	Moderately Exposed.	Exposed.	Moderately Sheltered.	Sheltered.	Sheltered.	Exposed.	Sheltered.	Moderately Sheltered.	Moderately Sheltered.	Exposed.	Moderately Sheltered.	Exposed.	
	Low Altitude.	Medium Altitude.	High Altitude.	Medium Altitude.	Low Altitude.	Medium Altitude.	Medium Altitude.	Low Altitude.	Low Altitude.	Medium Altitude.	Medium Altitude.	High Altitude.	High Altitude.	
Ash,	15	15	9	12	15	12	9	15	12	12	9	9	9	
Alder,	12	12	...	...	...	12	...	12	12	12	...	...	...	With nurses.
Beech,	16	16	12	15	16	15	15	16	15	15	15	12	12	
Birch,	12	12	9	10½	12	10½	9	12	10½	12	9	9	9	With nurses.
Chestnut, Spanish,	20	20	...	15	18	12	...	18	16	15	12	...	...	
—— Horse,	18	15	...	15	18	15	...	18	18	15	...	...	...	Grows to a large size.
Elm, English,	18	18	...	15	20	16	...	18	...	16	12	...	...	
—— Scotch,	16	16	12	14	15	15	12	16	...	15	12	9	...	
Lime,	18	16	...	16	16	18	...	18	16	16	...	...	...	
Oak,	20	20	...	15	18	12	...	18	16	15	12	...	...	
Poplar,	10	10	...	9	10	10	...	10	9	10	9	...	...	With nurses.
Sycamore and Maple,	16	16	12	15	16	15	12	15	...	...	12	12	12	
Willow,	6	5	...	5	6	6	...	7	6	6	...	...	...	Without nurses.
Pine, Scotch,	5	4½	3½	4	5	4	3	4½	...	4½	3½	4	3	Very hardy.
—— Spruce,	4½	3½	...	3½	4	4	...	4½	4½	4	...	...	...	
—— Silver,	4½	4	3½	4	4½	4	...	4½	4½	4½	...	3½	3½	
—— Larch,	5	4½	3½	4	5	4½	3½	5	4½	4½	3½	4	3½	Grows well within the influence of the sea.
—— Austrian,	5	5	4	4	5	4½	3½	4½	...	4½	3½	4	3½	
—— Pinaster,	4½	4½	3½	4	4½	3½	3	...	...	...	3½	4	3½	
—— Corsican,	4½	4½	4	4	4½	4	3½	4½	4½	4	3½	4	3½	Fast grower.
—— Douglas,	4½	4	...	4	4½	4½	...	4½	4½	4	...	...	...	

VIII. *The Age of Trees.*

It was the opinion of De Candolle, and other eminent botanists, that trees cannot really be said to die of old age, since their tissues are renewed from year to year, but that we must attribute their decay chiefly to accidental causes. The baobab, which Adanson proved by ingenious and plausible calculations to be 5150 years old, the *Taxodium*, which analogous reasoning would make still older, and other examples, seem to confirm the idea that there may be at present some trees in the world of immense antiquity, witnesses perhaps of its later physical revolutions. "We can easily conceive," says De Candolle, "that errors may happen in calculations of this kind, and that they cannot be considered as the expressions of exact truth, until examples of this vegetable longevity are multiplied to such an extent as to support one another." The means of ascertaining the longevity of trees would be greatly increased were observations such as we are about to record more frequently made on the subject.

Mr Twining was engaged in the year 1827 in measuring and inspecting hemlock timber, cut from the north-eastern slope of the East Rock, New Haven, America, destined for the foundation of a wharf. While thus employed, he took particular notice of the successive layers, each of which constitutes a year's growth of the tree, and which in that wood are very distinct. These layers were of various breadths, and plainly showed that in some seasons the trees made a greater advance than in others, some layers being five or six times broader than others. Every tree had thus preserved a record of the seasons for the period of its growth, whether thirty years or two hundred; and every tree told the same story. Thus by beginning at the outer layer of two trees, the one young, the other old, and counting back twenty years, if the young tree indicated by a full layer a growing season for that kind of timber, the older tree indicated the same. "I had then before me," says this intelligent writer, "two or three hundred meteorological tables, all of them as unerring as Nature; and by selecting one tree from the oldest, and sawing out a thin section from its trunk, I might have preserved one of the number to be referred to afterwards. It might have been smoothed on the one side by the plane, so as to exhibit its record to the eye with all the neatness and distinctness of a drawing. On the opposite side might have been minuted in indelible writing the locality of the tree, the kind of timber, the year and month when cut, the soil where it grew, the side and point which faced the north, and every other circumstance which can possibly be supposed ever to have the remotest relation to the value of the table in hand. The lover of science will not be backward to incur such trouble, for he knows how often in the progress of human knowledge an observation or an experiment has lost its value by the disregard of some circumstance connected with it, which at the time was not thought worthy of notice. Lastly, there might be attached to the same section a written meteorological table compiled from the observations of some scientific person, if such observations had been made in the vicinity. This being done, why, in this age of science, might not this natural, unerring, graphical record of seasons past deserve as careful preservation as a curious mineral, or a new form of crystals?"

To ascertain the respective ages attained by different kinds of trees is not merely a curious inquiry which may pleasantly occupy the time of an enlightened observer of nature, but it is one which may reasonably be expected to produce useful results, determining points in the history of the globe, and throwing light on many parts of vegetable physiology and the art of forestry. But in order to make observations on this subject that shall be really useful to the cause of science, we must first become acquainted with a few simple laws by which the growth of trees is regulated. Trees belong to two great classes, with the structure of which it is necessary that we be acquainted. The first contains a much larger number than the second, and presents more important objects for consideration. The vegetables in it have a woody stem and bark, and their method of growth is to add every year a new woody layer on the outside of preceding ones, and immediately within the bark. The new layers are therefore the most outward, and the division is on this account named "*exogenous*," which signifies increasing by addition to the outside.

The second division is composed of vegetables, whose trunks, cylindrical and seldom branching, present a woody stem, properly speaking, without bark, whose outer fibres are older and harder, while the inner are younger and softer. As the newest and latest formed portions of these vegetables are within, the division is termed "*endogenous*," which signifies increasing by addition to the centre.

Now, to the first or exogenous class belong almost all the trees in temperate regions; and this class, therefore, has been made the subject of special study by scientific men.

While it is ascertained beyond a doubt that these trees grow by the addition each year of a new woody layer, it follows as a consequence that, by the number of these layers, distinctly marked by the rings which are seen on cutting through the trunk or branch of a tree, we may ascertain, with tolerable correctness, the number of years which have passed since the tree or branch began to grow.

The cut made through a branch determines the age of that branch, while that made through the trunk determines the age of the tree. The irregularities which sometimes occur are so trivial that they need not obstruct our inquiries; for we may take it as a general rule, that the number of rings or layers indicates the number of years.

In order that the inspection may lead to true results, not only the number of rings, but the width of each ring, must be noted. This will give the rate of growth in different seasons, as well as the age of the tree. Let us note the method followed by De Candolle: "Whenever I meet with a clean cut, off an old tree," says the professor, "which is sufficiently sound to enable me to discover its layers, I place a slip of paper on the branch from the centre to the circumference; on it I mark, with a pencil or pen, the junction of each zone, noting the side of the pith, of the bark, the name of the tree, its native country, and the particular observations which it has suggested. The collection of these slips, not unlike those in the shops of tailors, gives me an exact appreciation of the growth of trees, and the means of comparing them. I am in the practice of marking in a more striking manner the lines which indicate the tens of years, and also of measuring the width from tenth to tenth. My measures being taken from the centre to the circumference, give me the radius. I double the figures, if I require the diameter: I sextuple them, if I require the circumference of the ligneous body."

De Candolle strongly recommends travellers, and those who live near extensive clearings of wood or dockyards, to prepare such tables as those just described. Where it is impossible to obtain a transverse section of trunks, other modes are recommended, *i.e.*, to find out old trees, the date of which is known, and measure their circumference, and by that measure to calculate the age of other trees of the same species. It would even be useful to take the circumference of some very old trees which we may meet with, though we are ignorant of the precise time when they were planted. Such measurements repeated at intervals, would give some idea of the rate of growth in aged trees.

In the collection of natural history at the museum at Cassel, in North Germany, is, or was a few years ago, a very interesting set of volumes, as they appear to be, though, when examined, they prove to be no real library, but specimens of the woods of five hundred different European trees, made up in the form of books. The back is formed of the bark; the sides, of the perfect wood; the top, of the young wood, with narrow rings; the bottom, of the old wood, where the rings are wider apart. When one of the volumes is opened, it proves to be a little box containing the flower, seed, fruit, and leaves of the tree, of which it is a specimen, either dried, or imitated in wax. Something of this kind, though with a more special reference to the age of trees, might be made an interesting portion of our own collections in natural history, both private and public.

Note.—The above paper was given in competition in 1874, without name of author.

IX. *On the most Profitable Mode of disposing of Home-grown Timber.* By D. F. M'Kenzie, Forester, Meldrum House.

Much has been already written upon this subject, but it may not be out of place for me to record my experience.

The most profitable mode of disposing of home-grown timber is to convert and sell it in the manufactured state. The idea is entertained by many foresters and others that it will not pay a proprietor to manufacture his own timber. Some gentlemen may think it out of place to be retailers of timber; but this is no reason why those who wish to make the most of their wood should not do so. I have for many years manufactured timber for a timber merchant, and also for landed proprietors; and in both cases found it to pay. I shall mention some instances of profit realised to my employers, which may be of interest. One wood bought at £3000 gave 57 per cent., another at over £2000 gave 85 per cent. I may, however, state that the reason of this very large profit was, that the wood consisted chiefly of larches, which were considered diseased in the heart, but very few trees turned out to be so. Another wood, bought at over £5000, gave 55 per cent.; one at £1700 gave 34 per cent.; and a number of smaller purchases realised from 7 to 130 per cent. In these cases the lots were bought either at public auction or by private tender. Only in one case have I known a loss on a lot, and this happened after the memorable 3d October 1860, when the gale upset so many trees that the market was glutted. The loss in this case was *1 per cent.* Further, on different occasions, I have exposed standing timber for sale, and the price offered was so very low, according to my estimate, that I was induced to buy machinery, and manufacture the wood, when I realised profits of from 18 to 110 per cent. over the value of the highest offer. All these profits are net, after accounting for the wood at the prices offered, and paying all expenses, including interest on capital, invested in machinery. Properly speaking, the producer should realise a greater percentage than the timber merchant, as the latter is generally bound by strict conditions, which hamper him at every turn. He is bound to remove the timber in a given time, and may have to sell it at a disadvantage: so that in buying a wood he calculates on this, and makes his offer accordingly. On the other hand, the producer can leave his timber standing to suit his convenience, or await a rise in the market price. When a timber merchant inspects a wood offered for sale, he first considers the present state and prospects of the timber trade at home and abroad. He calculates the number of thousands of cubic or superficial feet of sawn timber he will probably have in the lot, and the price he is likely to receive for it. From this price he deducts the cost of manufacture, tear and wear, interest on capital, and from 10 to 20 per cent. for the chance of a decline in the value. By this method he arrives at the price he is able to pay for the timber in the rough state.

I have been frequently asked by proprietors whether or not it would pay them to manufacture their own timber. Some tried it a few years ago, and still find it pay well. One assures me that he has realised 60 per cent. over the price offered for the same lot standing. This proof is conclusive. Some have tried it and failed, but the reason of their failure I cannot state. I know one case where the wood sawn at the mill did not pay the expense of manufacture, without accounting for the wood. There must have been something radically wrong in the management, but such a case is rare. Common sense teaches men of ordinary intelligence that, if it pays a certain class, fettered by rules and regulations, to do certain things, it must pay an *un*fettered class to do the same work.

Other advantages are to be gained by the producer manufacturing his own timber. All thinnings and back-going trees could be removed at the proper time, and their full value realised. This could be done at little extra expense. The same forester could as easily sell the manufactured timber as the wood in the round state, and no special training is required, except a few lessons on the most profitable sizes into which the different kinds of timber should be cut, and the most approved principle on which the work should be done. This is all that is necessary for a practical forester to know, and I shall offer some remarks on these important points. The appliances should be of the best description, and their power should correspond to the extent of timber on the estate, specially the extent matured. For most estates a 10-horse power portable steam-engine is suitable. This is capable of driving three saws at light work, and a circular cross saw. If the roads are firm, a road locomotive could be profitably used, both in driving wood to the saw-mill, and the sawn timber to the railway station, or other places. This engine should be of 6-horse power, and under steam would weigh about 6 tons. With an ordinary portable steam-engine, having a fly-wheel of 60 inches diameter, no intermediate motion is required. Two saws can be driven direct from the wheel, and the other two from a pulley on the shaft of the former two; the pulleys should be of good cast-iron, 14 inches diameter by 6 inches broad. None of the saws should be under 42 inches diameter to begin with. Slabbing saw and cross-cut, not thicker than No. 13 by the wire gauge, and both the others 14 slack, or 15 tight; pitch of teeth might be from $2\frac{1}{2}$ to $2\frac{3}{4}$ inches. By using thin saws, there is a great saving of power as well as of timber. The saving of timber is great. In cutting 1000 superficial feet of inch boards with a common saw gauge 11, 100 cubic feet of rough timber is required. Saw the same measurement with a saw gauge 15, and there are 92 cubic feet required—a difference of 8 cubic feet, the value of which would depend on the class of wood sawn. We shall suppose it to be of larch, at 1s. 3d. per cubic foot, and the difference in favour of the thin saw on 1000 feet will be 10s. 2500 feet of larch deals, 1 inch thick, is good sawing in one day, on which the gain is 25s. Carry this forward for 300 days, and we have the incredible sum of £375. Timber merchants use very thin saws, and save a great quantity of timber. In cutting up valuable timber into planks, I use saws of gauge 16 tight. The objection to these saws is, that they are worse to trim and keep in good working order than thick ones. I examined a saw-mill lately, and found the thinnest saw to be 12 gauge, and the others 11 tight. This seems a small matter, but is not so, and is one reason of many failures in realising high profits. How to cut the timber into profitable sizes is another important point. We shall suppose a mixed plantation to be felled, the timber of which is of ordinary dimensions. The first thing is to ask for specification and prices, and then cut accordingly. Scotch fir, of about 10 inches diameter, at 9 feet long, should be cut into railway sleepers. I may give a full specification for timber usually manufactured in Scotland, and which finds a ready sale at most English ports:

Scotch Fir.—Sleepers, 9 feet by 10 inches by 5 inches, one-third of which must have a flat surface of 4 inches on the back; the remaining two-thirds may be half round. Sleepers, 9 feet by 9 inches by $4\frac{1}{2}$ inches, slabbed or half round; 8 feet by 8 inches by 4 inches, half round; 7 feet by 7 inches by $3\frac{1}{2}$ inches, half round; all free of bark and integument (this size is seldom ordered).

Larch.—Sleepers, 8 feet 9 inches by 10 inches by 5 inches. All slabbed on the back 4 inches. Also, 8 feet by 9 inches by $4\frac{1}{2}$ inches, slabbed or half round—free of heart-rot or other disease.

Fir.—Deals, 8, 9, 10, and 12 feet, $\frac{5}{8}$, $\frac{3}{4}$, and 1 inch thick. Staves, 20, 22, 24, 26, 28, 30, 32, 34, and 36 inches by $\frac{1}{2}$ inch, to average 4 inches; the first four sizes often wanted $\frac{3}{8}$ inch thick. 38, 40, and 42 inch staves are cut $\frac{5}{8}$ inch thick. Boxwood is generally cut 6 feet 8 inches long, $\frac{3}{8}$ inch thick, and from 2 to 10 inches broad, to be all good lengths and square edged, sound and marketable timber. *Larch* staves, 31 inches by $\frac{5}{8}$ inch. Heading for do., 18, 36, 72, and 88 inches long by $\frac{3}{4}$ inch. *Alder* the same. Large sizes of *larch,* suitable for boat or ship building, should be sold in the rough state, as also *oak, elm,* and other woods suitable for these purposes, as the appliances of ordinary saw-mills are unsuitable for the profitable manufacture of such sizes. *Spruce* may be cut into sleepers 9 feet by 9 inches by $4\frac{1}{2}$ inches, and 8 feet by 8 inches by 4 inches; also, into fence posts, 6 feet by 7 inches by 3 inches, or 6 feet by 6 inches by 4 inches; and pit-wood, $3\frac{1}{2}$ inches by $3\frac{1}{2}$ inches—any length. Small *oak, ash, elm,* and *sycamore* may be cut into staves and heading, 42 inches by $\frac{3}{4}$ inch, pit-wood, etc. The best ports to send Scotch fir and spruce sleepers, and pit-wood, fence posts, etc., to, is Sunderland; larch sleepers, deals, and hardwood staves, to Hartlepool; fir deals and staves to Newcastle; boxwood to Bristol; larch staves and heading should be sold to local curers. Wood for shipbuilding purposes should be sent to the best shipbuilding ports in Scotland or England. The small trees should be cut into rails for fences, paling, rick posts, and other country requirements; and, along with the brushwood, fragments, and refuse, sold by public auction. These sales should be periodical.

All the work should be done by contract; felling and cross-cutting, sawing and piling, and all the cartage, unless done by road locomotive. The latter mode is certainly the cheapest. The steam-engine should be placed in charge of a careful, steady, and experienced man, whose business it should be to look after the plant, and prevent *bashing,* and the whole placed under the charge of the forester or wood manager, who should have full power to act as if he were transacting business on his own account, except that his books and accounts should be examined quarterly, or oftener if required, by the factor or employer. All payments should be monthly, and should be done by cheques, except to day labourers.

The selling of the timber should be by *the forester only,* or his assistant; and, to prevent mistakes, all thicknesses over one inch should be sold by the cubic foot—one inch and under by the superficial foot. For local sales, the terms should be *cash* within a month, and for large consignments, *cash on delivery,* less $2\frac{1}{2}$ per cent.

No timber should be sold to doubtful individuals or firms. In such cases it should be *cash on invoice;* and in all offers there should be reference made to the bankers, in order to know the financial position of those to whom the timber is about to be sold.

I have endeavoured, to the best of my ability, to lay before the reader the most profitable mode of disposing of home-grown timber, manufactured to any extent; and to describe, in as short a manner as possible, the system practised by me for the last seventeen years, to the satisfaction of my employers.

TRANSACTIONS

OF THE

SCOTTISH ARBORICULTURAL SOCIETY.

VOL. VIII.—PART II.

EDITOR AND SECRETARY.

JOHN SADLER, F.R.P.S.,

LECTURER ON BOTANY IN THE ROYAL HIGH SCHOOL, AND ASSISTANT TO THE REGIUS PROFESSOR OF MEDICINE AND BOTANY, UNIVERSITY OF EDINBURGH.

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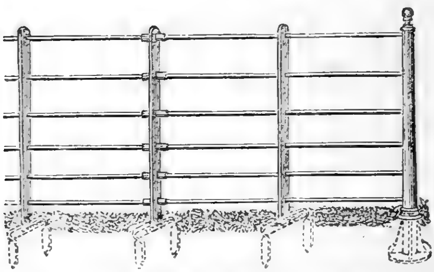

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TRANSACTIONS

OF THE

SCOTTISH ARBORICULTURAL SOCIETY.

X. *On the Anatomical Structure of the Leaf as a means of determining the species of Abies.* By W. R. M'Nab, M.D., Professor of Botany, Royal College of Science, Dublin. (With Plate.)

In 1874 Dr C. E. Bertrand of Paris published a work on the comparative anatomy of the stems and leaves of the Gnetaceæ and Coniferæ.* In that work, after giving an historical sketch of the literature of the subject, he describes the minute anatomy of the leaves of most of the important genera, and in many cases gives synoptic tables by which the species of certain of the genera may be determined. In the present essay I propose to state very briefly the results of an independent investigation, made during the past eighteen months, on the anatomy of the leaves of the various species of *Abies* of Link (*Picea*, Don) and *Pseudotsuga*, Carrière (*Abies* of authors). In so doing, I hope to be able to correct many errors that Bertrand seems to have committed, owing probably to the imperfection of the materials at his command; and, further, to throw some light on the obscure synonymy of this extremely interesting group of plants.

In examining the structure of the leaves of the species of *Abies*, it is chiefly necessary to obtain good transverse sections from the middle of the leaf. These must be thin and accurately cut, and are best rendered suitable for careful examination by being placed in a solution composed of equal parts of glycerine and water. The slices require to be examined with a moderate magnifying power, say of from 80 to 100 diameters. The chief points to notice in

* "Anatomie comparée des tiges et des feuilles chez les Gnétacéas et les Conifères," par C. E. Bertrand. Paris: G. Masson, 1874.

the transverse section are the following. First, carefully examine the central midrib or vein of the leaf. It consists, in *Abies*, of a pair of fibro-vascular bundles, placed in general very close together, and exhibiting distinctly two wood portions, or groups of wood prosenchyma, one belonging to each of the separate bundles. *Abies* can be at once separated from *Pseudotsuga* and *Tsuga* by this character, as in both of these the bundle is single, only one wood portion being visible. Second, observe the sheath of delicate parenchymatous cells surrounding the single or double bundle. It is a single layer of cells, very different from the tissue of the mesophyll or ground tissue of the leaf on the one side, and from the cells of the fibro-vascular bundles on the other. Thirdly, the general parenchyma of the leaf is to be scrutinised. If stomata are developed on one side of the leaf only, that is, on the under side, then the chlorophyll-bearing cellular tissue is loose, with many intercellular spaces communicating with the stomata of the under surface. On the upper side the chlorophyll-bearing cells are generally placed so as to form two zones or more of the pallisade tissue. If, however, stomata be present on the upper side, then the pallisade tissue is interrupted, and the loose tissue, with the usual intercellular spaces will be noticed. Fourthly, in the mesophyll, two resin canals will be found, their position varying in different species. The resin canal is an intercellular canal, surrounded by a zone of small rather thick-walled cells. The canals are, in one series, placed in the middle of the parenchyma, and run from base to apex of the leaf parallel to the midrib, but about equidistant from the midrib and margin, and also nearly equidistant from the upper and under sides of the leaf. In another series the resin canals are placed very close to the epidermis of the under side of the leaf, running parallel and close to the margin of the leaf. The resin canals are very conspicuous objects in the transverse section, and are of great importance in separating the different forms. Fifthly, the epidermis of the upper and lower surfaces of the leaf, and the cells immediately beneath it, have to be carefully examined. The epidermis consists of a single layer of cells with thick walls, and externally provided with a well developed cuticle. It also bears the stomata in rows, the rows forming very definite white bands on the under surface, one on each side of the midrib. When stomata are present on the epidermis of the upper side, they generally occur in long rows, sometimes over the whole surface, or limited to the upper half or third of the leaf; or, lastly, may form a narrow band down the whole centre of the leaf above the midrib. Beneath the epidermis a series of thickened cells is generally developed. These belong to the ground tissue of the leaf, and have nothing to do morphologically with the epidermis. These thickened cells form a continuous, or interrupted, or scattered series called the *hypoderma*, and in a few rare cases they are wanting altogether.

The study of the minute anatomy of the leaf, as shown by making a simple transverse section of the fully developed leaf, cannot fail to be useful to all arboriculturists. After the examination of several hundreds of specimens, native and cultivated, I can testify to the permanence of the characters, and to their value in separating many closely related forms. It must be kept in mind, however, that attention must be paid to the proper selection of the leaves for examination. They must be full grown, and from plants of some size, as the leaves of very young specimens (say two or three years old) often differ from those of mature ones. The differences in the structure of young and old leaves generally have a certain relation. Thus a species, which has no hypoderma in the mature leaf, will not have any in the young leaf; and a leaf, with a continuous zone of hypoderma, when mature, will have a more or less interrupted one in the young leaves. In a few cases the position of the resin canals seems a little variable in the young and old leaves. This has been observed in a few cultivated forms, as *Abies bifolia*, A. Murray, *Abies firma* of gardens, and in *Abies pichta* of gardens. In some of the species, two kinds of leaves are produced, those in the ordinary vegetative shoots being different from those on the cone-bearing axes. This is very well marked in *Abies bifolia*, Murray (hence the specific name), also in *Pseudotsuga magnifica* and *nobilis*, and probably also in *A. Pinsapo*, but I have not been able to examine the cone-bearing shoot of an authentic specimen.

In this essay I propose to take Parlatore's species, as described in De Candolle's *Prodromus*, and make some remarks on the synonomy. It will be necessary to depart from his arrangement somewhat, as it is of importance to separate the anatomically distinct species belonging to *Pseudotsuga* (of which *A. nobilis* is the type) from *Abies*. It is also impossible to give full details of the microscopic structure of the leaves of each species, as that would require more space than I have at my disposal, and would need numerous drawings to render the description intelligible. It is the less necessary as a full account of the structure of these plants will shortly be published in another place.

Abies, *Link* (Picea, *Don, Loudon*).

No. 1 (88).* *Pinus* (*Abies*) *bracteata,* Don, Parlatore.
Abies bracteata, Hooker and Arnott.

Leaves pointed, stomata on under side of leaf only. Resin canals close to the epidermis of the under surface. Hypoderma forming a continuous zone under the epidermis of the upper side.

Most nearly related anatomically to *A. religiosa,* but distinguished by the form of the leaf, and by the non-resinous, yellow bud-scales, as well as by the conspicuous difference in the cones.

Several cultivated and native specimens have been examined. The characters are very uniform, and, as far as observation goes, it is a plant that does not vary in appearance or in the structure of the leaf.

Living specimens have been examined from the Royal Botanic Garden, Edinburgh; from Glasnevin Garden, Dublin; and from Elvaston Nurseries, Derby, kindly sent by Mr Syme. Native specimens have been examined in Kew Herbarium, from Douglas, and also from Lobb (No. 119). Leaves and cones in the Museum, Royal Botanic Garden, Edinburgh, from Mr Andrew Murray, have also been carefully studied.

No. 2 (90). *Pinus* (*Abies*) *Fraseri,* Parsh., Parlatore.
Abies Fraseri, Lindl.

Leaves short, blunt at the points. Stomata on both sides of the leaf. Hypoderma slightly developed under the epidermis of the upper side. Resin canals in the parenchyma of the leaf.

Most closely related anatomically to *A. balsamea,* from which it can be distinguished by the appearance and position of the leaves, as well as by the very distinct cones. Although placed close to *bracteata* and *religiosa* by Parlatore, it is in no way related anatomically to these species.

I have only examined one living specimen of this species, kindly sent to me by Mr Fowler, from Castle Kennedy; and have examined a cone (without leaves) in the Museum, Royal Botanic

* The numbers in brackets refer to the numbers in Parlatore's Monograph in De Candolle's *Prodromus,* vol. xvi.

Garden, Edinburgh, presented by Mr Fowler, and grown at Castle Kennedy.

Specimens from Kew Herbarium have also been examined. One from the summit of the Hoosack Mountains, Massachusetts; another from Canada, and a third from Newfoundland, named *Pinus Americanus;* but I am rather doubtful of the two last, as some leaves of *Fraseri* and *balsamea* approach each other exceedingly closely anatomically, and are not readily separated when dried specimens only are consulted.

No. 3 (91). *Pinus* (*Abies*) *religiosa,* Humbl., Parlatore.
Abies religiosa, Schlecht, Lindl.

Leaves long, sharp at the points; stomata on the under side of the leaf only. Hypoderma, forming a continuous, or only slightly interrupted, layer under the epidermis of the upper surface. Resin canals close to the epidermis of the lower side of the leaf.

Most closely related anatomically to *A. bracteata,* but distinguished by the form and arrangement of the leaves, by the very resinous, yellow bud-scales, and also by the cones.

Living specimens have been examined from Glasnevin Garden, Dublin, where it is kept with difficulty; and from Castle Kennedy. I have also examined leaves from a cone-bearing shoot from Castle Kennedy (1867), now in the Mnseum, Royal Botanic Garden, Edinburgh.

An authentic specimen of *Abies hirtella* was examined from Kew Herbarium. It differs in having the leaves blunt and emarginate, and having only a few large, scattered hypoderm cells. As some of the leaves from the rather unhealthy plant in Glasnevin Garden exhibited a similar character, I am not disposed to consider *hirtella* a distinct species.

(92.) *Pinus* (*Abies*) *Abies,* Duroi, Parlatore.

As Parlatore unites *Abies pectinata,* De C.; *Abies Nordmanniana,* Spach.; *Abies Cephalonica,* Loudon; *Abies Apollinis,* Link; and *Abies Reginæ-Amaliæ,* Heldr., and makes them either synonyms or varieties, I must depart from his arrangement.

No. 4. *Abies pectinata,* De Candolle.

Leaves rounded or emarginate at the apex. Stomata on the under side of the leaf only. Hypoderma forming a very slightly interrupted layer under the epidermis of the upper side of the leaf. Resin canals in the parenchyma of the leaf.

All the specimens of *A. pectinata* examined have the resin canals in the parenchyma of the leaf, and are thus at once separated from *A. Nordmanniana.*

No. 5. *Abies Nordmanniana,* Spach.

Leaves emarginate at the apex. Stomata on the under side of the leaf only. Hypoderma forming a slightly interrupted layer under the epidermis of the upper side of the leaf. Resin canals placed close to the epidermis of the under side.

Closely related to *A. pectinata,* but has the resin canals in a different position.

No. 6. *Abies Cephalonica,* Loud.

Leaves pointed at the apex. Stomata rarely forming a row or two on the upper surface of the leaf, generally confined to the lower. Hypoderma well developed, forming a zone two or three cells thick under the whole epidermis of the upper side. Resin canals placed close to the epidermis of the under side.

Very different from *A. pectinata.* More nearly related to *A. Nordmanniana,* but at once separated by the enormous development of hypoderma.

A. Apollinis, Link, and *A. Reginæ-Amaliæ,* Heldr., have both been examined. They can hardly be considered, anatomically, as being anything more than slight varieties of *A. Cephalonica,* having a slightly less development of hypoderma, and having the stomata more constantly present on the upper side of the leaf.

No. 7 (93). *Pinus* (*Abies*) *cilicica,* Antoine and Kot., Parlatore.
Abies cilicica, Carrière.

Leaves obtuse and emarginate at the apex; upper surface with no stomata. Hypoderma well developed, but consisting of rather scattered cells. Resin canals near epidermis of lower side.

Living specimens of *Abies cilicica* have been examined from Glasnevin Garden, Dublin, and from Elvaston Nurseries, and an authentic specimen from Kotschy (370), in the Herbarium of Trinity College, Dublin.

It is extremely closely related, anatomically, to *Abies Nordmanniana,* but as I have not had the opportunity of examining an authentic cone-bearing shoot, I shall consider them quite distinct.

No. 8 (94). *Pinus* (*Abies*) *Pinsapo*, Boiss, Parlatore (*part*).
Abies Pinsapo, Boiss.

Leaves projecting all round the stem, short, rigid, with a very sharp point; upper surface with six or eight rows of stomata, placed rather distantly over the whole surface, below with a band on each side of the midrib. Hypoderma well developed, often two or three cells thick, but forming a zone, interrupted by the stomata. Resin canals close to the epidermis of the under side.

Living specimens only of *Abies Pinsapo* have been examined; and I have not been able to examine leaves from an authentic cone-bearing shoot.

Related, although distantly, to *A. Nordmanniana* and *A. Cephalonica*, more nearly to *A. Baborensis*, but in all respects a remarkable distinct form.

No. 9. *Abies Baborensis*, Coss (*Pinsapo*, Parlatore *in part*).
Abies Numidica, De Lannoy.

Leaves short, blunt, or emarginate at the apex, above with one or two short rows of stomata near the apex, below with a band on each side of the midrib. Hypoderma scanty. Resin canals close to the epidermis of the under side.

Somewhat intermediate between *Pinsapo* and *Nordmanniana* in appearance, but differing anatomically in the presence of stomata on the upper side, and in the scanty development of the hypoderma. Living specimens only have been examined from the Royal Botanic Garden, Edinburgh, from Glasnevin Botanic Garden, and from Elvaston Nurseries. It is cultivated under the names of *Numidica* and *Baborensis.*

No. 10 (95). *Pinus* (*Abies*) *balsamea*, Linn., Parlatore.
Abies balsamea, Mill.

Leaves short, apex emarginate; upper surface with two or more rows of stomata in the middle line, near the apex, below with a band of stomata on each side of the midrib. Hypoderma wanting. Resin canals in the parenchyma of the leaf.

Closely related to *A. Fraseri*, and not easily separable anatomically. Living specimens have been examined from the Royal Botanic Garden, Edinburgh, and from Elvaston Nurseries. Two American specimens from Kew Herbarium, and the leaves from a cone-bearing shoot in the Museum, Royal Botanic Garden, Edinburgh, have also been examined. The cones of *A. balsamea* and *A. Fraseri* are sufficiently distinct.

(96.) *Pinus* (*Abies*) *firma*, Parlatore (not Antoine).

Parlatore gives *Abies bifida* and *Abies homolepis* as synonyms of his *P. firma*. In this I cannot concur.

No. 11. *Abies firma*, Sieb. and Zucc. (not Parlatore).

Leaves slightly wider near the apex than above the base, apex rounded and emarginate. A few stomata occasionally in a patch on the upper surface near the apex, below with a band on each side of the midrib. Hypoderma well developed. Resin canals in the parenchyma of the leaf.

Only two specimens of *firma* have come under my notice, both of them in Kew Herbarium, and named *firma*, Sieb. and Zucc. One was sent from Nagaski, Japan, by Oldham, in 1862; the other was collected in Japan, Nippon, by Maximiowicz in 1864. It is not in cultivation, all the plants I have seen under this name being *A. bifida*. *Abies homolepis*, Sieb. and Zucc., sunk by Parlatore as a synonym of *firma*, I have not seen; but, according to Bertrand, it only differs from *A. firma* in having fewer stomata on the under surface of the leaf, a character of no importance. *Abies brachyphylla*, Maximiowicz, *Pinus brachyphylla*, Parlatore (No. 98), is anatomically the same as *Abies firma*.

No. 12. *Abies bifida*, Sieb. and Zucc.

Leaves tapering towards the bifid apex; no stomata on the upper surface, below with a band on each side of the midrib. Hypoderma well developed. Resin canals close to the epidermis of the lower side of the leaf. Parenchyma of the mesophyll of the leaf with numerous scattered, elongated, unbranched, greatly thickened, liber-like cells (idioblasts), quite peculiar to this species.

I have received the plant under the name of *bifida* from the Royal Botanic Garden, Edinburgh, and have compared it with an authentic specimen in Kew Herbarium. A narrower leaved form of the same species is also cultivated (without a name) in the Edinburgh Garden. It is the form cultivated as *Abies firma*, and has been sent to me under this name from Messrs Veitch of Chelsea, and from Castle Kennedy. Mr Fowler sent me a "late variety," in one of the leaves of which there was a slight abnormality, the resin canal of one side being slightly distant from the epidermis.

(97.) *Pinus* (*Abies*) *holophylla*, Parlatore.

One of Maximiowicz's species, of which I have seen neither living nor dried specimens.*

(98.) *Pinus* (*Abies*) *brachyphylla*, Parlatore.

The examination of an authentic specimen in Kew Herbarium, *Abies brachyphylla*, Maxim., Japan, Yokohama, 1862, shows that *A. brachyphylla*, Max., is *A. firma*, Sieb. and Zucc. (not Parlatore), while *A. firma*, Parlatore (not Ant.), seems to have been described from a mixed set of specimens of *firma* and *bifida.*

No. 13 (99). *Pinus* (*Abies*) *Pindrow*, Royle, Parl.
Abies Pindrow, Spach.

Leaves long; apex bifid, with two narrow sharp points. No stomata on the upper surface of the leaf. Hypoderma forming an interrupted layer of cells. The margin of the leaf sharp. Resin canals close to the epidermis of the lower side of the leaf.

Closely related anatomically to *A. Webbiana*, and differing more in the outline of the transverse section than in the actual structure. Living specimens from Glasnevin Garden and Elvaston Nurseries have been examined.

No. 14 (100). *Pinus* (*Abies*) *Webbiana*, Wall., Parl.
Abies Webbiana, Lindl.

Leaf slightly contracted towards the bifid apex, the two portions either small and very sharp, or slightly rounded. No stomata on the upper side of the leaf. Hypoderma forming an interrupted layer of cells. Margin of the leaf rounded. Resin canals close to the epidermis of the lower side of the leaf.

Closely related to *A. Pindrow*, I have received living specimens from Glasnevin Garden and from Elvaston Nurseries, and have examined dried specimens (with leaves) from Castle Martyr, Cork; and two without leaves, from Castle Martyr and Holkam Hall, all in the Museum, Royal Botanic Garden, Edinburgh.

A third form has come under my notice, the first specimen in the Herbarium of Trinity College, Dublin, from the Himalayas, named *A. Webbiana*, from Hooker *fil.* and Thomson's collection; and a second specimen of the same thing bearing a cone, from Castle

* Since the above was written I have been able, through the kindness of Professor Oliver, F.R.S., to examine an authentic specimen of *A. holophylla*, Maxim., from Kew Museum. It is a distinct form, not yet in cultivation.

Kennedy, in the Museum, Royal Botanic Garden, Edinburgh, and named *A. Pindrow.* Both these are distinguished by the position of the resin canal, which is in the parenchyma of the leaf. It requires further investigation.

No. 15 (101). *Pinus* (*Abies*) *sibirica*, Turcz., Parlatore.
Abies sibirica, Ledeb.

Leaves with the apex rounded or slightly truncate. No stomata on the upper surface. Hypoderma wanting. Resin canals in the parenchyma of the leaf.

Cultivated in the Royal Botanic Garden, Edinburgh, and in the Glasnevin Garden, Dublin, under the name of *A. pichta.* Also received from Elvaston Nurseries as *A. sibirica.* Anatomically a most distinct species, most nearly related to *A. balsamea* and *Fraseri*, but at once distinguished by the form of the leaf, the total absence of any trace of hypoderm cells, and the absence of stomata on the upper surface of the leaf.

No. 16. *Abies amabilis*, Douglas (not Parlatore).

Leaves rounded and emarginate at the apex, peculiarly arranged, forming two lateral rows, and those on the upper side of the shoot twisted so as to bring their upper surfaces superiorly, and placed with their axes nearly parallel to the long axis of the shoot. No stomata on the upper surface. Hypoderma well developed, forming a thick, slightly interrupted layer of cells. Resin canals close to the epidermis of the under side of the leaf.

Many specimens of this species have been examined. It is the *amabilis* of gardens, the *Abies grandis* of A. Murray ("Synonyms of Various Conifers," p. 18), who figures the peculiar arrangement of the leaves (*op. cit.*, p. 19, fig. 20). It is cultivated in the Royal Botanic Garden, Edinburgh, at Elvaston Nurseries, and by Mr Anthony Waterer, as *amabilis.* Three specimens in Kew Herbarium, collected by Dr Lyall, have also been examined. On the Continent it is known as *Abies spectabilis*, Herpin de Fremont, (*teste*, Bertrand). Parlatore confounds it with *lasiocarpa* of Hooker and *Abies bifolia* of Andrew Murray, the description given by Parlatore referring to *bifolia*, Murray.

This species was sent home by Jeffrey as No. 409, and was described and figured as *Picea lasiocarpa*, Balfour. No plants seem to have grown from Jeffrey's seeds, as all the plants called *lasiocarpa* are *grandis.* The examination of the original specimen in the Museum, Royal Botanic Garden, Edinburgh, enables me to state with confidence that *A. lasiocarpa* (Balf.) is *A. amabilis* (Dougl.). Mr Murray's figures (*op. cit.*, p. 34, figs. 1 and 2) also prove the same thing. *A. lasiocarpa* (Hook.) is a distinct thing, and equals *A. bifolia* (A. Murray), *A. amabilis* (Parlatore).

No. 17. *Abies lasiocarpa*, Hooker (not Balfour).
A. bifolia, A. Murray, Syn. var. Conif., p. 31.
A. amabilis, Parlatore, De C., Prod., 426, No. 102 (not Dougl.).

Leaves of two kinds, those on the vegetative branches rounded or emarginate, on the cone-bearing shoots sharp and pointed. Stomata on both sides of the leaf. Hypoderma well developed. Resin canals in the parenchyma of the leaf.

Very different, anatomically, from *A. amabilis*, with which it is confounded by Parlatore. It was confused by the Oregon Committee and Jeffrey with *Pseudotsuga magnifica*, both plants being mixed in Jeffrey's (No. 1480) in the Museum, Royal Botanic Garden, Edinburgh. I have examined Hooker's type specimen in Kew Herbarium, a specimen sent by Douglas in the same Herbarium, five specimens from the Oregon Boundary Commission collected by Dr Lyall in 1860-61, with the native name "*Marielp.*" It is also *P. bifolia* of Murray. I have examined specimens from M. Roezl, sent to me by Mr Syme. The only living plants observed were seedlings from Elvaston Nurseries. None of the seeds sent out by the Oregon Committee seem to have germinated. A glance at the figures of the bracts given by Mr Murray in his work already quoted, p. 34, figs. 4 and 12, will show that *lasiocarpa* (Hook.) equals *bifolia* (Murray).

No. 18 (103). *Pinus* (*Abies*) *concolor*, Engel., Parlatore.
Abies concolor, Lindl.

Leaves obtuse at the apex, closely covered with stomata on both sides. Hypoderma scanty. Resin canals touching the epidermis of the under side of the leaf.

A very distinct form, related to *Lowiana* and *grandis*, and more distantly to *amabilis*. I have only seen dried specimens from Engelmann (No. 828) in the Herbarium at Kew and Trinity College, Dublin, and have not as yet seen it in cultivation in this country. Bertrand (*op. cit.*, p. 90) gives the anatomical characters of *A. concolor* as those of *grandis* (Lindl.), and cites *grandis* and *lasiocarpa* as synonyms, *grandis* of Douglas being Bertrand's *Gordoniana.*

No. 19 (104). *Pinus* (*Abies*) *grandis,* Dougl., Parlatore *in part.*
Abies grandis, Lindl.
Abies amabilis, A. Murray.
Abies Gordoniana, Carrière.
Abies lasiocarpa, Hort. (not Balf. or Hooker).

Leaves obtuse and emarginate at the apex, without stomata on the upper surface (very rarely with two or three in a small cluster near the apex). Hypoderma consisting of a few scattered cells under the upper epidermis. Resin canals touching the epidermis of the under side of the leaf.

A very distinct form (No. 393 of Jeffrey), the scale of which is figured by Mr Murray (*op. cit.*, p. 25, fig. 32). Known commonly in gardens under the names of *grandis* and *lasiocarpa.* It is *A. Gordoniana* of Carrière and Bertrand. This species can be distinguished with the greatest ease from all its allies by the hypoderma of the leaf, as well as by the bracts of the cone.

No. 20. *Abies Lowiana,* Murray, Syn. var. Conif., p. 27.
Picea Lowiana, Gordon.
Pinus (*Abies*) *grandis,* Parlatore *in part.*
Picea Parsonsii, Hort.
Picea lasiocarpa, Hort.

Leaves long, narrow, obtuse or emarginate at the apex, with a broad band of stomata on the upper surface, running in the middle line from base to apex. Hypoderma well developed. Resin canals touching the epidermis of the under side.

Closely related to *Abies grandis,* but distinct. Separated by the different development of hypoderma, by the presence of the stomata on the upper side, and, when growing, by the paler, more yellow colour of the young leafy axes.

Many native and cultivated specimens have been examined. Specimens from Mr Low of Clapton in Kew Herbarium. Two in the Museum, Royal Botanic Garden, one from Jeffrey (without a number), the other from Mr Andrew Murray, collected by Mr William Murray. It is cultivated extensively, and passes under different names, such as *Lowii, Lowii glauca, Parsonii,* and *lasio-*

carpa. It was described in 1862 by Mr Gordon as *Picea Lowiana.*

No. 21 (105). *Pinus (Abies) Veitchii.*
Pinus selenolepis, Parlatore.
Abies Veitchii, Carrière.
Picea Veitchii, Lindl.

Leaves obtuse and emarginate at the apex. Stomata on the under surface of the leaf only. Hypoderma wanting. Resin canals in the parenchyma of the leaf.

Only a single specimen of the remarkably distinct form has been seen. It is in Kew Herbarium, and bears two labels, "*Abies microsperma*" and "*Picea Veitchii* (Lindl.)." It has nothing to do with the *Abies Veitchii* in cultivation.

No. 22. *Abies Harryana.* New species.
Abies Veitchii, Hort., Veitch. Not of descriptions.

Leaves acute at the apex. Stomata on the under surface of the leaf only. Hypoderma forming a continuous or almost continuous layer under the epidermis of the upper side of the leaf. Resin canals touching the epidermis of the under side.

This is the plant cultivated as *A. Veitchii*, and sent to me under that name by Messrs Veitch. It differs in appearance from true *Veitchii*, and can be at once separated anatomically by the great development of the hypoderma, and by the position of the resin canals. If further investigation confirms the opinion that it is new, the name *Harryana* will be retained in compliment to Harry J. Veitch, Esq., the head of the firm of Veitch & Sons, in London.

No. 23. *Abies sp.*, from Drummond.

A single plant, in the Royal Botanic Garden, Edinburgh, has been examined, and I fail to refer it to any of the forms already noticed.

PSEUDOTSUGA, *Carrière.*

Leaves not in cushions, but inserted directly into the stem, as in *Abies.* Two resin canals, one on each side of the leaf. Fibrovascular bundle single.

No. 1 (89). *Pinus (Pseudotsuga) nobilis*, Dougl., Parl.
Abies nobilis, Linn.
Picea nobilis, Loudon.

Leaves projecting upwards on the upper side of the shoot; leaf with an obtuse apex. Stomata on both sides of the leaf. Leaves on the vegetative shoot furrowed on the upper side. Hypoderma chiefly developed at the margins of the leaf and below the longitudinal furrow. Resin canals close to the under surface of the leaf.

Very many specimens of *P. nobilis*, native and cultivated, have been examined. The leaves are rather variable, being flattened in young plants, and on the cone-bearing shoots approaching that of the next species, *P. magnifica.* I have examined specimens from Douglas, and also from Jeffrey (No. 398).

No. 2. *Pinus (Pseudotsuga) magnifica.*
Abies magnifica, A. Murray, Syn. var. Conif., p. 27.
Abies amabilis, Parlatore, under 102.
Abies robusta, Hort.

Leaves rounded or acute at the apex, more or less tetragonal, not grooved on the upper surface. Stomata on both sides of the leaf. Hypoderma well developed. Resin canals close to lower epidermis, surrounded by hypoderma.

Many specimens of this have been examined, both cultivated and native. The specimens from Lobb are in Kew Herbarium. It was also sent home by Jeffrey (No. 1480, part), and is extensively cultivated in the Royal Botanic Garden, Edinburgh, under the names *magnifica* and *robusta.* It is very closely related to *P. nobilis*, but separated at once by the short bracts of the cone. The bracts are well figured by Mr Andrew Murray, Syn. of var. Conif., p. 28, fig. 42. It is difficult to understand how Parlatore could have confounded it with his *P. amabilis*, and it seems inexcusable when he had Mr Murray's most excellent figures before him.

A specimen of *amabilis* (Douglas) in Kew Herbarium, and sent to me by Professor Oliver, as the type of Douglas's species, is either *magnifica* or *nobilis*, so that some confusion must have been made at a very early time. Further investigation will, however, be made on this point.

No. 3. *Pseudotsuga Davidiana*, Bertrand.

A species from Thibet, unknown to me, and described by Dr C. E. Bertrand, *op. cit.*, p. 82. It is not in cultivation.

No. 4 (111). *Pinus* (*Pseudotsuga*) *Douglasii*, Sabine, Parl.

The characters of specimens of *Douglasii* seem variable, and I have seen two distinct plants under this name. The large plant in the Royal Botanic Garden, Edinburgh, may be taken as the type of the one form. The other I have only seen herbarium specimens of, one from Kew, and two from the herbarium of Trinity College, Dublin. These latter—the herbarium specimens—are all distinguished by the presence of remarkable star-like, thickened cells of large size lying in the parenchyma of the leaf. The specimen from Kew Herbarium is from the Rocky Mountains, and marked "*Douglasii?*" The next, from Trinity College Herbarium, is from New Mexico, C. Wright (No. 1885). The third is from the same herbarium, and was collected by Fendler in New Mexico (No. 829). Parlatore cites this plant as belonging to *P. amabilis*, but it is anatomically identical with Wright's specimen referred by Parlatore to *Douglasii.* Further observation is wanted to clear up the difficulties in the synonymy.

No. 5 (112). *Pinus* (*Pseudotsuga*) *Fortunei*, Parl.
Abies Fortunei, Lindl.
Abies Jezoensis, Hort.

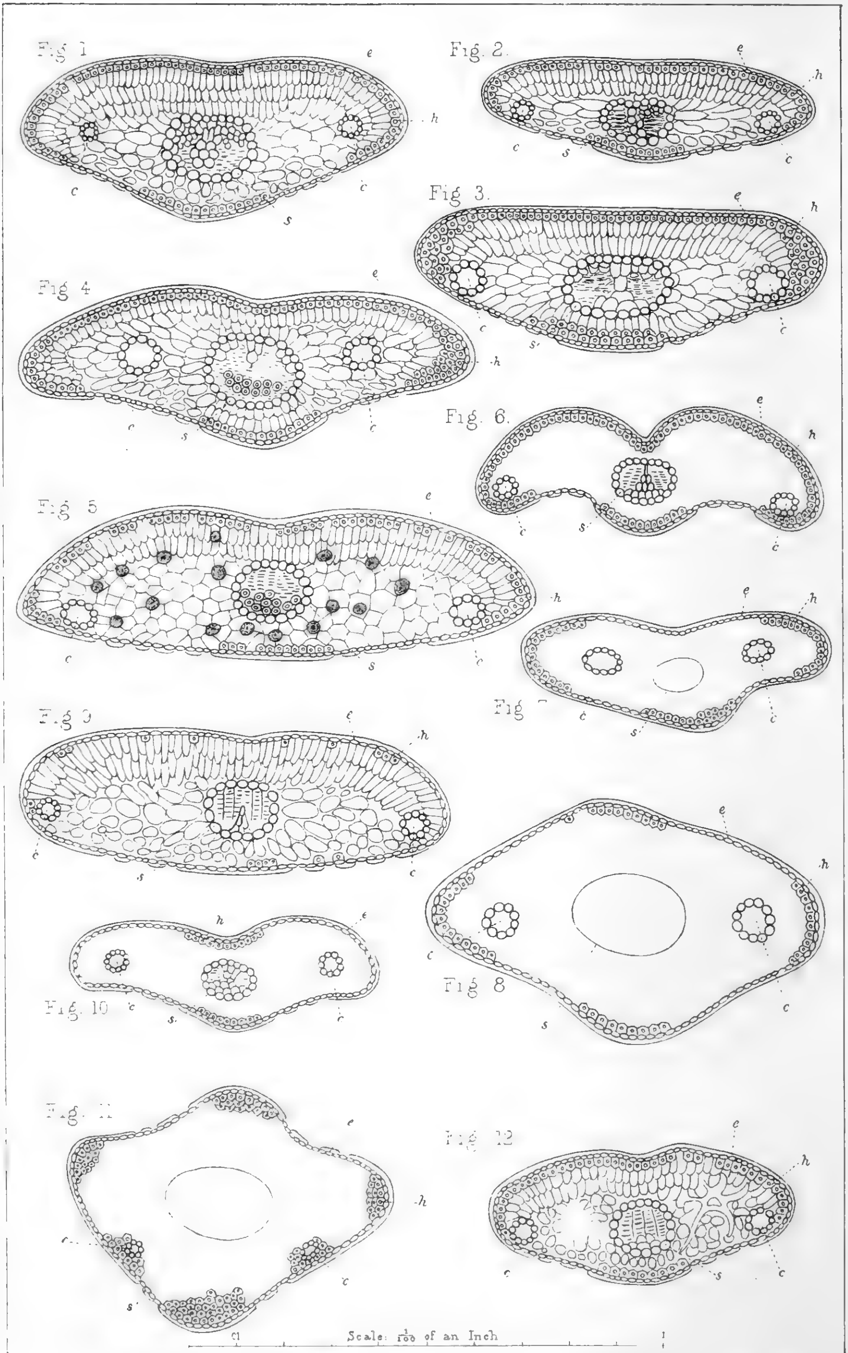
Leaves long and pointed. No stomata on the upper side of the leaf. Hypoderma not very well developed. Resin canals close to the lower epidermis.

A very distinct form, most closely related to *Abies Veitchii* (Hort., Veitch), *A. Harryana mihi*, differing only in the larger leaf and single fibro-vascular bundle. I am indebted to Messrs Veitch for the only living specimen I have seen. It is well described and figured by Mr Andrew Murray in his "Sketch of the Conifers of Japan."

LIST OF SPECIES OF ABIES AND PSEUDOTSUGA

Abies.

No. 1	(88).	*A. bracteata*, Hook. and Arnott.	
,, 2	(90).	*A. Fraseri*, Lindl.	
,, 3	(91).	*A. religiosa*, Schlecht.	(*A. hirtella*, Humb.)
	(92).	*Pinus Abies*, Duroi, Parl.	
,, 4	(92).	*A. pectinata*, D. C.	
,, 5	(92).	*A. Nordmanniana*, Spach.	
,, 6	(92).	*A. Cephalonica*, Loud.	(*A. Apollinis*, Link.) (*A. Reginæ-Amaliæ*, Heldr.)
,, 7	(93).	*A. cilicica*, Carrière.	
,, 8	(94).	*A. Pinsapo*, Boiss, Parlatore *in part.*	
,, 9	(94).	*A. Baborensis*, Coss.	(*A. Numidica*, De Lannoy.)
,, 10	(95).	*A. balsamea*, Mill.	
	(96).	*Pinus firma*, Parlatore, not Antoine.	
,, 11	(96).	*A. firma*, Sieb. and Zucc.	(*A. brachyphylla*, Maxim.)
,, 12	(96).	*A. bifida*, Sieb. and Zucc.	(*A. firma*, Hort.)
	(96).	? *A. homolepis*, Sieb. and Zucc.	
	(97).	? *A. holophylla*, Maxim.	
	(98).	*A. brachyphylla*, Maxim.	(*A. firma*, Sieb. and Zucc.)
,, 13	(99).	*A. Pindrow*, Spach.	
,, 14	(100).	*A. Webbiana*, Lindl.	
,, 14*a*.		*A. nov. sp.* ? ?	(*A. Webbiana*, Hook. *fil.* and Th.) (*A. Pindrow*, Mus. R. B. G., Edin.)
,, 15	(101).	*A. sibirica*, Ledeb.	(*A. pichta*, Hort.)
,, 16.		*A. amabilis*, Dougl., not Parlatore.	(*A. grandis*, A. Murray.) (*A. spectabilis*, Herp. de Fr., Bertrand.) (*Picea lasiocarpa*, Balf.) (Jeffrey's, No. 409.)
,, 17	(102).	*A. lasiocarpa*, Hook.	(*A. amabilis*, Parl., 102.) (*A. bifolia*, A. Murray.) (Jeffrey's, No. 1480, *in part.*)
,, 18	(103).	*A. concolor*, Engel.	(*A. grandis*, Bertrand.)
,, 19	(104).	*A. grandis*, Lindl.	(*A. grandis*, Parl. *in part.*) (*A. amabilis*, A. Murray.) (*A. Gordoniana*, Carrière.) (*A. lasiocarpa*, Hort.)
,, 20	(104).	*A. Lowiana*, Murray.	(*A. grandis*, Parl. *in part.*) (*Picea Parsonii*, Hort.) (*Picea lasiocarpa*, Hort.) (*A. grandis*, A. Murray, in Mus. R. B. G., Edin.)



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No. 21 (105). *A. Veitchii*, Carrière. (*P. selenolepis*, Parl.)
,, 22. *A. Harryana*, nov. sp. (*A. Veitchii*, Hort.)
,, 23. *A. sp.*, Drummond.

Pseudotsuga.

No. 1 (89). *P. nobilis*, Dougl.
,, 2 (102). *A. magnifica*, A. Murray. (*P. amabilis*, Parl., *in part.*) (Jeffrey, No. 1480, *in part.*) (*A. robusta*, Hort.)
,, 3. *P. Davidiana*, Bertrand.
,, 4 (111). *P. Douglasii.* (Two forms ?)
,, 5 (112). *P. Fortunei*, Lindl. (*A. Jezoensis*, Hort.)

EXPLANATION OF PLATE.

(The figures are copied from the Plates (46, 47, 48, and 49) in the Proceedings of the Royal Irish Academy, Series II., Vol. ii., Science.)

Letters in figures:

e. Epidermis.
h. Hypoderma.
c. Resin canals.
s. Sheath of fibro-vascular bundles.

Fig. 1. *Abies pectinata* (Glasnevin Garden), Pl. 48, Fig. 20.
,, 2. *A. Nordmanniana* (Glasnevin Garden), Pl. 48, Fig. 22.
,, 3. *A. Cephalonica* (Glasnevin Garden), Pl. 48, Fig. 24.
,, 4. *A. firma* (Kew Herbarium), Pl. 47, Fig. 14.
,, 5. *A. bifida* (Messrs Veitch, Chelsea), Pl. 47, Fig. 15.
,, 6. *A. amabilis* (Jeffrey, No. 409), Pl. 46, Fig. 3*a*.
,, 7. *A. lasiocarpa* (Kew Herbarium), Pl. 46, Fig. 7.
,, 8. *A. lasiocarpa*, leaf from cone-bearing shoot (Kew Herbarium), Pl. 47, Fig. 9.
,, 9. *A. grandis* (Royal Botanic Garden, Edinburgh), Pl. 46, Fig. 4.
,, 10. *A. Veitchii* (Kew Herbarium), Pl. 47, Fig. 13.
,, 11. *Pseudotsuga magnifica* (California, Lobb, in Kew Herbarium), Pl. 49, Fig. 30*a*.
,, 12. *P. Douglasii?* (Fendler, No. 829, in Herb., Trinity College, Dublin), Pl. 49, Fig. 32*b*.

XI. *On the Timber Supply of Australia.* By the Hon. Mr KRICHAUFF, Member of Legislative Assembly of South Australia. With Note, by R. HUTCHISON of Carlowrie, V.-P.S.A.Soc.

The following deeply interesting and instructive paper was recently read before a Meeting of the Chamber of Manufactures, in the South Australian Institute, Adelaide, under the Presidency of His Excellency the Governor of South Australia. As much of the ground so ably traversed in his address is very suggestive, and at the same time instructive to the practical forester of our own country, and to the younger Members of the Scottish Arboricultural Society, Mr Krichauff's paper is here reproduced, in the hope of showing the strenuous calls for forest conservancy and extension of plantation works which exist, and are being grappled with in some of the most important colonies of the British Crown. A perusal of so able an advocate as Mr Krichauff's views may suggest reflections applicable to our own native land, and arouse the attention of Arboriculturists to the fact that, if such conditions of necessity for forest conservancy exist in comparatively sparsely-peopled and new countries, it is surely the more incumbent upon the practical labourer in the cause of Arboriculture in the mother country, to endeavour, by all the means in his power, to further the art of his profession, and to promote the home growth of valuable timber, seeing so many of the old timber supplies in countries whence we have been accustomed to draw largely for our constructive wants at home, must now have yearly increasing demands upon their resources, in competition with our own, from those rapidly progressing colonies which Great Britain has established for her surplus population in all quarters of the world, even in climates where timber for constructive purposes is by no means over abundant.

Mr KRICHAUFF said: No raw material, I venture to say, is of greater importance to a larger number of tradesmen and manufacturers than timber, and, even by the simple appellation of fuel, wood takes with manufacturers a place at least next to coal. If, therefore, the Chamber of Manufactures takes an interest in the supply of timber and fuel, it is a duty which the Chamber owes to its members; and I feel proud of being requested to call this day special attention to our forests, and the supply of timber and fuel. I may not be able to furnish much that is new, but the collection into a small compass of available statistical information, and extracts from various books, lectures, or speeches bearing upon the question, but not accessible to everybody, may secure your attention for a short while, and show you that the preservation of our never very extensive native forests is urgently required; and I hope you will only earnestly recommend the planting of forest trees on a large scale. A thousand pities that the present planting season, with such abundant rain, should be again lost. My statistical information as to the number of persons who work in wood is neither complete nor of a late date. In the year 1871 we had in South Australia 6 manufactories of organs and pianos, 13 of picture frames, 1 of washing machines, 16 establishments for boat and ship building, 29 saw mills; and in the municipalities alone there were as long ago as in the year 1866 already 146 shops occupied by carpenters and cabinetmakers, 18 by coopers, 12 by turners, and 42 by wheelwrights. At least 30 of the more reputed mines require in the aggregate an enormous quantity of both timber and fuel. For the year 1873 coal and coke have been imported into the colony for the sum of £88,002; timber of all kinds (deducting re-exports) for the sum of £125,726, 5s. During the first quarter of the year 1875 we have actually imported timber for the very large sum of £62,971, and admitting that the larger proportion of our present importation of timber consists of such kinds as we may probably have to import, even if we plant forests, it is yet noteworthy that we have not yet exported one shilling's worth of our native timber against such large sums. I think we are the only Australian colony which cannot or does not export some kind of native timber. With the increase of population this large importation will, however, not simply become larger still, but must, even if we found coal, increase in the same ratio as our supply of native timber decreases. To fortify this position, it is best to give you an idea of the very great consumption of firewood, and consequent rapid decrease of native timber. As we have no peat, and only imported coals, the quantity of firewood used in our households, considering our mild winters, is proportionately large; and we may assume that 15 tons of fuel, irrespective of the consumption for manufactories, is consumed in each of the 38,333 households which the census of 1870 enumerated. With a consumption of 574,995 tons in 1870, we certainly used more than 600,000 tons of firewood in 1875. Add to this the yearly increasing quantity of sleepers and firewood required by our railways, the timber for our mines, and the fences for our farmers and graziers, and I have no doubt it will make it clear to you that something must be done for the future. Of late years this subject—the necessity of preserving and planting forests—has presented itself more forcibly to the attention of all civilised Governments. Dr Hooker, of Kew Gardens, says, in a letter dated October 22, 1873, addressed to the Under-Secretary (Herbert): "The duty of conserving the natural resources of the colonies for the benefit of future generations, whilst encouraging a fair use of them by the present, is becoming the most pressing and arduous duty of those entrusted with their government." This was written after he had perused the rules for the conservation of the Ceylon forests. Mr Dalzell, the Conservator of Forests, Bombay Presidency, says in his observations on the influence of forests: "It has been said that to pursue the progress of man step by step in the destruction of forests, would be to write the history of civilisation, as man is developed only at the expense of forest vegetation. Hence an endeavour has been made to establish it as a maxim that civilisation is antagonistic to the conservation of forests. When this sentiment is analysed it is more distinguished for brevity than for truth, for it is in civilised countries such as Germany and France that the conservation of forests is considered of vital importance to the progress and well-being of man, and that without forests these would become, like Asia Minor, the cradle of the human race, a country of ruined cities. It is only in the first step of civilisation that man is the enemy of forests." To some Governments, like that of Mauritius and some of the Leeward Islands, in the West Indies, it is, or must become, the question of questions, as most affecting the present or immediate future. Much as France, Austria, Sweden, and especially Germany, have done for the preservation and planting of forests, it is quite certain that even in these countries timber and firewood are rising in value. In North America forests were thought to be inexhaustible only thirty years ago; now, it is estimated that, while the Western States of the Mississippi already import timber, the whole region east of the river will be without useful timber within another twenty years. Even now the regular depth of this river is decreasing every year, and sudden floods are occurring, which were formerly unknown. American oak for shipbuilding is nearly exterminated, and the price of walnut, so much valued for cabinet-work, is greatly increasing, in consequence of the distance it has now to be brought to the shore. Mr N. Hawthorn now tells us that the New England yeoman is at the present time as niggardly of each stick of firewood as if it were a bar of Californian gold. The reports of the Agricultural Department of the United States predict that the export of timber cannot long be continued, as the consumption within the States increases, and now requires annually more than one million of acres of forest land. No wonder is it, therefore, that Congress now offers a liberal bonus in land to all those who will plant forest trees on one quarter of such land! The Parliamentary librarian, Mr J. C. Morphett, has kindly supplied me with the following information respecting recent Congressional action about forests in America: "A very important bill was lately introduced into Congress by Mr Haldeman, of Pennsylvania, and has now become law. It provides that every future sale of Government land shall be with the condition that at least 10 per cent. of the timbered land shall be kept perpetually as woodland; and if the land be not timbered, then the patent is to be issued on the condition that 10 per cent. of the quantity is to be planted with forest trees within ten years, and to be kept for ever as woodland. If this be done, an abatement of 50 per cent. is to be made on account of the expense of planting. A violation of this agreement is to be met by forfeiture of the land. It is also proposed that any one who may wish to acquire title to the public land, under the Homestead Act, can do so by proof of the fact that he has had, at the end of three years after taking possession, at least one acre under cultivation with timber for two years,' and that this shall be continued until one acre in every ten is planted with trees, in clusters not more than sixteen feet apart (House Bill, Forty-Second Congress, 3008)." The great attention which is paid in East India to forest conservancy and planting is well known, and certainly did not commence too early. To a great extent the famines occurring periodically in certain portions of that vast empire, through absence of rain, are a consequence of deforestation. If we observe the alarm so generally expressed by members of the Legislature in New Zealand (Dr Hector calculated the area of forest land in New Zealand in the year 1830 at 20,370,000 acres, in the year 1873 at only 12,130,000 acres) at the rapid disappearance of the native forests of these, in our opinion, still densely wooded islands, it is certainly for South Australians a matter of far more immediate and pressing importance to think of the preservation of our native forests, and the planting of others by private means as well as by the Government. On purpose, I speak also of planting by private means, as I hope to see at least many of our wealthy colonists take a special interest in tree planting. If gentlemen will follow the good examples of C. B. Fisher, Esq., and of John Hodgkiss, Esq., J.P., and plant as extensively on their estates (I think 40,000 forest trees), it will go far to show a good example to others, who can only be moved to follow their steps if they see the success of such plantations,

> "Which shielded them against the broiling heat,
> And with green branches decked the gloomy glade;"

and find that after twenty or twenty-five years such a plantation pays handsomely. The demand for timber is beginning to arise, but it will be sometime before it presses on the people with sufficient force to make them turn their attention to the growth of trees, which is expensive, and may yield only a return after years of patient culture. Meanwhile these difficulties will increase as the country becomes more and more exposed to the full force of the winds, hot winds especially, sweeping over it with a violence which trees cannot stand, or which cause young seedlings to be scorched. "How long will the supply of native timber probably last in your locality, if no further steps are taken for the preservation or planting of timber, keeping in view a gradual increase of population?" was the question to which an answer was requested two years ago from corporations, district councils, and private gentlemen. Many of the answers received by the Commissioner of Crown Lands were of the following kind, viz.: Very little useful timber left, except in a few isolated patches too far from any centre of population. In a large number of the northern districts the supply of firewood even is so limited that there is scarcely time for trees now planted to attain a sufficient size to supply it when wanted. How many of our farmers will manage to renew their fencing, except at a ruinous cost, appears to me a mystery, when, even in the better wooded districts, posts already command 50s. to 80s. per hundred. Thus far I have not heard of any attempt to claim a land order under the Forest Planting Encouragement Act of 1872. This may be because our Government has proclaimed no districts under that Act, or because the bonus offered is considered insufficient, and therefore nobody asked the Government to pro-claim districts. Certainly, New Zealand, with a climate more congenial to tree-growing, because of its greater humidity, has acted far more liberally in offering a bonus twice as large, and relatively perhaps three or four times as large. At all events it is clear that the preservation and planting of forests is too important to be left under the Crown Lands Department, with a bare chance of being once attended to at the right time, and at another forgotten or neglected, with no trained staff, or employing men who take no special delight in their duties, or executed by men who put in a tender for it. If such plantation is successful, it would be a surprise to me. Compare with this the care which is taken by the foresters in Germany, of which Dr Brandis, the Inspector-General of Forests in India, says the following: "The steepest and most rocky sides of the hills are covered with forests which have been, so to speak, created by the ingenuity and labours of the Forest Department. In many such places, where even the few handfuls of soil placed round the young tree have had to be carried some distance, it is not contended that the first plantations will yield a direct pecuniary profit, but the improvement in climate by the retention of the moisture, and reclamation of large tracts formerly barren and unproductive, is taken into account, besides which the droppings of leaves and needles from the trees will ere long create a soil and vegetation, and ensure the success of plantations in future years, and consequent surplus." And in another place: "Nothing that I can say or write can convey too high an idea of the attainments and thorough knowledge of their work possessed by German forest-officers of all grades. A very little time served to convince me that the practice of the German foresters was as good, if not better, than their theory, and that they were, in fact, perfect masters of their duties in all their details." And again: "Where are we to look for a model or precedent on which to work? and the reply appears ready—To Germany, where forestry has been carried on for hundreds of years. Not the mere planting of a few hundred acres here, or reserving a few thousand acres there, but a general system of forest management, commencing by a careful survey, stock-taking, careful experiments in the rate of growth, the best soil for each description of tree—in fact, in every branch of the subject, and resulting in hundreds of thousands of acres mapped, divided into periods and blocks, and worked to the best advantage, both with regard to present and future, and the annual yield of which now and for many years to come is known and fixed to within a few hundred cubic feet." Compare with our happy-go-lucky style the grand success in planting with *Pinus pinaster*, the Dunes or shifting sands near the mouth of the Gironde, 150 miles in length; and the equally grand success of making the poor, swampy, formerly uninhabitable Department des Landes, by draining and planting, productive and habitable. I think, therefore, with Dr Schomburgk, "that a Forest Board, consisting of men enthusiastic on this question (and if possible having some knowledge of forestry), not merely friends of Chief Secretary or Commissioner, should be a *sine quâ non*." Victoria also has called into life a Board of Forests, with an Inspector of Forests, and under this direction the preservation of forests and young plantations has been secured. Local Forest Boards do not seem to have given much satisfaction where tried in the neighbourhood of the gold mines. Eventually Local Forest Boards may be desirable; but, for the present, unity of action under one Conservator may be preferable until the extent of our plantations may make a division desirable. The necessity of one such board, however, and the appointment of a well-qualified man as conservator, is, in my opinion, obvious. Although the Government cannot undertake the obligation of providing firewood or other timber for the people throughout the country, and experience may eventually show that our Government cannot accomplish such undertakings so successfully, or at least not as economically as private individuals; and although it might be impolitic to monopolise a branch of industry which ought to attain considerable importance, it is still very desirable that a well-conducted example should be set to the people in different localities, where it is quite unlikely that private enterprise will step in. It is desirable to obtain really reliable information on the subject of growing timber and firewood by commencing a series of systematic experiments as to the best description of trees for the respective purposes in different localities, the best time and mode of planting or sowing, the proper number of different kind of trees to the acre, the best age at which to cut, etc. I know, of course, that in Germany the State derives a very large profit from State forests; and here also the Government may be forced, through the neglect of private enterprise, to grow timber for the necessary public works, especially railway sleepers. Every mile of new railway requires at least 2000 sleepers—to be renewed in perhaps ten years. I can, therefore, subscribe to the following passage, being an extract from a letter, addressed by the

Secretary of State for India to the Governor in Council, Madras, dated the 24th day of April 1863 : "To forests, from their nature, the usual maxim of political economy, which leaves such undertakings to private enterprise, cannot be applied. Their vast extent, the long time that a tree takes to reach maturity, and the consequence that few persons live long enough to obtain any, and more especially the highest returns for expenditure, even once in the course of their lives, are proofs of the necessity that forest management should be conducted on permanent principles, and not be left to the negligence, avarice, or caprice of individuals, and therefore point to the State as the proper administrator, bound to take care that in supplying the wants of the present generation there is no reckless waste, no needless forestalling of the supply of future generations. This is a matter of experience, not in India only, but in all other countries of the world." We must at once admit that here also the principal causes preventing at present the planting of forest trees on a really large scale are : (1.) The want of capital to wait for a return, and the necessity of incurring meanwhile the further expense of tending and protecting any such plantation as long as the same capital and labour devoted to grain-growing or sheep-farming bring a more immediate and a more certain, probably for some years even a larger profit. (2.) The physical unsuitability of certain districts, at least at present, for the successful growth of forest trees, unless at a great risk and too great cost. But if we neglect this matter much longer, the question of reproduction of forests may have to be taken up under such adverse circumstances, even in the more favourable districts, as to baffle all our attempts by either private enterprise or the Government, unless at a ruinous expense. Enlightened nations fully appreciate their duty to posterity, and will provide with keen forethought beforehand what cannot be called forth at any time at will. I can fully agree with the proposal of our Surveyor-General (Mr Goyder) to establish at first in various parts of the colony, on the Forest Reserves, nurseries of forest trees. Irrespective of their necessity for the plantations by the Government, they will give great encouragement to private plantations. Seeds or seedlings might be supplied either gratis, if planted by public bodies, or at a cheap rate, and the young plants would be in less danger than if they had to be carried perhaps one hundred or several hundred miles from Adelaide or Melbourne. Before, however, entering upon the subject of establishing these nurseries here, it may be well to see in what manner operations have been carried on, for instance, in Madras, East India, where the necessity for a future supply of timber has led to great exertions. The report by the officiating Conservator of Forests (Major Beddome) for the year 1869-70 contains seventy-nine folio pages of small print, and shows the great interest taken by the Government in forestry, the energy of the official staff, the great success with which many experimental plantations have been made, and the reasons for failure in other instances. The report deals with several thousand square miles of forests under conservancy; also with seventeen nurseries and plantations, of from 50 to 500 acres each, and in at least as many more places, operations were begun and plantations contemplated. In many places the operations were tentative, intended as experiments and for the instruction of the subordinates of the department. The following items in this report appear to me of particular interest, as either referring to Australian trees or to the mode of sowing or planting adopted: "Codoor plantation is 50 acres in extent, surrounded by a bank topped with an aloe fence. The trees are generally watered only for one year after transplantation. They are mostly planted out in pits; others sown in trenches at 15 feet apart." A tree known in Mexico as the Genisaro (*Pithecollobium saman*) had been received from Dr Thwaites, director of the Botanical Gardens in Ceylon, and was praised as of rapid growth. If this tree is a native of Mexico, and not, like others of its genus, of Brazil, it might be advisable to introduce it here for the above reason. At Trevellan Nursery 358 acres have been planted with 52,310 Casuarina or sheaoak, at distances 12 by 12, or 15 by 15. They had to be shaded when planted, and watered occasionally during the first year, but their planting had been found far less precarious than any other on the plains. In the Putney Hills plantations most of the gum seedlings (*Eucalyptus*) that were first put down were killed by the frost. In many other places our gums do well in India. At Talliamally plantation of sandalwood, various experiments were tried at first, such as growing the seed in nurseries, and transplanting into bamboo pots, baskets, etc., and eventually in the ground; also growing the seed in bamboo pots, and the result was that the most successful plan was to plant the seed in pits where the tree was to stand, water well, and never transplant. Shade being very necessary to young plants, experiments were made with different sorts of shade; cotton was tried, but abandoned, and now the seeds of the Chili plant are sown round the seedling sandal for a shade, as the leaves of this plant remain always green, and are not large. At Parapa 70,471 teak (*Lagerstroemia*) were planted on 30 acres, and these trees attained in six years a height of 20 feet, and more than 7 inches in girth. At Gooty the plantation is 404 acres and 3 roods. The soil is a stiff black clay, with an admixture of sand, salt, and lime, on which scarcely anything appears to thrive. During the early rains of June, 23 acres were sown broadcast with *Acacia arabica* and *speciosa* seeds, which have grown successfully, although in other places they have generally failed if so sown. Of other trees transplanted, it would not be a wide remark that, with the number of substituted plants in the place of those which failed, the whole land could have been planted once again. Sowing in trenches has there been found to be the most suitable and simple mode of planting. The expense of these nurseries and plantations is, even with the low rate of wages in India, very considerable, yet the success of the plantations as an ultimate source of revenue to the State, becomes more and more certain every year, since even failure one year with one kind of tree, leads to the adoption of another mode of sowing or planting, or the substitution of other trees more likely to succeed the next year. Nurseries in India or here, are not likely to produce any considerable revenue, although such is the case with forest nurseries in Europe. I find that the average cost of keeping the Royal nursery for forest trees at Kiel, in Holstein, consisting of only six acres, was about 400 dols. a-year, and the income from sales, at a very low figure, about 700 dols. If we can manage to keep such nurseries, after a few years, without a pecuniary loss, I dare say nobody will complain in view of the advantages which we shall derive indirectly. The salaries of the Conservator of Forests and of the men constantly employed at the forest reserves, will be afterwards the chief expenditure, and nearly all the work can be done by common labouring men, or even boys. In the details I cannot agree with Mr Goyder's estimate of the first year's expense; but our sum total is nearly the same. Mr Goyder omits all reference to a matter which is an absolute necessity in most places—the sinking of wells for watering, or the forming of large reservoirs of rain-water. My estimate of the first year's expense for each nursery will be £1530, irrespective of salaries and wages, viz.:

Two horses and cart,	£80
Cottages and sheds,	500
Implements,	50
Seed,	50
Hay and fodder, and sowing of same for next year,	50
Pots and boxes,	300
Fencing,	250
Wells and tanks,	250
	£1530
Wages and contingencies,	670
	£2200

This does not include the salary of the Conservator of Forests, which ought to be not less than £400 a-year; and if we intend to keep three forest nurseries and establishments for planting, also a travelling party, who may attend to the travelling reserves about to be planted, a sum of £3000 may be required after the first year, and a sum total of £9000 for the first year. I believe it is too uncertain to calculate the direct profits which may be received by the Government or Forest Board as a return for such outlay. Mr T. Calcutt, of New Zealand, says in a memorandum as to the cost of planting and managing forest trees: "I have little or no hesitation in believing that £10,000 expended properly in planting trees would within fifty years result in their having a market value of half a million sterling." With a few favourable seasons at the commencement, the direct profits arising after the first eight or ten years ought to be sufficient to pay not only current expenses, but at least interest on former outlay, and after the timber arrives at maturity the whole of the principal sunk will doubtless be obtained, and as much more, as will enable the State to constantly undertake operations on a larger scale, with men who have become experienced in the work, at a greatly reduced cost, and with far greater certainty as to results. You will undoubtedly agree with Pope's lines:

> "First follow Nature, and your judgment frame
> By her just standard, which remains the same,
> Unerring;"

and only extend operations in the same ratio as you have collected much-needed experience in arboriculture. It may be that in some of our reserves little more is required to ensure the certain and quick growth of young saplings than to keep cattle out and to sow during the early rains some seeds on the surface. It is more likely, and probably safer, to plough and harrow the land either for sowing broadcast, or, better still, in well-prepared strips in rows. It may be advisable to plant some kinds of trees in pits after raising them in nursery-beds or pots, and to specially prepare the soil in those parts by adding ashes or compost, or to cover the surface by an inch of sand, ashes, chaff, or sawdust. In dry localities it may be preferable to have the tree planted in a hole a few inches deeper than the surrounding soil, and not to fill the whole of the soil into the pit back again. In Europe, forestry has in the course of centuries become an art; but the difference in climate upon many of the kinds of trees to be raised, is such that experience gained in Europe can only assist us in arriving at rational conclusions, by which we must be guided. Even in South Australia our foresters will have to follow different rules in north and south. Much of the land in the south-east may be too cold and wet for a great many varieties, but by raising strips of the land, 8 feet wide, by the sod of other 8 feet, successful plantations can surely be made. The dry soil of the north requires, again, the greatest care as to shading, and watering from creeks, reservoirs, or wells, during the first season. In the report for 1874 on the Dandenong Forest the Secretary for Agriculture in Victoria says: "The renewal of the consumed trees by the hand of Nature seems to be sure under certain condition. The great fire of 1851 cleared large areas of every kind of vegetation. These are now covered with a thick growth of fine young trees from 80 to 100 feet high. The only fault that can be found with Nature's handiwork in this case is the fact of the young trees growing much too thickly to render it probable that, without thinning, trees such as preceded them will be produced. Very different to this exuberant growth is the appearance of those parts of the forest thinned by the hand of man. Here seedlings do not, as a rule, take the place of the felled trees, but the forest in these places is left open, with an appearance of bareness. It is such places as these that suggest the expediency of assisting Nature's efforts to renew the original tree-growth, or to attempt improvement of the forest-production, by the substitution of improved species of trees. There are several spots in this forest that require attention, and some that offer special facilities for the experimental raising of the trees of other than the prevailing species—the best species of Eucalyptus which is suited to elevated volcanic regions, is, for instance, the Tasmanian bluegum.

Expense would be necessarily incurred, in the first instance, in burning off the vegetation now covering these spots, and in afterwards preventing its growth, so as to keep any accidental fire within bounds. It would be sufficient, beyond this, merely to sow the seed on the burned surface. Other places on the lower ranges, covered with rough grass, are not so likely to suffer from fire. The soil is poor compared with the higher ranges, and is more or less stony, and the existing trees few and far between. No other spots in the forest seem, at first sight, so well adapted for a trial plantation of some species of coniferæ, if deemed advisable to attempt to create a local supply of the soft woods now so extensively imported." It will require many years' experience before we can ascertain the most profitable trees for different localities, or before we can point to trees which are safe to plant as a narrow belt or break-wind, in the shelter of which afterwards the more desirable timber can be grown. And here I will take the opportunity of making a remark in reply to a very incorrect notion held by a great many persons. The wood of one and the same kind of tree is not always of the same value. Suitable or unsuitable position has considerable influence on the value of the timber, and there is generally a great superiority in timber growing artificially to that growing wild. But artificial planting is not only preferable from the greater absence of knots and other faults—it is even more endurable—and the quantity which may be grown per acre is very much larger. In artificial plantations you hope and can fairly expect to turn every tree into prepared stuff, not one-nineteenth only, as is, for instance, the case with the natural forests in New Zealand. Forests sown broadcast are also almost in every case inferior to those where the trees stand in rows as regards the quantity of useful timber, although in other respects every care and attention may be paid to both alike. I can show most remarkable comparative tables relating thereto, which conclusively prove quicker growths and larger numbers of trees upon the same area and soil. Another matter, however, connected with the value of timber is of still greater importance, namely, the selection of the proper season for cutting the trees, and not to cut them all the year round, as has been the custom in South Australia. I presume we must select the close of the summer season, and before the heavy rains have again circulated the sap more freely, as the best season. I found posts and rails cut in spring decay sooner, and so will posts, if put into the ground quite green. We should hear far less said against our colonial timber if we took the trouble to cut at the right time, and to season it with as much trouble as other persons take with imported timber. If this is not well seasoned, it will shrink quite as much. If only efficient means are adopted to extract the sap from sawn timber, or to steam it or to impregnate it with salt or some mineral oil, that will preserve it: it can be cut at any time. No person who has had any practical experience in the construction of public works, or who is constantly working in timber, will undervalue the importance of cutting timber at the proper season. It is well known how difficult it is to sell even full-grown trees, which a hurricane sometimes uproots at any other time than the proper season for felling them. The sap being up, they are considered almost valueless, except for immediate consumption as firewood, and only with the assistance of chemical compounds, and at considerable expense, can such timber be made useful for other purposes. The formerly perhaps despised and little-valued native timber-trees of Australia, and those belonging principally to the genus Eucalyptus, are extensively planted in many countries (as lately near St Louis), which find themselves in a similar position to our own, that State forests must be established without delay. Garibaldi's scheme also to regulate the banks of the Tiber, and to drain the swamps of Pontini, seems intimately connected with a very large plantation to be made of bluegums, probably the Tasmanian bluegums. And no wonder, if we consider the excellent qualities of many kinds of gum-trees, their quick growth, the great durability in some, flexibility and strength in others, and their decided influence in purifying the air from malaria, we also ought to make them the first trees which we attempt to plant in great numbers. With them we may be pretty sure of success; the seed is cheap, easy to collect, and—a matter of importance—fresh. As soon as we decide on planting other trees, especially different kinds of Pinus, we will do far better to collect what fresh seeds are obtainable in the colony or in the neighbouring colonies, even at a much higher price. Imported seeds are too often dear at any price; we lose a year and our labour to save a few pounds. We may succeed in raising these and other trees in places where nobody expected it previously. Our first aim must therefore be shelter plantations, consisting perhaps of *Robinia pseud-acacia*, *Acacia lophantha*, our native black wattle, the tobacco tree, *Callitris*, or native pine, or shrubs answering the purpose. It may be well to excavate a ditch 2 feet 6 inches deep, 4 feet wide at the top and 2 feet wide at the bottom, and to form by means of the earth thrown out a bank of similar dimensions. In some positions shrubs might be grown on the top of this, in others it may be only possible to gain further protection against wind and cattle by an upright fence of stakes or stronger timber firmly driven or dug into the embankment, and held together by means of hoop-iron bands, to which the stakes are nailed. Several kinds of poplar besides the common, as *Populus alba* and *tremula*, also the American ash and *Pinus alba*, are well known in Germany as trees which grow in the most open and exposed localities. They defy there the cutting north-westerly winds even on the poorest soil, and we may hope that they or other trees may grow near to the sea, or where for 100 or more miles no trees at present exist. Eventually they may enable us to plant such trees in their shelter as are preferable to them. I am, however, quite unable to advise as to forest-planting from my experience gained in South Australia, and I fear but little experience is available from other persons in the colony. I am therefore obliged to leave this subject, and refer to some other subjects connected with the conservancy of our native forests, which are of sufficient importance to be mentioned in such a paper as I have prepared. I heard at different times that the gum-trees died without any apparent cause in many parts of the colony, and especially in the south-east. I observed once, many years ago, that our bluegums died suddenly over an area of perhaps 15 or 20 acres in the Bugle Ranges, in the midst of a well-wooded district. Last summer, however, my attention was called to the following alarming fact: On a very large tract of timbered country in the Hundred of Strathalbyn, said to be about 15 or 20 square miles in extent, not a bluegum remained alive. All other gums, white, yellow, or red, were luxuriant, while the bluegums, from the largest tree to the smallest sapling, were dry, and the bark, already cracked, ready to fall down this winter. It was remarkable and perplexing to observe the exactly straight boundary-line on one of the outskirts of this tract of land which I visited. Within a few yards all bluegums were dead, and outside the line they were as vigorous as ever. My time being too short, I could not examine the trees properly to ascertain anything further; but such an examination ought yet to be made. At all events, inexplicable as it is to me, I thought it right to mention it, so that one or other of my hearers or readers may venture an explanation, or the enigma may be solved by comparing the observations of a number of persons at different localities and times, and perhaps as regards different kinds of trees. Another matter of the greatest importance as regards forest conservancy and timber supply is the issuing of timber licences. In the report of our Surveyor-General (Mr Goyder), he advises to let the present system of granting licences for cutting timber remain intact, except in fenced reserves. This seems to me a more than questionable policy. I am sure he did not give such advice with the view of obtaining the paltry sum raised by such licences for our Treasury. He must have thought of the necessities or convenience of our rural population. I admit that timber is needed, and the convenience of our farmers should be consulted, but I venture to say in a different manner. No forest can stand the present issue of licences—there must be a restriction and supervision from the Forest Department. The total amount received by the Crown Lands Department during the year 1874 for timber and bark licences, and licences to carters to remove the timber, was only £1305. This is no compensation to the State for the enormous injury done to our forests. To fell a number of trees, perhaps the growth of ages, and leave them because they do not split quite so easily and freely as was expected of them, to cut them 3 feet from the ground, to take perhaps merely one length of rails or posts and leave the rest of the trunk, together with all the branches, to be consumed by the next bush fire, or to cut numberless young saplings for rails and posts, which will last, as a matter of course, only a few years, while the forest may contain plenty of trees of mature age which might give really lasting rails or posts, is a waste of the property of the nation—a sacrilege. I do not object to give all settlers an ample supply under proper regulations and at a reasonable rate, but I object to the present state of affairs, whereby valuable trees are cut down indiscriminately to save a little trouble or delay. On this matter I give a short extract from the above report on Victorian forests: "Timber trees would be economically utilised if the men were forced to pay for each tree they felled. There would then be some check upon the enormous waste and the indiscriminate destruction of the largest timber trees in Victoria—which trees, once cut, will naturally require centuries to replace—and the selfish indifference to the wants of future generations displayed by timber-cutters would not be exhibited as at present." Another extract is taken from a report of Mr J. Innes, Dunedin, to the Chief Commissioner of the Waste

Land Board, New Zealand: "It is of the utmost importance to the community to have the existing forests protected from the reckless extravagance which is so prevalent in this province. If prompt measures be not taken all the sound timber will, in the course of a few years, be entirely destroyed, and the consequence will be a sudden rise in the price of that material. The public are admitted into the forests of the country simply by paying a small licence fee. While this is the case, no regulations, however rigorous, and no staff of officials, however numerous and zealous, can control the wasteful destruction. Young trees as well as matured ones are cut at 2, and in many instances 3 feet from the root. Timber that could be profitably used in the construction of a railway bridge or of the most refined piece of architecture, is cut down for fuel or some temporary construction. A method must be adopted whereby the person who fells timber will have an interest in using it economically, and the public be supplied through a less extravagant system." He suggests: (1.) "That the public be excluded from the Crown forests; (2.) That the demand for timber be supplied by selling at auction annually, or at any other time that might be deemed expedient or necessary, such quantities of growing timber as the state of the market might require for local or outside consumption." These suggestions seem rational. We ought to be guided by the principle, that we should no more than absolutely necessary curtail the usefulness of our forests to our farmers and the colonists generally, but at the same time prevent unnecessary waste. No farmer will ever consider the interests of posterity or any climatic consideration, however important, of any moment as compared with his present convenience—that of obtaining posts and rails or timber for building purposes or firewood, and a person who splits for sale still less so. Such considerations must come from the Government or from the Forest Department as soon as we have it. It is quite true that even on their own land farmers destroy frequently too much valuable timber, as being impediments to the plough or reaping-machine, as expressed in the lines of an American poet, Mr J. R. Lowell:

> "This tree, spared
> I know not by what grace—for in the blood
> Of our New World subduers, lingers yet
> Hereditary feud with trees, they being
> (They and the red man most) our fathers' foes."

I recollect only too well how many thousands—no, millions—of tons of useful timber were in former years destroyed to make room for the plough; how, night and day, fires were fed with the giants of the forest, to leave nothing but a heap of ashes, upon which the grain grew luxuriantly, but generally became blighted. In other instances, where the timber trees stood more dense, they have been only girdled by the axe, and left standing upon cultivated fields, their whitened trunks being a sad spectacle by day, and looking like huge spectres on a moonlight night. These trees, while green, represented perhaps a greater value, and were more important to the State than the produce of all the grain crops which may have been grown on these fields since the settler took possession of his land. I myself did err twenty and more years ago, before I became better acquainted with other treeless portions of South Australia. A settler who finds himself in the middle of a well-wooded tract of country naturally has no other idea than to get rid of the timber somehow, and at the smallest amount of trouble and expense, and the consideration of the national welfare is with him out of the question. The mischief being done, nevertheless, should act as a warning; and in such parts of the colony where it is found desirable to protect the timber either for the necessities of future generations or for climatic advantages, it will be important to prevent the ringing of trees by all possible means short of an absolute prohibition. I hope the farmers of the day do not waste so much: and that if they grub and destroy, they will find time, and also a suitable place on the farm, along the boundary lines of their holdings or different fields, along watercourses, around wells, reservoirs, and homesteads, and in their permanent grazing paddocks, where they will plant again. If they have no other example nearer their home, let them look at the plantations of native and other trees on the Adelaide Park lands, how well they grow. It has been suggested that the planting of a certain number of forest trees should be made one of the conditions to be inserted in all agreements with the selectors of land on credit; and that no Crown grant should be given to any person who has not planted and properly tended such number of trees on his selection. Such a condition, if carried out—and I am inclined to think it can be as well reported upon by Mr Bonney and his subordinates as other improvements—would be of incalculable value to the whole colony, and especially to the farmer himself, or his family, in after-years. Still, we ought to hesitate. Intending settlers may see in this another objection to our land law. It may deter them from selecting land where special difficulties for the raising of trees are to be expected, and thus drive further numbers across the border. It may therefore be far better to give even a greater bonus than that offered by the Forest Trees Planting Encouragement Act of 1873 to those who will plant trees after the heavy work on the new farm is behind them. If at any time the Legislature should decide that only perpetual leases shall be granted, and not the fee-simple, the former suggestion would probably be of easier attainment. But the time until the fee can be purchased is rather short. You cannot in fairness ask the selector to plant any considerable number of trees before he has a considerable part of his selection under the plough, nor until a few good harvests make him somewhat independent as regards time and money. The only way which appears to me safe and fair under the present law is the following: that selectors claiming an extension of time beyond the five or six years for paying their purchase-money might be compelled to accept the planting of a number of trees as a further condition imposed on them. We shall not lose them on account of such a condition, for they have already settled, and they have had time enough during the previous years to get their farm in order, so as to be able to spare a little time for the carrying out of such a condition. And the number of selectors who will claim such an extension of time in after-years may be very considerable. This condition will also give the State somewhat of a *quid pro quo*, if the selector does merely intend to crop the soil for ten years, and to leave an exhausted soil without making it his permanent home. If a Government nursery be near, or extensive State plantations, I believe farmers will soon see the importance of such plantations and apply for established seedlings. I know that in some Continental States it is even a question how far private landholders can be allowed to destroy the timber upon their land, whereby they may seriously affect climatic influences, on which agricultural results may depend. In Tinnevelly, Madras, for instance, the small clearances already made for coffee plantations may have caused some small streams, previously known as perennial ones, to become perfectly dry at some seasons, and rushing torrents at others. And for a number of similar cases I refer to the remarkable speech made in 1874 by the Premier of New Zealand, the Hon. J. Vogel, especially to his extracts from Dr Lindley's leading article in the *Gardener's Chronicle*, which quotes numerous instances of humid localities having become arid in France, North America, and even Britain. A meeting of the Geographical Society was held at Vienna on the 22d of January 1875, at which Mr Hofrath Wex read a lecture on "The Decrease of the Water in Rivers and Springs." He and others had made observations as to the decrease of the height of the water, and had found since fifty years a decrease in the rivers Elbe and Olga of 17 inches, in the Rhine of 24 inches, in the Vistula of 26 inches, in the Danube, at Orsova, of 55 inches. And this decrease in the depth of the rivers does correspond with the decrease in the quantity of water in these rivers. These observations are corroborated by the constantly decreasing number of springs during the last hundred years. The lecturer is afraid, if it continues as heretofore, that the large German rivers will become unnavigable, the smaller dry; industrial pursuits, etc., will be in danger; future generations be unable to rely upon a sufficient supply of water, and this within a time not very remote. The causes, as given by the lecturer, are destruction of forests; and, as a consequence, the far less quantity of rain-water or snow which is absorbed by the soil, also the artificial draining of lakes, ponds, etc. Mr Hofrath Wex therefore only confirms more fully what was already contained in certain resolutions passed in 1873 by the International Congress of Land and Forest Culture, held at Vienna. The resolutions there passed were to be forwarded to the various Governments of the globe; and in a few words they may be condensed as follows, viz.: "That international agreements are needed to effectually check the continually increasing devastation of forests, and that the efforts of legislators should be directed to causing exact data to be gathered, with a view of obtaining a sufficient knowledge of the evils—disturbances in nature—which are caused by the devastation of forests." History records that many countries described as covered with immense forests are now an almost hopeless desert. Thus the interior of Spain, which now only is little better than a bare heath. Greece has, in the place of her former beautiful oaks and beeches, only poor scrub; and where formerly cattle were feeding, the goat alone can find her food; or where previously kinds of forest trees bearing leaves solely occupied the ground, the most miserable specimens of pines eke out their stunted growth. The deforestation on the sources of the Rhone and Saone in France led to the too well-known sudden inundations during the last fifty years. And the climate of Iceland—formerly well wooded—has deteriorated in the most marked degree.

Through the centre of Schleswig-Holstein and Zetland the soil is now only overgrown with heather, here and there intermixed with low bushes of oak, covering many square miles; and yet from that part of Holstein the magnificent timber was exported from which the large city of Amsterdam is erected; and 800 years ago the country town of Jevenstedt was situated in a forest of oaks, and the church erected from this kind of timber. Incidentally, I wish to make here a few remarks about our "*mallee*" country, as I am inclined to compare it with the low scrubs of oaks in Schleswig-Holstein, and to express my opinion that "*mallee*" also is only the remnant of a stately gum-tree destroyed by extensive fires, and that thereafter the duration of droughts increased so materially as to preclude the possibility of a re-establishment by nature of the ancient forests in these extensive tracts of country. My own acquaintance with the mallee scrub, however, is imperfect; but Victoria having in its north-eastern corner fully 270 miles of mallee, while our wide belts of mallee along both sides of the Murray, and the scrubs between the great Australian bight and the overland telegraph line cover such an immense area, it is of course not merely a matter of curiosity, but of the greatest importance to obtain full information whether this vast area at any former period was clothed with timber trees. Very large stumps have been found frequently in Holstein; and there it has been found quite possible to re-establish forests by careful forestry. If persons who cultivate land in the Murray, or other extensive scrubs, find large stumps under the surface which appear to be those of trees, not of mallee, I hope they will make it known; and also whether they dissent from my herein-expressed opinion. In observations made by Alfred Selwyn, and presented by him in a report on the Geological Survey of Canada for the year 1873-74, the following passages occur, p. 58: "The drying-up of the country already alluded to has been ascribed to various causes, but it is generally supposed to be connected with the gradual destruction of the forests over large areas by fire, diminishing the rainfall. Whatever the effect may be of these destructive conflagrations, in reference to the water supply of the region, there is no doubt that at different times almost every square mile of the country between Red River and the Rocky Mountains has been subjected to them, and that hundreds of miles of forest trees have thus been converted into wide and almost treeless expanses of prairie. After leaving the valley of the Assineboine, the second and third prairie steppes may be said to be entirely denuded of good timber. For a total distance of 400 miles neither oak, ash, elm, birch, pine, or spruce trees were seen, and even the poplars were of small size, and suited for little else than firewood." We are aware that very destructive fires have also taken place not long ago in the United States—fires which seem to have swept over enormous tracts of land covered with forests. In Austria it is now impossible upon a large tract of land, 1700 to 2000 feet above the sea, to grow cereals. The forests which formerly protected the land have been cut down, and the soil has become too dry, parched, and sterile, through exposure to the cutting winds. The inhabitants of the island of Mauritius are now obliged to turn their most serious attention to tree-planting; and it is to be hoped that they may succeed in quickly arresting the evil effects which the destruction of the natural forests have upon their climate, and the growth of the staple produce of that island. With so many examples before us of a deterioration of the climate and soil as a consequence of the unreasonable destruction of forests, it is almost as easy to prove the amelioration of climate and soil almost destitute of trees after successful planting of forests. In Lower Egypt, and in Algeria, the extensive planting of trees by many millions has had a most marked effect upon the yearly rainfall. From the report of the Department of Agriculture for the United States, I take the following: "In many parts of the country forest planting, in the opinion of many observers, is changing the climate and capabilities of the plains beyond the Missouri. Twenty years ago the plains were nearly destitute of trees, and vegetation was parched and scanty; but it is now claimed that in some localities —where farms have been taken up, villages built, and trees planted —they are clothed with verdure; and river-beds, which were then dry, are now covered with constantly running water. A part of the city of Denver was built on one of these ancient river-beds, where it was supposed that water would never flow again; but there is now a constantly-running stream, so large that it has been found necessary to bridge it. Great Salt Lake is said to be seven feet higher than it was ten years ago, and is constantly rising." The reappearance of the spring on the Island of Ascension, which had dried up after the trees had been felled, is another instance of the influence of the planting of trees on springs. The town built near the Lake of Valentia, in Venezuela, found itself 200 years later fully two miles farther from the water's edge; and Von

Humboldt, visiting the town, ascribed the gradual diminution of the water to the extensive clearings of the forests. Twenty-five years later the waters of the lake had gradually risen again, agricultural operations having almost ceased, and the forest regained possession of the soil. Whatever may be the direct effects of trees on the rainfall, there is no doubt that the actual temperature of the country becomes considerably higher by the destruction of its forests. Trees attract moisture, and retain it; their roots retard too rapid drainage, their presence benefits springs, their shade checks evaporation; and we shall have heavier dew in the neighbourhood of forests. Sir George Strickland Kingston says, in his valuable "Notes on the Rainfall of Adelaide, Melbourne, and Sydney," printed in Parliamentary Paper No. 10, of 1875: "During the first four months of the year want of moisture in the atmosphere, accompanied by intense heat, putting a stop to vegetation, and baking the surface of the ground, has a somewhat similar effect, in so far as agricultural pursuits are concerned, to that produced by the wet and frosts of the winters of England. The benefit of the rainfall depends not so much on the quantity during a given month as on the rapidity or otherwise of its fall, as well as the season of the year." After stating that during the first four months of the year nothing under an inch of rain at one fall is of much value to renew the exhausted energy of vegetation, he remarks that from the end of April to September the quantity of rain during the twenty-four hours is of little importance as compared with the frequency of its occurrence, keeping the ground moist, and provided that the average of the monthly falls are fairly kept up, the ground is more benefited by the occurrence of numerous rainy days than by a great fall in any one day. As an instance he mentions the year 1860, where the rainfall was much below the average, yet the harvest was in excess of the average yield of the four years 1855 to 1858, in which the rainfall was considerably above the average. But the rains were gentle, continuing for several hours, soaking into the ground, and being followed by many days of cloudy weather, little or no evaporation took place, and the crops derived the fullest possible benefit from the limited quantity of rain." This is unquestionably true; and I believe that tree plantations will add to the number of showery days and the general humidity of the climate. The former and present climate of St Croix is a case in point. As long as trees were everywhere abundant on this island rains were profuse and frequent. Twenty-five years later one-third of the island had become an utter desert. With the destruction of the trees the short copious showers which frequently occurred in former times had ceased, and the process of desiccation gradually advanced. The sugar-canes failed, and desolation came slowly but irresistably. Before I come to my closing remarks I wish to say a few words of well-merited praise in honour of the few persons in the Australian Colonies who have tried to advance our knowledge of forest conservancy, and matters connected therewith. Foremost I must name Baron von Müller, the Government botanist of Victoria, who, as far as I know, has acted as pioneer in this respect; and next to him Dr Hector, of New Zealand, and our Dr Schomburgk and Mr Goyder, who have, either by lectures or reports, or lists naming the principal timber trees which may be suitable in the respective colonies, done much to arouse public attention. The interest now evinced by the Legislatures of these three provinces must be chiefly ascribed to their public services. I wish to call your special attention to a map prepared by Mr A. Everett for the State Forest Board, with the assistance of Baron von Müller, showing in different colours over the whole province of Victoria the distribution of the principal timber trees, and also to two maps kindly prepared by Mr Goyder's order—one to show our intended, although not yet proclaimed, timber reserves and travelling-stock reserves, the other the proposed districts under the Forest Trees Planting Encouragement Act of 1872. If you peruse the number of papers which have lately been laid before Parliament in the provinces of Victoria, New Zealand, and South Australia, you will say the time for action has come. With such an amount of valuable preparatory work now collected in the various lectures and Parliamentary papers, it may be safely predicted that with proper machinery we ought to have a fair start, and we will eventually succeed. I have dwelt, perhaps, rather long on the importance of obtaining for the settled portions of South Australia a due proportion of woodland to our open agricultural and grazing lands; also on the necessity of a supply of timber and firewood for our industrial pursuits and households; and I have alluded only cursorily to some of the indirect advantages which a country, with a climate like South Australia, most certainly will derive from more extensive forests. With their increase, the number of birds will increase, which may delight us with their melodies; and they will aid us in the destruction of many insects. The bee-keeper will be more certain of his crop of honey, and our eyes will rest with pleasure on the improved aspect of the landscape, which is now, especially on our wide northern plains, extremely monotonous. Surely you value also these minor advantages, and many of you still think with delight of the beauty and grandeur of European forests, and the pleasure you derived while roaming through them. Byron, in "Childe Harold," says:

> "All things are here of *him;* from the black pines,
> Which are his shade on high, and the loud roar
> Of torrents, where he listeneth, to the vines
> Which slope his green path downward to the shore,
> Where the bowed waters meet him, and adore,
> Kissing his feet with murmurs; and the wood,
> The covert of old trees, with trunks all hoar,
> But light leaves, young as joy, stands where it stood,
> Offering to him, and his, a populous solitude.
>
> "A populous solitude of bees and birds,
> And fairy-formed and many-coloured things,
> Who worship him with notes more sweet than words,
> And innocently open their glad wings,
> Fearless and full of life: the gush of springs,
> And fall of lofty fountains, and the bend
> Of stirring branches, and the bud which brings
> The swiftest thought of beauty, here extend,
> Mingling, and made by Love, unto one mighty end."

We ought not merely to bear in mind the words, "Woodman, spare that tree," and to preserve our present native forests; we want also plantations. The answer to those who ask where we will get the money for it, is also simple enough. The present yearly income from our forests is certainly not large; but what has become of the large aggregate sum received by our Treasury in years gone by? During the last eleven years no less a sum than £18,494, 17s. has been received for timber and bark licences, and licences to cart timber. Previously the licence-fee was in all cases £5; now monthly licences are issued at 15s.; and I venture to say that fully £40,000 was received since the foundation of the colony, irrespective of the not inconsiderable amount which district councils have collected, and which may swell the total sum thus derived from our native forests to £50,000. Since writing this, I have received a return from the Surveyor-General, showing that the amount is even more than I have calculated. I accept as correct, what I read somewhere, that the present generation has merely a life estate in the forests of a country, and I claim, therefore, as a right for those who come after us, at least in young plantations, a full equivalent for all the forests already destroyed. Can such a demand be resisted? Can any valid arguments be brought forward to show that our children and grandchildren should not have timber as cheap and as plentiful? Old colonists—farmers as well as graziers—know to their cost that we have had long droughts; they cannot wish their recurrence. They themselves, however, have now in their hands the future of South Australia. They may also decide the future climate of South Australia, and on this point I give you another extract from Mr Dalzell: "Man, feeble as he is, wants only time and proper combination to produce the most marked changes, not only in the climate of the country he inhabits, but on places far distant from his abode. If this be found to be really the case, then forests deserve to become an object of careful examination, not only in a financial, but in a politico-economical point of view." At all events, we may prevent floods, obtain permanent water, and our crops and fruit-trees will receive the much needed shelter from hoar-frosts while in blossom, and from the scorching effects of our north winds. The soil of South Australia is certainly generally very good in the settled portions, and if we can be sure of about as large a rainfall as in Victoria, the average of our grain crops will be as good, if not better, and the number of cattle and sheep which can be kept will increase in the same ratio. In many parts of South Australia, perhaps by far the largest part of it, the absence of useful timber is one of the principal impediments to settlement. A Mr Thompson once said that in some plains the wind was at times so strong that the sheep had to hold on by the tussocks. Nothing is more calculated to add to the wealth of this country than the growth of forest trees; this is my firm conviction. For years to come we may not be able to materially alter the hygrometrical condition of our atmosphere, or to break the force of our "brickfielders," or to increase the number of permanent springs, but we ought to commence, without further delay, a series of experimental plantations of forest trees, preparatory to a most determined attempt, not only to avert the calamity of a future want of timber, but to make it possible for South Australia to become the home of millions of a happy, healthy, wealthy, and industrious population.

XII. *On the Cheapest and most Effectual Means of Clearing Land for Planting.* By D. F. M'Kenzie, Forester and Overseer, Meldrum House, Old Meldrum.

On this important subject little has been written, and it is difficult to give a reliable estimate to guide intending planters, on account of the variable condition under which we find land covered with whin, broom, or other shrubs. In some cases the land is wholly, and in others partially covered, causing a greater or less amount of work on a given extent of land; the wages also vary in different localities. Although I have practical experience in such work, and have paid large sums for the removal of brushwood, etc., in various localities, yet I know my figures may be at fault when applied practically to other places, even under the same circumstances.

From the available data, I give a brief account of what I believe to be the best mode of clearing off heavy crops of brushwood, whin, broom, and thorn, and removing the roots. The implements required are—an ordinary pickaxe, four or six chains, about 6 feet in length, made of $\frac{1}{4}$-inch round iron rod. To each chain there should be attached a large link at one end, and a strong hook at the other, made of $\frac{1}{2}$-inch iron rod. One, or a pair of well draughted oxen, yoked with ordinary plough harness, and plough or harrow drawing bars, made of strong but light material, fitted to use singly if wished.

To conduct the operations properly, one man is required to drive the oxen, another to use the pickaxe, and two or three lads to arrange the chains in the following manner: Pass a chain round the bush, close to the ground, bring the ends of the chain to meet, pass the hook through the large link, and pull it as tight as possible with the hand. Attach the hook to the eye of the drawing bar, which is fastened to the oxen; move the oxen in such a direction as will tighten the chain, without allowing it to slip over the bush. The animals should be moved slowly forward; and the person with the pickaxe cuts any roots too large for the animals to tear away with ease. Meanwhile the lads arrange the other chains, one of course relieving the chains after the bush has been pulled and thrown aside, and returning the chains to those arranging them round the bushes. If the cover is close, and consists entirely of thorns, the cost per acre will be about 58s.; and if broom and whins, about 40s. The thinner the crop, the less the cost of clearing, provided the shrubs are of the same size. The same work done by steam power would cost 70s. to 75s. per acre imperial.

If the land to be cleared is near a town or village, the broom and whins may sell readily at from 6d. to 1s. per cart-load. In some cases I have had considerable profit from clearing such land, by selling the materials, especially the roots. In one exceptional case, the profit received for whins and broom clearings was over 30 per cent., after paying costs.

When land covered with rough herbage is to be planted, burning is often resorted to, but by this method the evils are increased, as, after being burnt down, whins, thorns, etc., grow with two-fold vigour, and the heat which the earth receives during the process, causes the seeds lying dormant in the soil to vegetate; and both crops coming up, any young trees within their reach are choked. Ininstead of burning then, the crops should be thoroughly rooted out before planting. The young trees will, in any moderate soil and climate, soon overtop the young herbage, which will eventually die out. To this end the plants should be set closer than usual. Scots fir and larch are the best trees to plant in such localities. If the herbage threatens to overtop the plants, it should be cut out at the roots with an implement resembling a ship-carpenter's adze. The cost per acre would be from 20s. to 23s. These figures represent the cost of clearing land of a close cover; for lighter scrub it would be proportionally less.

To clear land of a heavy crop of heather, burning is the best and cheapest method. This should be done one or two years before planting. If the situation be exposed, the heath should be burned in strips, only a few yards wide, all over the extent of land intended for planting. This is easily done by a man on each side of the fire, lashing it within the required space with brooms, spruce branches, or any soft supple material. Strips, one or two yards wide, should be left at intervals to shelter the young plants from the prevailing winds of the district. The burning can therefore only be done when the wind blows moderately, and from such a quarter as to burn the lines in the direction wanted. The breadth of these strips should be from 15 to 100 feet wide, according to the severity of the exposure. The cost per acre would be from 1s. 9d. to 2s. 3d. The broader the strips burned at one time the cheaper the work. I have burned heather in this manner, within and near plantations, without damage. The work is best performed when the heather is in a very dry state.

Clearing land from which a crop of heavy timber has been felled is the most difficult of all operations before planting, and the modes are various and expensive. Although such land is often planted, the roots are seldom removed, but these harbour and attract insects, which often ruin the crop. The most effectual means of getting rid of the roots is to trench the land, but the expense is so great that few resort to it; those who do remove them adopt those means which are most convenient, such as grubbing out with the pickaxe, etc. Besides trenching, the locomotive engine, the screw, lever, and lever by horse power, are all applicable and advantageous. But steam or horse power, combined with the block and tackle, is the most speedy and most economical, and I can recommend that system of clearing or extracting roots, carried out as follows: Procure a set of blocks of strong fender plate, fitted with 4-inch metal pulleys, of four and three pulleys respectively, laced with a strong close-made chain about 60 feet long, with a large hook, to which is attached the *steam* or *horse* power. With short chains attach the blocks to the longest and stoutest roots. Very often the root chosen for a stay comes away with the one wished to be pulled, in which case the chains must again be attached to a stronger one. The only preparation necessary is to have a few of the strongest roots cut away at the point. The working of the block and tackle is very simple. The blocks should in every case be attached to the longest limb, to have as much lever power as possible. With strong proportional blocks an ox will easily pull 15 tons, and with a four or six horse power locomotive steam-engine attached to one of them, the result is all that can be desired. When the trees are of the pine tribe, and the roots not very large, oxen will be more profitable than steam power.

Dynamite (Noble's Patent Blasting Powder) is now being used with good results in removing roots, but it is too expensive for general use; but where the roots are very large, it will be found to answer well, as when placed underneath the root it has the effect of blowing out the soil, which facilitates the application of the tackle and removal of the roots.

The cost of clearing by the steam-engine is from £4 to £5 per acre; smaller roots, by oxen or horse power, about the same. Clearing tree-roots by dynamite costs from £10 to £12 per acre, but it is by far the most economical method of blasting stones. Having used large quantities of it, I consider that it should always be exploded by electricity, and as many charges as possible at one time, for the gas evolved is highly injurious to those employed. The charges should be fired about the time the workmen leave at night. The gas will be dissipated before they return.

XIII. *On the Disease of the Larch.* By D. F. M'Kenzie, Forester and Overseer, Meldrum House, Old Meldrum.

The larch is the most popular as well as the most useful of our timber-producing conifers. It is popular for its rapid growth, its hardy nature, and its fine natural appearance; and it is useful, as its timber may be applied to most of the purposes to which pine, and in some cases hardwood, is adapted. Its timber is of long duration when of proper age before being felled. During recent years it has been found to become diseased in many of the plantations in Britain, and consequently many landed proprietors who had planted the tree largely have been disappointed, and the loss in many cases is great. It has been asserted that the larch has undergone a constitutional change; some arborists allege that since the Dunkeld larches were planted our climate has considerably modified. But both of these theories are unfounded, and are proved to be so by the laws of physiology. Others hold the most opposite views regarding the cause of the disease, such as degeneracy in the seed, atmospheric influences, ungenial climate, insects, fungi, etc., etc. All these are held to be the cause of one and the same disease. But where disease exists, there is always sufficient evidence to prove its origin, provided one takes the trouble to carry out the investigation further than by mere ordinary observation.

The writer having had considerable experience in the general management of woods, felling the various kinds of timber, and reclaiming land from which timber had been felled, the planting of larch, and disposing of large quantities of it as timber, in various forms, both in England and Scotland, has long since been firmly convinced that, by judicious planting and after-management, larch could still be planted with profit and advantage. The varieties of larch are numerous, but those chiefly planted in Britain for their timber are the red and white flowering varieties. The former is the best timber one of the two, the latter, though it grows more freely while young, and though no more liable to general debility than the other, is more tender in foliage, and seldom attains the same dimensions.

The diseases to which the tree is liable are many, but I shall only observe those of most consequence: (1.) Disease of the roots and heart, known as heart-rot; (2.) Blister or cancer; and (3.) Insect or blight. The first of these diseases is the most disastrous, being found under a great variety of circumstances, and apparently not peculiar to any soil or situation. The cause I have found, without exception, to be mutilated roots. When larch is planted on soil no matter how good, if the subsoil is unfavourable, heart-rot sets in when the tree is from fifteen to thirty years of age, the time of its attack being regulated by the depth of the hard subsoil from the surface, or the time the roots take to penetrate to it. After the roots are in, or in contact with a hard stony subsoil of whatever formation, the surface soil being invariably softer, subjects the roots to a large amount of friction when the tree is agitated by storms. The roots, by the surface soil yielding and the subsoil remaining stiff and stubborn, lose many of their spongioles and the underside of their bark, and, being thus mutilated, immediately cease to be of any use to the tree, either by way of supplying nourishment or throwing off excrementitious matter. After a while these mutilated roots absorb moisture from the soil, and in course of time begin to rot, the tissue being attacked by microscopic and other fungi. The disease presses slowly upwards, and eventually the tree dies or is blown over. This is not the case when the tree is grown on fissured rock, because the base is set on a solid foundation, the roots being held firm in the rock, the bole only is subjected to the pressure of storms. If the mutilation of the roots takes place during the latter part of the year, while the sap is descending, the wound may get sealed up with resinous matter. Unfortunately for the larch, its roots generally get damaged in the early summer, being at that time in full leaf, and presenting a greater resisting surface than in winter, when the foliage is off.

Scotch and spruce firs are also subject to the same diseases, and from the same cause.

In the case of the Scotch fir, however, though its roots be mutilated, yet from the nature of the tree, and it generally receiving the damage during the winter season, the resin, by sealing up the roots and thus excluding all unnatural moisture and other deleterious matter, prevents the heart-rot.

Some years ago I was called upon to examine, value, and dispose of a mixed plantation of nearly 300 acres in extent. A portion of this was planted on arable and part on heathy soil. The situation of the whole wood was at an average of 800 feet above the level of, and 9 miles distant from, the sea, and on the north side of a steep hill, freely exposed to the prevailing winds. About 15 acres, some of which grew on arable and some on uncultivated soil, was the first examined.

The soil was of a thin, yellow, hazel, loamy description, resting on a hard subsoil of granitic till, so hard that a pick could not be forced into it without the greatest difficulty. I found this portion in a very diseased state with heart-rot, blister, and aphis. In one spot, about the centre of the piece referred to, were a number of large trees in a thriving state, which on examination I found to be growing in loose deep soil formed by the filling up of large pits with weeds and earth, through which the roots penetrated for a distance of about 5 feet.

Each of the trees growing here had a few blisters, but none showed the least trace of heart-rot. The rest of the plantation was from seventy to eighty years old, and grew on different varieties of soil, but had the same elevation and exposure as the younger part. Where the soil was thin and the subsoil hard, almost all the trees were diseased; but where the soil was deep, and the subsoil loose and free from large stones, no disease was seen. One very large tree was found in a very diseased state when cut away from the root. The soil on which it grew was of a light loamy nature, and about 4 feet deep. On grubbing up the root a large boulder of rough granite was found directly under and in contact with the diseased side of the tree.

There is also good reason for supposing that soil previously occupied with Scotch fir tends to produce heart-rot in larch, because the subsoil is often very hard, much more so than if it had not been planted. The disease in this case is more disastrous than in any other, as the fungi on the old roots attack the roots of the larch on receiving the least injury. Consequently it is observed much earlier and on a larger scale than if planted on virgin soil of the same quality.

The only means at our disposal to prevent this disease are to plant the tree in such places, where not only the soil but also the situation and exposure are suitable to its nature. The best soils for growing larch are those formed by the *débris* of rocks and alluvial soils on the banks of rivers. Deep, sandy, loamy soils are all good for rearing larch, provided there is no stagnant water about the roots. Nevertheless it grows and thrives well though the roots are continually many feet under water, if not stagnant. For instance, on this estate on the banks of the lakes, where the soil consists of a thin, mixed, peaty loam, resting on sandy gravel, there are a number of fine old trees, and though the water often runs over their roots to within a foot of the level on which they grow, they are still, to all appearance, sound and full of vigour. The situation may be on hill-sides or on the bottom of ravines, other things being equal. As to exposure, the tree is very hardy, and will rear its head where the beech gives way; nevertheless, it ought to be planted where the natural configuration of the country screens it from the prevailing winds.

Blister, or Cancer, or Canker.—The appearance of this disease is too well known to all foresters, and requires no description here. Cancer is caused by anything that suddenly checks the flow of sap to the small lateral branches. It invariably begins in one-year-old wood, and in most cases at the junction of the branch with the main stem. It seldom breaks out in the latter, but when it does, it is always at a bud. In young plantations it affects first the most luxuriant grown trees when in warm, damp situations; and in all woods it affects most those trees already attacked with heart-rot, since the flow of sap presses to the outside vessels by being unable to circulate in the centre of the tree. Generally speaking, the disease usually affects the same side of the tree, but in some situations there are blotches to be found all over it. These appearances point clearly to the cause of the disease.

The flow of sap is checked by intense cold, such as early autumn frosts, which injure the buds and wood before they are matured, and also by late spring frosts after the buds are expanded. The main stem being thicker, is not so much affected by the frost as to prevent the flow of sap upwards through the trunk, but the congealed laterals check its passage through them till thaw takes place. Very often this suddenly occurs by the heat of the sun, the result being an increased pressure at the junction of the branch with the stem, which bursts many of the sap-vessels arranged round the base of the branch, and causes the sap to flow out at the rupture, producing an irregular growth, and leaving a gummy, black, resinous substance on the tree. Eventually the branch dies very often the first year after the rupture takes place; and if there are many of these ruptures, the tree presents a very sickly appearance, and in a few years dies off above the rupture. The wounds invariably occur on the side exposed to the prevailing winds, and generally more about the outside of plantations, and near cold, damp situations. Pressure on the branches from late spring snows, especially those storms late in April, after the tree is in leaf, are, along with the cold and frosts, the principal cause of this disease. Trees planted singly are seldom affected with cancer. The branches of such trees are more robust and better able to resist pressure, and this shows the necessity of early and judicious thinning, so as to admit light and air sufficient to encourage a strong and healthy growth. From the above statement it is not to be inferred that the larch is too tender for our climate, the contrary is the fact; it will stand any amount of cold and frost, provided they be seasonable. But this is not the case in our variable climate. This disease reduces the value of the timber very much. Large timber sometimes has to be sold for fence and pit wood at less than half price, as the blemish renders it unfit for boat or ship building. With our present limited knowledge of the diseases of trees, it is my opinion that we cannot do anything to cure them, but we can in a great measure prevent them by planting in suitable soils, situations, and exposure, early and judicious thinning, and subsequent good management in the latter.

Insect or Blight.—Although found on strong healthy trees, they seldom occur to any great extent, and only appear like a disease on plants and trees whose vigour is impaired by some other cause. The sap of such trees is of a saccharine nature, and favours the attack of insects.

Coccus laricis, or mealy bug, is the principal depredator. Both the insect and its eggs are microscopic, and can be observed to advantage only by a powerful lens. An ordinary magnifier shows the insect to be of an oblong shape, all closely corded across the body, and of a bluish purple colour. Its eggs are oval in form, and of a pale grey colour, approaching to green. They are encased in a white downy-looking substance, and under this covering the insect may be found. Plants or trees affected with the *C. laricis* are easily detected. The bark of the stem and branches presents a dirty black appearance in spring, and in summer the foliage appears of a grey whitish hue at a distance, but on close examination it is covered with small white woolly flakes, adhering tenaciously to the leaves and bark. The excrements of the insect make the branches feel gummy to the touch, and taste like the honey-dew of the oak or beech. As already stated, the *C. laricis*, although found on healthy plants and trees, mainly attacks only those growing under unfavourable circumstances. Trees affected with heart-rot, blister, those growing in a crowded state, and all the other circumstances unfavourable to larch, favour the disease, which I strongly suspect to be the effect rather than the cause. Plants in nurseries are often affected with the *C. laricis;* indeed, the larch is seldom free from this pest, and, when grown year after year in the same locality, and often transplanted in the same soil, no wonder that the plantations suffer. Before planting out, however, plants can be thoroughly cleansed by having all the plants sheughed in as dry a state as possible, and not too tightly packed. If the plants could be kept for a few days in the packing shed, they would be all the better. Take of perchloride of mercury 1 lb., and dissolve in thirty gallons of tepid water, syringe the plants with this solution, and when they are thoroughly dry syringe again. This quantity is sufficient for about 20,000 to 30,000 plants; the cure will be found to be complete, and its good effect remains in the tree for a number of years. The perchloride is a deadly poison, and should be handled with the utmost caution. This solution must not in any case be applied to fruit trees, as the poison might pass into the fruit. I am not of opinion that it is practicable to use it in plantations. The only remedy for them is to avoid all circumstances likely to favour the attack.

The larch, like all other forest trees, is more or less infested with cryptogamous plants, and whether it is a disease or not is a question of importance to arboriculturists. It is quite certain, however, that trees thickly covered with lichen appear to have lost their vigour, their foliage is scant, and in general presents a very sickly appearance. But this appearance is not due directly to the effects of the lichen. The lichen itself is produced by the tree being either affected with some other disease or grown in a crowded plantation, or on a heathy, peaty, ill-drained soil, or on too severe an exposure. Under these conditions, the lichen will insinuate itself and choke up the pores of the bark to the total exclusion of the necessary light, air, and heat. The consequence is, that the health of the tree, unless relieved, goes from bad to worse, and eventually the tree dies. Till the lichen lay hold and cover up the wood of trees from one to six years old, it has no injurious effect; but unless the tree is in a thriving state naturally, this it soon does with the results already stated. On the bark of old trees, lichen has no bad effect whatever, as it is rugged, and falls off periodically in scales (the smooth-barked trees excepted), and with these scales the lichen for the most part drops off. The formation of lichen may be prevented, and its injurious effects cured by thoroughly draining damp land, and by judicious planting and thinning. If these suggestions be followed, the larch will still remain one of our best and most useful coniferæ.

Although larch can be reared to advantage only under the conditions mentioned above, it does not follow that the tree should be planted in no other circumstance. On the contrary, it should be largely employed as nurses in all plantations, in most soils, and in most situations; to be thinned out at pleasure in those unfavourable to its growing in a healthy state, and to large dimensions. Such thinning requires to be executed in a very careful manner, taking soil, situation, and exposure to guide the operation, instead of the appearance of the tree, since at the age of from fifteen to twenty-five the larch would appear to be the proper tree to leave for the permanent crop, and would be apt to mislead the operator in his selection. Larch thinnings pay better than any other, and this alone is a recommendation to plant it largely as nurses, and have the greatest possible returns in a given time.

XIV. *Report on Old and Remarkable Trees growing on the Estates of Bayham Abbey and Wilderness Park, in the County of Kent.* By JAMES DUFF, Wood Manager, Bayham Abbey.

No. 1 is a gigantic ash tree, growing on a strong loamy soil, resting on a substratum of sandstone, on the farm of Great Shoesmith, in the parish of Wadhurst and county of Sussex. The dimension, at 1 foot from the ground, is 15 feet 4 inches in circumference, and at 5 feet high it is 12 feet 6 inches in circumference; from thence it runs up with a straight, clean, sound trunk, with no perceptible taper, to a height of 38 feet, where it sends out gigantic limbs, expanding from tip to tip 83 feet wide. All these branches are healthy, and send out vigorous young shoots. The total quantity of marketable timber in this tree, including the largest limbs, is 356 cubic feet, which, at 2s. 6d. per foot, would yield a return of £44, 10s. The entire height of the tree is 84 feet.

No. 2 is a large beech, growing also on the farm of Great Shoesmith, in a clump of beech, called the Beechin Toll. At 1 foot from the ground it is 13 feet in circumference, and at 5 feet it is 11 feet 6 inches in circumference, with a straight, clean, and sound stem, without a single branch, to the height of 48 feet, where it sends out giant branches, which are of an upright habit of growth, owing to their being pressed upon all sides by rival trees. The spread of branches is 70 feet from tip to tip, and the entire height 95 feet. This tree is quite healthy, and is growing vigorously.

No. 3 is also a beech, growing near No. 2. At 1 foot from the ground it is 18 feet 6 inches in circumference, and at 5 feet it is 13 feet in circumference; from thence it runs up, with a clean bole, to the height of 20 feet, where it sends out large limbs, three of which contain 90 cubic feet of timber, with a spread of 66 feet from tip to tip. The entire height is 95 feet. Numerous trees of similar magnitude are in this clump, and all are healthy, and growing vigorously on a sandy loam.

No. 4 is a gigantic hedgerow oak, growing on a sandy clay loam, on the farm of Wickhurst. Its circumference at 1 foot from the ground is 24 feet 4 inches; at 5 feet, 17 feet 4 inches and 19 feet high to the first branch; at 9 feet 6 inches, which is the middle of the tree, it is 15 feet 8 inches in circumference; and from 19 feet high to 27 feet high, there is a length of 8 feet, girthing in the middle 12 feet 9 inches. After making ample allowance for bark, this giant, together with the limbs, which alone amount to 236 cubic feet (some of them large trees in themselves), amounts to 548 cubic feet of marketable timber, which at 3s. per foot, would be £82, 4s. The entire height of this monarch is 65 feet, and the spread of branches is 92 feet across one way, by 98 feet the other. This tree is quite sound and healthy, growing vigorously, and has the appearance of growing for many generations to come.

No. 5 is a hedgerow beech, also on the farm of Wickhurst, which, at 1 foot from the ground, is 15 feet 10 inches in circumference; at 5 feet, is 12 feet 3 inches in circumference; and at the height of 27 feet 2 inches it is 10 feet 11 inches in circumference. This is a model specimen of a park tree. The outline of its branches is symmetrical, and expanding to 94 feet in width, with an entire height of 80 feet.

No. 6 is an oak, growing on a sandy loam on Little Shoesmith farm. At 1 foot from the ground it is 22 feet in circumference; at 5 feet it is 14 feet 6 inches in circumference; and at the height of 31 feet 6 inches it is 11 feet 8 inches in circumference, where it sends out giant branches to the spread of 78 feet. This tree shows slight signs of maturity. Its entire height is 85 feet.

No. 7 is a large oak, growing on a clay loam, in a grove of oak trees, several of which are nearly of equal dimensions, and growing in the home park, near the old Abbey of Bayham, in Sussex (the new Abbey being in Kent). This tree measures 18 feet 6 inches at 1 foot from the ground; at 5 feet it measures 12 feet 6 inches in circumference; and at the height of 30 feet it is 11 feet 6 inches in circumference. At this height it sends out a great number of giant branches (many of them equal to large trees themselves), the whole of which contain 235 cubic feet of marketable timber, and expanding to the unusual width of 110 feet from tip to tip. The number of cubic feet of marketable timber in this tree, including the large limbs, is about 460. It is to all appearance quite sound and healthy, and making good annual growth. The entire height of the tree is 90 feet.

No. 8 is a huge pollard ash tree, supposed to be about 800 years of age, and the largest extant. It is now a mere shell, or part of a shell, as one side is entirely crumbled away. The relic which is left measures 38 feet round at 1 foot up, and at 5 feet up it measures 28 feet round. There is an archway right through the centre of this tree, wide enough at one side to admit a horse and cart. It is clasped with iron hoops, its branches are supported by wooden props, and every care is used to prevent the wind blowing it asunder. The primary branches of this monarch have crumbled away by the hand of time, and those that remain are all covered with moss and ivy, and only expand 45 feet—a poor remnant of what they must have once been in their meridian splendour. The tree grows on a sandy loam, close to the old ruins of Bayham Abbey. A few more years and this old monarch will be numbered among the things that were.

No. 9 is an oak in the home park. At 1 foot from the ground it is 19 feet 7 inches round; at 5 feet it is 14 feet round; and at the height of 22 feet it is 12 feet 9 inches in circumference. The entire height of this tree is 70 feet, while the spread of its branches is 84 feet. It is quite sound and healthy, and growing on a loamy soil.

No. 10 is an oak, also in the home park, growing on a clay loam. At 1 foot from the ground this tree measures 22 feet 4 inches round; at 5 feet up it measures 12 feet 6 inches; and at the height of 28 feet it measures 11 feet 7 inches, where it sends out giant branches, some of which measure 7 feet 8 inches round, and a spread of 86 feet from tip to tip of its branches. Entire height, 86 feet. All the foregoing trees are in the county of Sussex (while the following trees are in Kent).

No. 11 is an oak tree, also in the home park, growing on a clay loam, by the side of the stream which divides the two counties. At 1 foot high this tree is 16 feet 7 inches in circumference; at 5 feet is 14 feet 2 inches; and at the height of 23 feet 6 inches it is 12 feet 8 inches in circumference; the spread of its branches, 92 feet; and the entire height, 80 feet. The trunk of this tree is straight, clean, and sound, and a very handsome piece of timber, quite healthy, and growing vigorously.

No. 12 is a tall oak tree, in Rear Wood, growing on a hazelly loam, and at 1 foot high it measures 14 feet 5 inches round; at 5 feet up, 10 feet 1 inch; at the height of 47 feet it is 7 feet 4 inches round; and at 55 feet high it is 4 feet 3 inches; the entire height is 83 feet, with a spread of branches 72 feet from tip to tip. This tree is very healthy, and growing very fast, and has every appearance of being some day a monster oak.

No. 13 is an old beech, growing on a sandy soil near the village of Pembury, and called the Pembury Beech. At 1 foot high it is 22 feet 5 inches round; at 5 feet high it is 13 feet 8 inches; at the height of 27 feet 4 inches it is 11 feet 2 inches; and at the height of 36 feet it measures 8 feet 11 inches round, where it sends out some branches, measuring 7 feet round, which spread out 56 feet, and are crooked and twisted in all manner of shapes and forms; frequently artists are to be seen sketching the outlines and rustic branches of this fine old venerable beech.

No. 14 is an old oak tree, growing on a sharp sandy loam in Wilderness home park, one of the seats of the Marquis of Camden, which measures at 1 foot from the ground 23 feet 8 inches in circumference; and at 5 feet up it measures 16 feet 10 inches, running up with a handsome stem to the height of 30 feet. At this height, giant branches are thrown out in all directions, which expand 100 feet wide, while the height of the tree is only 76 feet. The tips of the branches begin to show signs of decline.

No. 15 is an old oak, also in Wilderness home park, about 230 years of age, and growing on a sandy loam. At 1 foot up it measures 23 feet 10 inches round; and at 5 feet up it is 17 feet 2 inches round, with a straight, clean, and very handsome stem, 20 feet to the first of the branches, some of which measure 3 feet through. The entire height is 104 feet, while the spread of its branches is only 91 feet from tip to tip. About one-third of the branches of this tree are dead, or what is called stag-horn topped.

No. 16 is an oak in Wilderness Park, which is 20 feet 2 inches at 1 foot from the ground; at 5 feet up it is 15 feet 10 inches round; and at the height of 20 feet it sends out large branches, expanding to the width of 90 feet from tip to tip, while the entire height of the tree is 80 feet.

No. 17 is a cedar of Lebanon, growing on the lawn at Wilderness Park. This tree was planted by the first Marchioness of Camden about ninety years ago. It is now a perfect beauty, one of the gems which decorate the lawn of this fine park. At 1 foot from the ground it measures 17 feet 5 inches round; at 5 feet up it measures 15 feet 4 inches; and at the height of 11 feet it sends out a profusion of branches, which expand to a width of 80 feet; and the entire height is 75 feet. The deep, sombre appearance of this tree, which is thickly set with cones of a light-green colour, forms a very striking and pleasing object on the lawn.

No. 18 is a minor companion cedar to No. 17, and evidently planted at the same time, but in poorer soil, which accounts for its inferiority. At 1 foot high it measures 12 feet; and at 5 feet up it is 11 feet 10 inches in circumference. The entire spread of its branches is 53 feet, while its total height is 70 feet.

No. 19 is a pollard Spanish chestnut, in one of the avenues at Wilderness Park, which measures 19 feet 3 inches in circumference at 1 foot from the ground; at 5 feet is 17 feet round; and at the height of 11 feet it sends out monster branches, expanding to the breadth of 60 feet. The breadth and height of the branches of this tree are equal.

No. 20 is a pollard Spanish chestnut, growing beside No. 19, which measures 21 feet round at 1 foot up; at 5 feet is 19 feet 4 inches; and at the height of 9 feet it sends out eight large branches, some of which are nearly 3 feet in diameter. There are several pollard trees in this avenue, which have had large branches broken off by wind close to the stem; their stumps have been neatly sawn off, and the wounds plastered over with Portland cement, which is admirably adapted for this purpose, as it entirely excludes rain, sun, and weather from acting on and decomposing the tissues of the wood, and thereby prevents decay spreading in the trunk.

No. 21 is a fine old park beech, in the home park at Wilderness, which is 30 feet round the swell of the roots 1 foot from the ground; at the height of 5 feet it is 17 feet 6 inches in circumference; at the height of 12 feet it sends up a profusion of branches, which expand 74 feet wide; and the height of the tree is 66 feet.

No. 22 is an oak in Chance Wood, on Wilderness estate, and growing on a sharp sandy loam. At 1 foot from the ground it is 15 feet 10 inches round; and at 5 feet it is 12 feet 6 inches. From thence it runs up with a fine, clean, straight, sound, and handsome stem, without a single branch to the height of 40 feet, where it is 8 feet in circumference. At this height it sends out its branches, which expand only 30 feet, being pressed on all sides by tall heavy beech trees. The entire height of this fine oak is 85 feet.

No. 23 is an oak, also in Chance Wood, which is at 1 foot from the ground 17 feet in circumference; at 5 feet is 12 feet 6 inches; and from thence it ascends with a very handsome, clean, straight, and sound bole, to the height of 52 feet to the first branch. At this height it must be between 8 and 9 feet in girth. Trees of this description are seldom to be met with, having such a girth and length, and so straight. The spread of branches of this handsome tree is 75 feet, while its entire height is a little over 100 feet.

No. 24 is a very tall beech, also in Chance Wood, which at 1 foot up is 14 feet 6 inches round; and at 5 feet is 9 feet 8 inches, rising to the unusual height of 65 feet (to the first branch), its stem as straight as an arrow, clean and sound. This is certainly one of the handsomest trees to be seen growing in any county. The spread of its branches is 40 feet, while the apex reaches to 110 feet high. Many trees in this wood are of much larger dimensions, but not so clean, tall, and handsome.

No. 25 is an evergreen oak, growing on a loamy soil, by the side of the turnpike road near Bidborough. It is 13 feet 9 inches at 1 foot up, and at 5 feet high it is 9 feet 9 inches in circumference; at 7 feet high it sends out four branches, expanding 68 feet from tip to tip; and at the height of 13 feet, where it is 8 feet round, it sends out a profusion of branches, two of which are each 5 feet 9 inches in circumference. These two branches were a few years ago bolted together with a $1\frac{1}{2}$ inch iron bolt, to prevent them being split asunder by wind. The entire height of this beautiful tree is 48 feet. Its outline is very compact and uniform, and of a globular form, with its branches nearly touching the ground all round. It is quite healthy, and makes annual shoots 6 inches long. It is enclosed for protection by a continuous iron bar fence.

XV. *On the Arboriculture of the County of Kent.* By JAMES DUFF, Wood Manager, Bayham Abbey, Tunbridge Wells.

The county of Kent, the extreme south-eastern corner of England, 64 miles in length from London to North Foreland, and 38 miles in breadth from North Foreland to Dungeness, has an acreage of about 996,480 acres, while the woods, coppices, and plantations cover an area of 78,000 acres. Kent differeth not more from other counties than from itself; in some parts health and wealth are many miles distant, and in other parts abide in the same place.

The physical features of the county are strongly marked, dividing it into three very distinct districts: (1.) That of health without wealth, embracing the higher parts of the Downs, and forming what is called the backbone of Kent; (2.) That of wealth without health—this consists of parts of the tree-covered Weald of Romney Marsh, and along the rivers Medway and Swale, where the pasturage is deep and rich, but where ague and low fever are common; and (3.) That in which health and wealth are found together, covering by far the greatest part of the county.

Five geological belts, of varying width and outline, extend throughout the county from north-west to south-east. The first, stretching from London to the Isle of Thanet, and embracing the Isle of Sheppey, consists partly of plastic and London clay, and is a continuation of the basin of London. The second belt, of chalk, is a continuation of the North Downs; it extends from Surrey to the sea or eastern coast, forming a broad mass of cliff. A low marshy coast stretches from Walmer to the Isle of Thanet, where the chalk reappears and forms the fine promontory of North Foreland.

The chalk intrudes through the valleys of the Darent and Medway, and extends in a thin line along the banks of the Thames from Greenwich to Gravesend. The third and fourth belts consist of gault and lower green sand, both underlying the chalk. The fifth is the Weald clay, which covers the greatest part of the county, the flat of Romney Marsh lying below it. Some portions of the Hastings sand formation of Sussex are occasionally found isolated in the Weald clay, but are not sufficient to constitute a sixth belt.

Except the marshes along the Thames and the south coast, no part of Kent is level; the Weald is a succession of low hills rising gradually to the height of 400 or 600 feet above the sea. From these heights the rich tree-covered Weald is of extreme beauty, the quick-set hedges which enclose the pasture-fields and hop-gardens, the hedgerow trees, and the apple and cherry orchards, make the country look like one garden, and Kent may justly claim to be the garden of England. The hop, for which this county is so celebrated, covers from 95,000 to 100,000 acres of soil, and is the most valuable crop.

Kent must have been at some remote period covered with vast forests of primeval oak, for throughout the county the oak is the predominating tree, except on the chalk formation, where beech luxuriates. Larch and Scotch fir frequently grow tolerably well on the chalk formation, where the chalk is not near the surface, but I have never seen large fir trees on chalk. Scotch fir is only planted for ornament, as so far from coal mines there is no demand for such timber. The acorns dropping from the oak trees in October readily germinate, and in summer the woods are covered with young oaks, most of which are soon smothered with the thick coppice. In autumn large herds of swine are to be seen attended by a boy, which live on acorns for several months; and men, women, and children, out of employment, gather the acorns, and sell them for feeding swine at 1s. per bushel. Against the oak, which at one period covered the county, there has been a constant warfare waged by man, clearing woodland for pasture and agriculture, and, above all, for the cultivation of hops. Even in the present generation large quantities of woodland have been cleared, and we now find that woodlands occupy a small percentage of the former area.

Before the introduction of hops into England in the beginning of the sixteenth century, the forests were purely of timber, but after hops began to be extensively cultivated, the demand far exceeded the supply, and proprietors found that the cultivation of coppice for hop poles paid better than the growing of timber. This great local demand has steadily increased, till it has now become the primary object of arboriculture in the south-east corner of England, by the oak trees being severely thinned, and chestnut and ash planted instead, so that he who plants may often reap. Contrasting the acreage of woodland and coppice, now only 78,000 acres, out of 996,480 acres which the county contains, and that the acreage of hops amounts to nearly 100,000 acres, it is evident that the cultivation of coppice for hop poles must yield a handsome return. And as, in our time, present profit is more looked at than future prospects, consequently it is not to be wondered at that the cultivation of coppice, which often realises from £30 to £40 per acre in ten years, receives so much attention.

The demand for hop poles has recently increased much owing to the extension of hop plantations, and has caused the importation of spruce fir hop poles from Norway and Sweden, which sell from 20s. to 45s. per 100, according to size, leaving the importer a large profit. As supply and demand are the ruling agents in all trades, the less acreage of coppice and the more of hop plantations, the price of hop poles, in proportion, must inevitably rise.

The system of management in this county has been to thin the oaks severely, and fill up with Spanish chestnut, ash, willow, or alder, as the ground is adapted for each of these trees. The hazel and oak coppice, natural to the soil, is gradually giving place to coppice of chestnut and ash. As the hazel and oak are not nearly so durable for hop poles as chestnut and ash, they sell at a correspondingly low price. This system has been carried on for a considerable time, and now many of the plantations are in a satisfactory state, thickly studded with fine, clean, straight, and thriving coppice, carefully looked after, and with all vacant spaces filled up.

Previous to the underwood being exposed to public sale, which is the usual system of disposal, the coppice is inspected, and a number of the best oak tellers, grown from the acorn, are marked with red paint, to be reserved for oak timber, so as to maintain the amenity of the estates. This operation is tedious and laborious, owing to the thickness of the almost impenetrable coppice, and much time is occupied in the operation on estates where from 200 to 250 acres are sold annually.

The underwood is afterwards lotted in different sizes, and exposed to sale by public auction, subject to such conditions as insure the vendor the payment of each lot, and that the ware is all cut and cleared within the time specified. Before commencing to cut the underwood the purchaser pays a deposit, and finds security for the remainder, failing in such, in the given time specified, the lot or lots are resold, and the deficiency, if any, made good by the defaulter.

The underwood is afterwards cut and cleared out of the wood, before the 1st of May, by the purchaser, and all ware found in the coppice after that date is forfeited. The mode of cutting is this: A man with a hand-bill brushes off all side branches, and ties them into kiln faggots for brick-burning, at 2s. 6d. per 100, which sell at 4s. 6d. per 100. Being far from the coal mines, these faggots supply the place of coal in many ways; but in many places this small spray is worthless, and is either gathered into heaps and burned, or it is allowed to decay in the wood. The coppice is then cut off the slab with an axe, and cut into hop poles of different lengths, as the ware will admit. 10 feet poles are cut for 1s. 1d., and sold at 9s. per 100; 12 feet poles, cut at 1s. 4d., and sold at 15s.; 14 feet poles, cut for 1s. 8d., and sold for 22s.; and 16 feet poles, cut for 2s., and sold from 30s. to 36s. These are the average prices for good poles in the wood, inferior poles will not realise these figures, while choice poles will exceed them.

The smaller ware is cut into hooping for cement and flour barrels, both for the home and foreign trade. These are cut for ½d., and sold at 1s. per 100. Large quantities of flower-sticks and pea-boughs are cut, which greatly contribute to the revenue. The refuse is made into house faggots for firing at 5s., and sold for 22s. per 100. When the coppice grows too long for the poles wanted, a bat is cut off the butt end, and sold at 20s. per 100 for sheep hurdles, which are always in demand.

Fences.—The woods are enclosed by a turf bank; the proprietor makes the fences by piece-work; the ditch around the wood is cleaned out, and small stakes, 3 feet long, are driven into the top of the bank 15 inches apart, around which are twisted long straight rods, forming a strong basket-work, which protects the coppice for ten or eleven years. This cleaning the ditch and making the fence is done for 8d. per rood of 5½ yards.

The oak timber to be cut is marked with red paint, selecting those trees that have attained maturity, and those that have a short stem and bushy top, as they will never produce large timber, and they injure the coppice. Trees of an upright habit of growth should be reserved, as they do less injury to the coppice.

In the woods there are oak trees of all ages and all sizes, from the young teller ten years of age up to full-grown timber. This is caused by the regular saving of young tellers at the fall of underwood every ten or eleven years. After the trees to be cut are marked, they are generally sold by private treaty to timber merchants at so much per foot measured down. The price is regulated by the size and quality of the timber the current price of which is as follows: Trees under 10 cubic feet of timber sell at 2s. per foot for top, lop, and bark; from 10 feet to 30 feet of timber, 2s. 6d. per foot; and trees measuring 30 feet and upwards are sold at 3s. per foot, the purchaser felling the timber and barking the trees, which is done for 32s. per ton of bark. For felling the trees, and stripping and drying the bark, the men are paid by the tanyard weight which is in Mid-Kent.

Some foresters may say that oak bark cannot be peeled for the money. I know from experience that in Scotland it costs double the money, but in the south of England the bark strips much more easily, and one man can strip a ton with greater ease than 10 cwts. in Scotland.

The tops of the trees are then made into faggots and cordwood, the smaller branches and spray into house faggots, at 4s. per 100, and sold at 22s.; the larger branches are cut into 3 feet lengths, and piled up 3 feet high and 14 feet long, called a cord of wood, and sold at 22s. for firewood, or charcoal for drying hops, and large quantities are sent to London.

The timber merchant can clear away the top and the bark when it is dry, but leaves the trees to be measured by the forester immediately afterwards, and pays by bill at three, six, or nine months' date.

The oak timber of Kent is of first quality, and generally grows to large dimensions. Trees measuring 300 to 400 cubic feet of timber are frequently seen, and trees ranging from 80 to 130 cubic feet of timber, and about the same number of years' growth, are annually cut. These are found on a good, deep, clay loam. But the oaks growing on sandy soil are subject to coult and ring shakes, which greatly reduce the value. I have often had to allow one-third where some trees were a mere bundle of laths. As the wood-merchant fells the trees, strips the bark, cuts up the top, and clears off the whole at his own expense, the price at which the timber is sold is the net revenue.

On some estates the timber is sold by public auction, but it is not a satisfactory system in this part of England, as the timber merchants are able to arrange before the sale which lot each is to buy, and in nine cases out of ten they have the oak at three-fourths its value.

The following winter all vacant spaces in the wood are planted with Spanish chestnut, ash, willow, or alder, as the ground is adapted for each tree, at the price of 1s. 6d. per 100 for digging the pits and planting; and even at this low price men can earn from 3s.

to 3s. 6d. per day, and more where the soil is easy to dig. The Spanish chestnut is extensively planted in Kent for hop poles; it is a first-class coppice producer, grows free, fast, and straight, and is durable as hop poles. It is surprising to see the growth it makes on poor soil, where it is dry and open; but on damp soil, even though rich, the result is unsatisfactory, as it grows stunted and sickly, and is often injured by late spring frosts. The first ten years after planting it yields no return, as it takes that time to get established, and to make a stub, but after the first cutting it grows strong, often producing three poles per stub at the second cutting, and increasing in vigour at each cutting, and strong shoots, 5 and 6 feet high, and from six to twelve on each stub, are seen the first year after it is thoroughly established. Spanish chestnut, as a timber or park tree, is very ornamental, but, in a financial point of view, it is comparatively worthless. I have cut large numbers in the last three years, and nine out of ten were so shaky they were worth little more than firewood.

The ash gives a valuable coppice crop on damp or retentive clay or loam, realising from £3 to £3, 10s. per annum. In 1874, at our annual sale of underwood, a large quantity of ash coppice was sold at £33, 15s. per acre, of ten years' growth. This is the most profitable crop of underwood where the soil is too wet for chestnut; where rabbits and hares are numerous, their depredations to the ash in winter, when the ground is covered with snow, are sometimes very great; they peel off the bark round the stem, when it dies, shooting again from the root only to be cut down next winter; and, where these creatures abound, they soon destroy the coppice. As a timber tree the ash ought to receive more attention than hitherto; it is a fast grower, valuable at all ages, and saleable at all sizes, and does not damage the coppice as oak does. Trees of large dimensions readily sell at 2s. 6d. per foot.

Alder and willow are planted in low soils, too wet and marshy for ash. These are next in value for hop poles; and in such soils they realise a handsome return. As timber trees here they are of little account, and only realise 8d. per foot. The foregoing trees are all planted from 3 to 5 feet high, and 4 feet apart. Smaller plants are useless, as the coppice soon smothers them. When the planting is finished, the coppice is left undisturbed for ten years, when it is again cut. On most estates there is about an equal number of acres ready to cut annually in rotation. The coppice is sold in November, cut in winter, and cleared in spring, then the oaks are marked, peeled in April and May, measured and cleared in summer, and the woods planted up in winter, everything in regular order.

Many foresters object to this system of growing coppice and timber together, and contend that two crops cannot be grown profitably at the same time on the same piece of ground, saying, either have all coppice or all timber. In many cases they are right, as timber can be grown better and more profitably alone; and coppice can be grown better, faster, and more profitably when it does not contain a single tree. But coppice pays an annual revenue of from £2 to £3, while arable land is only worth half that amount, and the timber will yield about 15s. per annum besides. It is only where the oaks have been severely thinned, and chestnut and ash coppice stand thick on the ground, that these prices are realised. There are many districts where this system has been neglected, and where the oaks stand wide apart for a crop of oaks alone, the underwood being of a description inferior for hop poles, viz., hazel and oak, which is natural to the soil and which only realises £4 to £5 every eleven years. I am certain that if all the oaks were cut, and only coppice grown, the revenue would be greater than at present, but the landscape effect would be greatly impaired, and the present beauty of the country altered.

If a Scotch forester were entrusted with the management of woods in the south of England, it would be a gross mistake to introduce the Scotch system, and *vice versa;* each country must be managed according to its peculiar circumstances. Planting larch for hop poles is by far the most remunerative crop that can be grown. In ten years larch pays an annual revenue of from £5 to £6 clear profit per acre. At our sale of underwood in 1874 a quantity of larch plantation was sold at £72 per acre, ten years old; in 1864 this enclosure was planted with chestnuts, 4 feet apart each way, and then filled up to 2 feet with larch, at a cost of £15 per acre, leaving a clear profit of £5, 12s. per acre per annum. The soil was a poor, sandy clay, worth about 18s. per acre for agricultural purposes. I am informed upon good authority that a quantity of larch plantation was sold several years ago on a neigbouring estate at the enormous price of £100 per acre, fifteen years old. What system of forestry can equal this? After the larch is cut, the young chestnut stub grows into permanent and profitable coppice.

On the chalk formation the principal tree is beech, but as coppice for hop poles it is worthless. Hop poles made of beech decay in two years, while Spanish chestnut and ash poles stand eight to twelve years; and chestnut has often lasted double that time. The poles are dipped in creosote, which makes them twice as durable.

In several parts of Kent English elm is grown, which sometimes attains large dimensions, measuring 250 to 300 cubic feet, and realises from 2s. to 2s. 6d. per foot. The county abounds in hedgerow timber and park trees in the pasture fields, which afford fine shade for stock in summer. Were it not for these hedgerow trees, it would be impossible to keep stock out of the coppice in hot weather. The hedgerow timber in Kent has escaped the barbarous treatment it is subjected to in many parts of England (especially elm), that of lopping the side branches, and leaving only a small tuft at the top, which gives the landscape a poor appearance compared to that it would have were these trees allowed to follow their natural habit of growth.

Larch, spruce, and Scotch fir are interspersed among the oak on many estates in clumps, and single specimens for embellishment, but are seldom grown for profit, except on the downs or poor moorish soil. The quality of Scotch fir grown in Kent is inferior to that grown in Scotland. It sells at 6d. to 9d. per foot, and is in little demand even at that price. In several districts in Kent and Sussex, where the soil is thin and poor, the oak trees spread out a bushy top at the height of 8 or 10 feet, which is caused by the roots not being able to descend into the soil, which rests on a white barren gravel or sand; but as chestnut thrives well, the oak trees have been cut, and coppice cultivated instead, which realises a far better return. Viewing this system from a financial point of view, it is the best that can be adopted, as the soil is not fit to grow oak profitably. The rate of growth is small. There is little yield of revenue from the oaks; and their spreading tops do great injury to the coppice. On the other hand, in a landscape point of view, the removal of the oaks greatly impairs the amenity of the estates where practised; and if only ten trees were saved per acre, they would give a clothed appearance to the country. Ash for timber ought to be cultivated, instead of oak, in moist clay; in such it is a profitable tree, always saleable of all sizes, a fast grower, and preferable among coppice, which it does not injure like oak.

Another system which is remunerative, especially on dry, open soil, is that of planting larch for timber among coppice. This is a system adopted on several estates of late years, but unfortunately the foresters have been compelled to abandon it on account of depredations by ground game. Larch was planted in the open spaces at the rate of twenty plants per acre, 4 to 5 feet high, strong and well rooted. The result is, that not 5 per cent. are now alive; only the largest plants have escaped being destroyed *by hares and rabbits.* Where ground game is less abundant, this would be the most remunerative system in this part of England. Thirty or forty years ago it was adopted; and in several places handsome larch trees stand at wide intervals among fine chestnut coppice, worth £30 in ten years. They are thinned at each fall of underwood, to prevent the coppice being too much shaded. The upright habit of the larch conduces to the growth of the coppice when trimmed up to the height of 15 or 18 feet. Its linear leaves do not exclude light and air. Its roots run shallow in the soil, drawing food from the surface, while the Spanish chestnut root is more of the nature of the oak, drawing nourishment from a greater depth. Under this system chestnut hop poles may be seen growing luxuriantly close to the stem of the larch. On the whole, I think, that in Kent the yield of revenue from woods and coppices can be compared favourably with that of any other county of Britain, where coppice is entirely ignored, and nothing but timber grown. In such counties hundreds of loads of firewood lie and rot in the woods as of no value, while here the smallest twig forms a source of profit. In Kent underwood is preferred to timber growing, as the returns are larger, quicker, and more certain; and by the annual increase in demand for hop poles, great inducements are offered to make new coppice plantations. These will not lose their value so long as hops continue to be cultivated; and as these have maintained their position for over two and a half centuries, there is little reason to anticipate their failure. On the contrary, the acreage is annually increasing; and to keep pace with this increase, fast-growing coppices are now cut two, and in some cases three years earlier than they used to be. Hop growers find that they get a better crop of hops by what is called under-poling, or using shorter poles, thereby enabling foresters to cut the coppice two years earlier. If coppice can be cut at nine years old, which used to stand till eleven, two years are gained at first cutting, while the coppice will be ready four years earlier next cutting.

Before hop growers adopted the system of dipping the poles in creosote, coppice was not cut till it was eleven years old, the object then being to get as much heartwood as possible; but by the creosoting process, poles full of heartwood or full of sapwood are brought more on a level, and made twice as durable. Had this process not been introduced, the county could not have grown poles to supply the demand; and even now large quantities are brought from Sussex, and also of late from Norway. For the most part, the underwood is bought by farmers and hop growers, who thus find winter employment for their men and horses in carrying away the ware. Wood is also bought by industrious, well-to-do workmen, who are able to pay 10 or 20 per cent. of the purchase-money, the balance for which they must find security to be paid that day twelve months. By this system we can realise 10 to 15 per cent. more for the coppice than by the payment of ready money, as ten buyers may come in place of one—a great consideration to the result of a public sale, as the price is thereby greatly increased, and men of enterprise may better themselves.

Underwood cutting is the chief outdoor work here during the winter months.

Birch is frequently cultivated as coppice for poles, on shallow, poor, hard soil, unfit to grow chestnut, ash, alder, or willow, and on such soil it often realises £8 to £12 in ten years, and in good soil £20 have been realised in some cases; but the stubs often bleed to death, and ground game kill the young shoots. The poles are inferior to larch, chestnut, ash, and willow; it is therefore not much cultivated as coppice.

In several districts, chiefly on the chalk formation, large plantations of beech have heen planted, which thrive luxuriantly, and yield a good profit for poor soil. At Sevenoaks, where the soil is a sharp sandy loam, resting on gravel, there are thriving plantations of beech and oak. Many trees measure 150 to 200 cubic feet; the beech realises 1s. 3d. per foot, and is much used for making windsor chairs, heavy planking, etc. These beeches often measure 40 to 60 feet to the first branch, and many trees measure 2 feet on the side at the height of 20 feet.

In the adjoining part of Sussex, on the estates of Eridge, Crobore, and Ash Down Forest, larch fir, extensively cultivated for hop poles and timber, thrives uncommonly well on a loamy soil. A surprising number of telegraph poles are grown on an acre of this soil, yielding a very handsome return; and trees, 70 to 90 feet high, and containing nearly the same amount of timber, are frequently met with, which realise 1s. 3d. per foot.

Prospects.—It will be seen from the foregoing that the cultivation of trees for timber in Kent is on the decline, while the cultivation of coppice is on the increase. On some estates the timber, much neglected during the lives of previous proprietors, has been indiscriminately felled or thinned, leaving about one-third of a crop to keep up an appearance. Several attempts have been made by the foresters to replant coppice for poles, but have been entirely baffled by the abundance of ground game, which have destroyed almost every plant to the extent of several thousand pounds value. Though the timber is disappearing, it is generally supplanted by coppice, which yields a better, more certain, and speedy return. It is more profitable to grow a crop for which there is a great local demand, than to grow a crop for a distant though profitable market. There are large tracts of poor sandy soil in several parts of Kent, yielding 10s. to 15s. per acre as arable land, which, if planted with chestnut and larch for hop poles, would realise in ten years £40 to £50 per acre, and after the larch was cut the chestnut would become profitable coppice. The superiority of larch poles over all others often leads to great mistakes in planting larch on soil only fit to grow Scotch fir and spruce.

There are several hundred acres of moorish peaty soil, part of which is covered with a healthy thriving crop of Scotch fir, but much is still lying waste. If it were planted, it would realise 20s. per acre for the time it occupies the ground, although small Scotch fir only sells at 6d. per foot, while trees 8 inches through sell at 9d. per foot. It is principally used for barrel staves, and who can tell but Scotch fir may yet realise 1s. 8d. or 2s. per foot? In all probability it will do so, when our supplies from America and the Baltic are exhausted. If the thousands of acres of waste land throughout Britain, in many cases now realising only 2s. 6d. per acre, were planted, much money would be secured to posterity, and the humidity of our island would be maintained and increased.

While spruce fir poles are imported from Norway, and fetch great prices, I do not see why the downs of Kent should not be planted with spruce for poles. As a rule, growing hop poles in this county pays better than growing timber of any kind. Larch is often planted on soil only fit for Scotch fir and spruce, on account of the greater demand for larch than for spruce of the same age.

On a shallow, peaty, wet soil, it unmistakably proves a failure; but if spruce were planted, a good result might be looked for. The oak is subject to be shaky on sandy soil, which greatly depreciates its value, and the more larch is planted on such soil, the better will the prospects be, as it does little or no harm to the coppice.

Large profits might be made on the chalk hills, where the soil is shallow, but where larch hop poles can be profitably grown. But larch never attains timber dimensions where the chalk is within a few inches of the surface.

Much is required throughout the county in filling up the coppices with trees suited to the soil. The soil would then be turned to the best possible account, and the coppices and woodlands be in a more flourishing and prosperous condition, and Kent would then be able to grow sufficient poles for her own wants.

XVI. *On the Deleterious effects of Sulphur upon Iron Fencing.* By Thomas Wilkie, Forester, Invergarry, Fort-Augustus.

The beauty of the policy, as well as the scenery of the landscape, is much increased by the style of fences adopted. Till within the last twenty years it was customary to erect stone walls or dykes of various kinds with common stob and rail fences, or hedges where suitable. These are now being superseded by iron and wire fencing, of which many thousand miles are erected all over the country. In some parts double-pronged standards have been extensively used; in others, self-fixing vases are adopted, but the kind most largely used hitherto has been batted into stones. Straining pillars or posts are batted 4 inches, and the common standards generally 3 inches deep. Sulphur has been adopted more largely for batting than any other substance. Several years ago I instituted inquiries as to the suitableness of sulphur for batting, as I believe it contains an acid; and as all acids are corrosive, I suspected that sulphur would corrode the iron. Only one practical forester corroborated my opinion. I examined several fences which were erected with sulphur, and stood only for six years. I found that the iron was being reduced nearly one-sixteenth, having adhered to the sulphur. I scraped this off, and found the sulphur as good as when run into the stone. I wrote to various quarters, and having spoken about it to some gentlemen, who made inquiries, it was found that some doubted the suitableness of sulphur. One said although the sulphur caused corrosion to a certain extent, it soon became expended, forming what engineers term a "rust joint," which is reckoned the best of all joints. I also learned that a fence erected with the use of sulphur, having standards, etc., of a common size, $1\frac{1}{2}$ inches by $\frac{3}{16}$ths had been corroded through. Having mentioned this fact, the answer given was, possibly the iron was not good, the sulphur not rightly managed, or bad stones were used. It was, however, erected by practical fencers. If the acid became expended, how was the fence corroded as described? Either the acid was present in the sulphur, or if expended, it caused corrosion to commence, and to operate on the iron subsequent to its being expended. A respectable fence contractor, whom I asked if he believed sulphur to be deleterious to iron, said, "Of course it is; and many practical fencers know the fact."

He had seen four fences, erected with standards the same as above, rendered as thin as the blade of a pocket knife, having stood respectively for ten, fourteen, sixteen, and twenty years. The pillars, straining posts, etc., were reduced in like degree; also a gate hung upon iron pillars, $1\frac{3}{4}$ by $1\frac{3}{4}$ inches, about fourteen years ago, during a sharp breeze of wind one night, was laid flat upon the road, pillars and all. I have sent for inspection samples of iron corroded by sulphur, with a paper giving the following particulars: Sizes, where and when erected, by whom, practical or amateur fencers. I need only say further that the iron is found in its early stages of corrosion firmly adhering to the sulphur, and is gradually reduced; more room for expansion having thereby been made, the corrosion goes on rapidly, and ultimately the iron is wasted.

Some stones more porous than others may tend either to increase or to retard the progress of corrosion. Another matter for consideration is whether the stone bedded in wet or dry soil has the greatest tendency to cause corrosion, or stone deeply bedded in the soil, or laid upon its surface. I would make a natural rise or fall with the ground where the fence is to be erected, and leave the top of the stone exposed, as the fence could be easily varnished during winter or spring before the foliage grows to cover the stone, or any part of the fence. Galvanised materials, however, are preferable, and the cost is little more; the process, however, reduces the strength of materials by about 20 per cent., as varnishing is thereby rendered unnecessary. Larger stones, in some cases, might require to be used if bedded upon the surface.

Batting with lead is the best plan in either case, as it does not injure the iron. I find iron which has stood for twenty years, batted with lead, as clean and sound as when put in, the rule surface of the iron never having been broken. Lead is not more frequently used, because it gets loose in the stone; the iron, heated by atmospheric influences, expands, and the lead yields before it; and when it cools and contracts, a vacuum remains round the iron. To prevent this, I drive in four small half oval wedges 3 inches long round the straining pillars and resisting posts, the hole 4 inches deep, as suited to size of bore in stone, and two similar wedges, 2 inches long for the standard, the holes being 3 inches deep, putting the flat sides inwards, and driving them tightly on the opposite sides at the same time, when the lead becomes solid round the pillars, etc., at top and bottom of the hole; and this process renders staving unnecessary at first, and, I believe, ever afterwards; but, if needed, a little driving home of the wedge will fix it.

I would suggest that all fences erected with sulphur be immediately examined, and the substance extracted, particularly from any ornamental or costly fence, as it will ultimately become useless, and only sell at the price of old iron or metal. This subject concerns proprietor and tenant alike; and if no antidote can be found to prevent corrosion, the use of sulphur must be discontinued, as the iron pillars, straining posts, standards, etc., will not serve for erecting a new fence of the same height.

XVII. *Report on the Meteorological Observations made at Carnwath, Lanarkshire.* By Alexander Buchan, M.A., F.R.S.E., Secretary of the Scottish Meteorological Society.*

Mr Buchan read the report of the Committee on the grant for the prosecution of the inquiry into the influence of forests on climate, and ultimately in reference to the influence of forests on rainfall. The Committee have already expressed their decided conviction that no amount of rain gauges, however placed, would throw any light on the question of the influence of forests on rainfall, for the simple reason that there were many causes which determined the amount of the local rainfall of which we knew nothing. The Committee had therefore come to the conclusion that the question could only be attacked by means of instrumental observations on the quality of the air, and particularly as regards its temperature and humidity. The greatest care has been taken to secure that the two sets of thermometers, with their protecting louvre-boarded boxes, are placed in positions so circumstanced that the one set is surrounded by air either not influenced at all, or only in an inappreciable degree by the forest, and the other set by air under the full influence of the trees of the forest, in so far as that is possible, when the instruments are at the same time placed directly under the influences of solar and terrestrial radiation; in other words, not under the shade of the trees.

As stated in previous reports (vol. vii., p. 285), the locality chosen for the observations was a wood at Carnwath, which was kindly placed at the service of the Committee by Hector Maclean, Esq., Carnwath House. The Committee particularly desire to state that, in selecting the locality for the instruments, their exposure and precise relation to immediately surrounding objects, the question of the viscosity or adhesiveness of the air, was kept steadily in view as regards currents of air, and the bearing of these currents on solar and terrestrial radiation.

The observations of 1876 were, as had been agreed on, made with the same instruments, and in the same positions as on previous years, with the view of testing the correctness of the results formerly arrived at. They were made by Mr Fotheringham, and extended

* Read at the Annual General Meeting, 1st November 1876.

over three months from August to October. The result is a general, and in many cases a minute correspondence with the conclusions previously obtained.

The following are the more important of these conclusions: *First*, and most important of all, the mean temperature inside the wood was greater than it was outside during the whole of the year, except the autumn months, the mean annual temperature being 45·5° inside, and 45·3° outside the wood; *second*, the temperature at nine P.M. was the same both inside and outside the wood; *third*, in the spring and early summer, the air inside the wood was both warmer and moister than outside; *fourth*, during the autumn the excess of moisture inside the wood is very greatly increased, and this result has been confirmed in a remarkable degree by the observations made during September last, when the weather was unusually damp.

Your Committee are of opinion that something should be done next year to have a more complete discussion of the observations made than had yet been effected. For instance, the daily observations ought to be separated as regarded strength of wind, the amount of cloud, the effect of sunshine, of cold, of frost, long continued cold, and the effect of continuous rain on the quality of the air, both inside and outside the wood, and the converse, the effect of continuous drought. Until this is done, the full value of the observations will not be realised.

It is proposed, about the close of the year, to remove the box with the thermometer from the station at Gallowhill, outside the wood, to a new position inside the wood, where the thermometers will be, as before, 4 feet above the ground, completely shaded by the trees, but otherwise in close proximity to the Winterlaw station inside the wood, at which the box is fully open to the influence of solar and terrestrial radiation. It is further proposed to add at each of these stations a set of underground thermometers, of depths of 3, 12, and 22 inches, which will be observed daily with the other instruments. It would have been preferable to have retained the instruments at Gallowhill, and procured a third set of instruments for the new station under the trees; but the funds placed at the disposal of your Committee will not admit of this additional expenditure.

The chief point in this large and important inquiry which these arrangements have been designed to elucidate is this: Whether there be not a very considerable difference in the mean annual temperature of the air, and of the ground at two stations in the same wood within 100 yards of each other, and under the same conditions as regards height above the ground and the sea, and slope of surface, etc., but differing in the important particular, that while the one is completely shaded by the trees from direct solar and terrestrial radiation, the other station is open to these influences, the instruments there being placed on a grassy patch, about 50 feet in diameter, surrounded on all sides with trees of various sorts, varying from 40 to 50 feet in height. We need scarcely add that, in thus pursuing this line of investigation, other important questions in connection with the influence of forests on climate will be brought under examination and discussion.

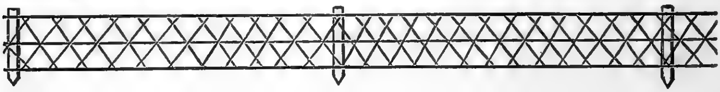
XVIII. *On Two New Modes of Fencing.* By THOMAS WILKIE, Forester, Invergarry, Fort-Augustus.

I suggest two methods of fencing, as possessing many advantages. They are not costly in the formation, and do not require frequent repairs:

1. *The Pollard Fence.*—If to be along the margin of a plantation of deciduous trees, or passing through one, I select a line either straight or circled, as the case may require, and if I have such trees growing say at distances of 12 or 20 feet, I put in a few stobs in the interspaces, in a straight line with the trees, on either side. I pollard all the trees in the line of fence, leaving a few of the lower branches to keep the pollard alive, and dress the cuts with a common pruning-knife. I then place double winders at distances of 150 to 200 yards apart; if much circled, I put them at the former distance, and if straight, at the latter. I then staple on the wires at various distances as required, and strain up by the double winder. Having done so, I pollard a sufficient number of other trees, which I transplant to the line of fence, placing them 6 feet apart. When on a level and straight line I staple on the highest and second lowest wires, to keep them in position. But when in hollows, I have a stob as near every pollard as possible, and staple on the highest wire only, lest they be raised up from the pits. This fence is not costly at first, and on outlying parts of property is not more expensive than good common larch stobs, and if plenty of pollards can be got near the line of fence, it would be no more so than strong stobs charred and tarred. With me the cost of erection was from 3d. to 4½d. per lineal yard, but all depends upon the number of trees in the line of fence, and the supply of those suitable for transplanting to it; my pollards averaged 7½ feet in height and 4 inches diameter at the small end, and consisted of oak, ash, beech, elm, birch, thorn, alder, and hazel.

It may be added, that where an unobstructed view is desired, this fence is not observed at a distance of 500 yards. For a divisional fence between fields none excels it for strength, durability, and shelter. A beautiful diversity of hedgerow can be introduced by this process, as every fourth or sixth tree may be allowed to grow, while the others are pollarded where necessary, otherwise the oscillation caused by the wind would make the wire to cut the staple or the staple the wire. When circles or angles occur, the wire ought always to be put on the outside, for the same reason. I found this fence impregnable to horses, cattle, or sheep, and if it be introduced as a divisional fence when the fields come under a course of cropping, by the time of pasturing it would be perfectly established. Trees suitable for this purpose can often be spared out of young hardwood plantations, and selected according to the nature of the soil. The alder, poplars, or willows are best for damp loamy soil, and the others enumerated for gravelly or richer soils. If carefully and economically done, this fence would supersede, in my opinion, any kind of fencing yet introduced, combining strength, durability, ornament, invisibility, as well as shelter. When plantations are being formed plants should be put in with a view to its subsequent adoption, and should larch stobs be used in the first erection, in most cases the pollard system can be adopted when the stobs are decayed.

2. *The Willow Hedge* was formed thus: I had a low 3-wire fence running along the edge of a leading drain outside the plantation, which was of itself a fence for cattle, but not for sheep. Having to make it so, I cut a trench 8 inches deep along the whole line below the wires, extending to nearly $\frac{3}{4}$ of a mile. I then prepared cuttings of common willow, 18 to 24 inches in length, and put them in 12 inches apart, with an angle of 30 degrees, and another cutting in the interspaces with an opposite angle, those forming two diagonals, thus:



This was done in September and October, and cost about $1\frac{1}{2}$d. per lineal yard. I disbudded all the lower end of the cuttings, and put the dampest and warmest of the soil next them, which I firmly tramped. Next season they were growing rapidly. When I left the place I intended to twist the young shoots round the highest wire, which I trust has been done. I tried for experiment 12 pieces of the same, 4 feet long and 4 inches at the small end; these also grew well next season. By the time the stobs decay I believe they will not be longer wanted, as I crossed the willows upon the two lower wires, and if the shoots have also been twisted, they will keep the fence firm and strong enough. From the yearly crop of basket willows this fence, in the neighbourhood of large towns, and especially in England, would be profitable to the proprietor.

XIX. *On Insects Injurious to Forest Trees, and their Destruction.* By MALCOLM DUNN, Palace Gardens, Dalkeith.*

Whether we look at our subject from a scientific or cultural point of view, it is of the greatest importance to foresters and others who have to do with the cultivation of trees and shrubs, and the management of timber, to be able to distinguish readily the cause of any injury they may suffer from, and to quickly apply a remedy, if such be known. No doubt trees suffer from many other causes beside the injuries inflicted upon them by insects; but when, at the present time, the attention of scientific and practical men in other branches of rural industry is so anxiously and laboriously directed towards finding out effective remedies against the voracious attack of some of the worst insect plagues that have harrassed cultivation in modern times, such as the ravenous attack of the Colorado beetle (*Doryphora decem-punctata*) on the potato in the United States of America, and the still more fatal ravages of the vine aphis (*Phylloxera vastatrix*) in the vineyards of France and the south of Europe, I consider it an opportune time for the Society to take up the important subject before us, and discuss it in an intelligent and practical manner, so that some useful result may be obtained from the expression of the various opinions of members present, the comparison of their notes on the injuries inflicted by insects upon trees and shrubs which have come under their notice, and the remedies they have applied or can suggest.

In order to open the subject for discussion, I will make a few remarks upon some of the best known insects which prey upon and do most injury to trees and shrubs in this country, as it would far exceed the time at our disposal to go into a minute and detailed description of all the species of insects that infest, and more or less injure our forests.

The *Aphidæ* or plant-louse family is perhaps the most universally distributed of all the pests that prey upon trees and the vegetable kingdom generally, and the injury done by them is incalculable, as there is not a tree or plant which appears to be exempt from their attacks in one way or another. Their extraordinary powers of reproduction render them a terrible scourge to forest trees in seasons favourable to their existence, and the rav-

* Read at the Twenty-Third Annual General Meeting, 1st November 1876.

ages they commit upon the young growth of the trees they fasten upon is always hurtful, and often the cause of irremediable injury. It has been calculated by Professor Owen of London, in one of his lectures on "Comparative Anatomy," that a single aphis (*Aphis lanigera*) is capable of producing the enormous multitude of 1,000,000,000,000,000,000—one quintillion—in a year, which affords some explanation of the vast multitudes in which these insects often appear. They live upon the young and tender wood and leaves, sucking the sap, and causing the leaves to curl up or blister, ultimately turning yellow, and dropping off prematurely, to the great and often permanent injury of the tree. The aphis emits the well-known honey-dew, so common on trees and hedges in spring and early summer, which is very deleterious to vegetation, by clogging up the stomata of the leaves upon which it is deposited, attracting other insects, and collecting dirt upon the surfaces of the leaves, which is not beneficial to them. From the investigations of some of our most eminent entomologists, it appears that almost every species of plant has a variety of aphis peculiar to it, and upon which alone it feeds; but it may suffice to mention one of the most mischievous to forest trees, viz., the larch aphis (*Adelgis laricis*), which has been so fully treated in the *Transactions* of the Society, by Mr M'Corquodale, forester, Scone Palace, Perthshire (see vol. ii., p. 45), and the able and interesting paper, read by Mr Gorrie of Rait Lodge, Trinity, Edinburgh, at our meeting last year, and printed in the *Transactions*, vol. viii., p. 61, in which papers are given full details of the grievous injury inflicted upon the larch by the aphis. Another variety of aphis well known to foresters, *Aphis cratægi*, or the thorn-fly, in some seasons does a vast amount of injury to young thorns in nurseries and hedgerows.

The chief means of destroying the aphides is tobacco, in some shape or other. So far as I am aware, there is no practicable way of destroying the aphis when it attacks large trees, except the final one, cutting down and burning.

To get rid of them on young trees in nurseries or plantations, when it is thought worth the trouble, the best remedy is diluted tobacco juice, applied by a syringe or engine to every part of the plants on which an insect can be seen. There are many other methods for eradicating the aphis from trees recommended by various authorities, some being applied in the same way as the tobacco liquor, such as a decoction of bitter aloes, laurel leaves, quassia chips, and soap suds; and others dusted over the insects, as snuff, soot, quicklime, etc., but none are so effective or easily applied as tobacco liquor. I find that one gallon of tobacco juice, of the ordinary strength sold in shops, to six gallons of water, is sufficiently strong to kill all aphides, if applied with force through a syringe or engine, so that every insect is thoroughly wetted with it; the operation is most effective in hot, dry weather.

There are some insects which ought to be protected and encouraged whenever possible, as they are deadly foes to all aphides —the larva of the ladybird (*Coccinella bi-punctata* and *septem-punctata*), the pearly moth (*Hemerobius perla*), the bee-fly (*Syrphus parasitica*), and several species of *Aphidius*, ichneumon or lion flies, all of which devour aphides with the greatest avidity. The earwig and ant are also said to be bitter enemies to aphides, but as they are themselves addicted to mischief, they ought not to be encouraged. There are also many birds which devour vast numbers of aphides as well as other insects, and all such birds ought to be strictly preserved and encouraged to increase as much as possible in our forests and plantations. If the insectivorous birds were more plentiful in the country, we would be less troubled with the ravenous attacks of insects upon vegetation.

In hot and dry summers, trees and shrubs suffer severely from red spider (*Acarus telarius*), one of the mite family, which often infests limes, elms, poplars, and other deciduous trees, so as to cause the leaves to turn a russety brown, and fall off prematurely, weakening and exhausting the tree of its sap, and preventing the season's growth from arriving at maturity. As the extent of the ravages of the red spider is much influenced by the dryness or otherwise of the season, it is hardly necessary to go into a lengthened detail of its nature and habits. I need only remark that it detests cold and wet, and if young plants are infested with it, a good syringing with soap suds is the best remedy I have tried. The spider is very tenacious of life in dry, warm weather, and the syringings will have to be repeated so long as the insects are seen to be on the move. If the plants are dry at the root, a heavy watering will be beneficial to them and assist in dispelling the spider. Should specimen conifers be attacked by spider, as they often are in dry weather, especially firs and spruces, the same treatment will clean them, that is, a heavy watering at the root, and a thorough washing overhead with an engine.

Of the numerous varieties of the coccus or scale family, some one or other of them infests almost every species of tree and shrub, when circumstances are favourable to their nature and habits. Unlike the aphis and spider already mentioned, the changes of climate and temperature in this country do not seem to have much influence upon them. Most of the species which infest trees and shrubs live through our severest winters unscathed, and ready to extend their devastations with renewed vigour when genial weather sets in. They generally prefer to attach themselves to the young bark and undersides of the leaves, where they can easily penetrate to the sap upon which they feed. When a tree is badly infested with them they cause great injury to it, and if allowed to remain unmolested, they dry up the bark, the tree becomes "barkbound," sickens, and ultimately dies from the baneful effects of the scale. During my experience in various parts of the three kingdoms, I have seen the oak, ash, elm, beech, willow, poplar, silver fir, spruce, thorn, and hazel, besides many varieties of shrubs, severely infested with scale of various species, the trees assuming a dried up and stunted appearance, leading to early decay, and deteriorating much from the value and usefulness of the trees. Although we have many recipes for the destruction of scale, none are thoroughly effective, except when applied with an excess of care that can only be given to a limited extent by foresters to some rare or valuable small specimen of tree or shrub. I have found a mixture of one gallon of paraffine to four gallons of water to be very efficient in getting rid of scale on dry, hard bark, applying it with a stiff brush, so as to raise as many of the scale as possible. This mixture must not be applied to green wood or leaves, as it will kill them. The only safe plan to clean young wood and leaves is to wash the scale off with a sponge and soft water. Any other plan, or a mixture applied strong enough to kill the scale, would certainly injure and probably kill the leaves and green wood. Diluted spirits, turpentine, and train oil, are recommended by some for killing scale. They will do so, but are very dangerous remedies, and ought never to be used except with the greatest care, and by some one having a knowledge of their strength and its effects. In regard to large trees and the ordinary run of plants that come under the care of a forester, if they are discovered to be infested with scale to any serious extent, they ought to be rooted out and burnt, taking care that every morsel of twig and bark is consumed that would afford shelter to a single insect. The bark and twigs of all old trees that are cut down, ought to be carefully collected and burnt, so as to destroy as many as possible of the numerous insects that haunt their crevices.

We will next devote a few remarks to the extensive Order of *Coleoptera*, or beetles, an order that includes some of the most destructive enemies with which the forester has to contend, and which, owing to their insidious habit of feeding in the dark, and committing many of their most serious ravages under the bark, or in the interior of the buds and branches, it taxes his utmost watchfulness to quickly discover their presence, and his determined perseverance and ingenuity to get speedily rid of them. One of the best known and most destructive to the Scotch fir is the pine beetle (*Hylurgus piniperda*), upon which, and all other insects which infest Coniferæ, a most able and instructive essay was written in 1873 by our highly-esteemed vice-president, Robert Hutchinson, Esq. of Carlowrie, and published in vol. vii., p. 123, of the Society's *Transactions*.

The next I would draw attention to is the fir beetle (*Hylobius abietis*), which is about as destructive as the pine beetle. In the Society's *Transactions*, vol. ii., p. 48, is a very instructive and practical paper upon it by one of the most experienced members of our Society, Mr M'Corquodale of Scone, in which is given an interesting history of the discovery of the insect in Scotland, and a full and clear detail of the operations he found to be successful in preventing the attacks of the beetle on young plantations of Scotch fir made on ground which had just been cleared of a crop of the same tree, and was badly infested with the beetle. There is also an excellent practical paper by Mr William Tivendale, forester, Houston, in the *Transactions*, vol. vii., p. 80, giving an interesting account of his experience with both the fir and the pine beetles. In the papers referred to, the subject is so fully treated, and the remedies tried and found effective, so clearly described, that I need not take up your time by recapitulating them. I may state, however, that the ravages of the *Hylurgus piniperda* are by no means confined to the Scotch fir, as I have seen it do severe injury to the Weymouth pine in the midland counties of England, and also do considerable damage to the shoots of *Pinus insignis*, *excelsa*, and *laricio*,—in fact, at one time and another, I have seen most of the pine tribe grown in this country attacked by it; so that wherever a collection of these is grown for specimens, a careful look-out ought to be kept for the enemy; and whenever he makes his appearance, attack him at once, and get rid of him by picking and burning as quickly as possible, to save the trees from irretrievable injury to their health and symmetry. I have noticed that the *Hylurgus* seems to have a partiality for trees growing in a dry, warm soil; and one of the worst infested trees of *Pinus insignis* I have ever met with, grew on the top of a dry steep slope on a gravelly subsoil, where for several years it was severely attacked by the beetle, while others growing in a deep and moister soil, in a hollow near by, were scarcely touched. I have also observed the same thing occur in other similar situations, and with other species of pine; but those having greater experience with the beetle amongst Scotch fir will be able to say whether or not this partiality of the beetle for dry spots is characteristic.

Several species of bark beetles commit great devastation amongst trees and shrubs by boring into the young wood or alburnum, and perforating it in all directions, thereby cutting off or interrupting the flow of the sap, and causing the death of the tree. *Bostrichus topographus* attacks the pine tribe, especially the silver fir, and works extensive mischief under the bark, where it cannot be easily detected until it is too late to apply any remedy, if such was practicable. Of the same nature are *Bostrichus pinastri*, *B. laricis*, and *B. orthographus*, which prey upon the alburnum of the pine, larch, and silver fir. *Scolytus ligniperda* also attacks the alburnum of some of the conifers. Some years ago great fears were expressed that the ravages of *Scolytus destructor* would destroy the fine old elms in Hyde Park and other places about the west end of London. Various means were suggested, and experiments tried, to stop its ravages, and if possible to exterminate it without sacrificing the trees, but none of the plans tried could be said to be really successful, nor were they of such a nature as to recommend them as generally applicable. *Scolytus intricatus* attacks the oak, *S. vittatus* the lime, *S. fraxini* the ash, and so on, all doing injury in the same manner by perforating the alburnum of the trees they live upon.

The grub or larva of the cockchafer (*Melolontha vulgaris*) devours the young roots and soft bark of the larger roots of trees; and as they remain about four years in the grub state, they commit sad havoc where they are numerous. As soon as they arrive at the fully-developed state of a beetle, they immediately commence a ravenous attack on the leaves of trees, preferring the oak when they have a choice. I have seen oaks in Worcestershire completely stripped of their leaves by the voracious vermin. The grubs of several species of *Curculio,* or weevil, are also very destructive to the roots of trees, and the best means for destroying them, and all grubs or larvæ that prey upon the roots of trees, is to thoroughly saturate the soil infested by them with a strong dose of lime-water, ammoniacal liquor, or salt and water. The last is generally found to be the most efficient, but caution must be used not to apply it too strong to tender-rooted or valuable trees. Many other beetles and weevils, which are more or less injurious to trees, might be mentioned, if time permitted, but I must pass on to notice some of the most destructive of the moth or butterfly family.

The goat moth (*Cossus ligniperda*) is not only one of the largest British moths, but also one of the most destructive to timber trees, attacking the trunks of the oak, lime, walnut, willow, and others, the caterpillars perforating the wood with holes or tunnels large enough to admit the finger; and when the insects are numerous, the trees attacked often fall a sacrifice to their ravages. I have seen many trees completely riddled by them in the midland and southern counties of England, especially poplars and willows, for the soft wood of which they seem to have a preference; but they have no reluctance to attack the hardest oaks and walnut, and bore holes right through them, making the perforated timber utterly worthless for any useful purpose.

The leopard moth (*Zeuzera æsculi*) is similar in its habits, and nearly as large, as the goat moth, and its caterpillar is a determined borer into the trunks of willow, poplar, and birch, rendering the timber worthless, and often fatally injuring the trees. The workings of these large caterpillars are easily detected, and when they are observed, a good plan for destroying the caterpillars is to run a wire into the holes, twisting it about so as to crush them, or to blow the fumes of sulphur into the holes, which is fatal to the insects.

The moths, *Tortrix turionana, resinella, buoliana* and *hircyniana,* are almost as injurious to pine trees as the pine beetle. They deposit their eggs in the buds, and when the caterpillars are hatched they eat the buds and pith of the shoots, similar to the pine beetle, only it works upwards and they work downwards. They are not very numerous in this country, but if ever they become plentiful they will be extremely injurious. The larva of the hawk moths, *Sesia bombyliformis*, and *tipuliformis*, perforate the branches and feed upon the pith of trees and shrubs. The caterpillar of many other moths and butterflies feed greedily upon the leaves of trees and shrubs, few plants or trees being free from their depredations. Most caterpillars that live upon the leaves of trees are easily destroyed, when they can be got at, by dusting them over in moist weather with snuff, hellebore, quicklime, or soot, either of which, if properly applied, will destroy all such caterpillars.

There are besides many other species of insects which, when they are numerous, are very injurious to trees and shrubs, but, owing to their small size and peculiar habits, they are not easily discovered before they have inflicted grievous injury to the health of the trees infested by them. When any of them are detected at their mischief, every opportunity ought to be taken to diminish their numbers and exterminate them altogether when possible.

We too often see our woods thickly strewn with fallen and decaying branches and other arborial *dêbris*, which forms the best breeding ground and nursery for many of the most destructive insects that afterwards ravenously prey upon the living trees; therefore, to assist in keeping our forests and plantations as clear of insects as possible, no dead or fallen wood should be allowed to lie rotting on the ground to harbour them, but it should be regularly collected and burnt, if it cannot be more profitably disposed of for firewood or some useful purpose.

All prunings and small thinnings should be similarly dealt with as soon as possible after the operations have been performed. When large trees are felled and found to be infested with insects, the bark ought to be stripped off, carefully collected, and burned, along with all the twigs and other parts likely to harbour the vermin.

By prompt and careful attention to such matters, the direful ravages of insects will be considerably curtailed, and the numbers of many species so far reduced as to be comparatively harmless, and by continued perseverance they may be extinguished altogether in many localities.

As I have already suggested, all birds that prey upon insects ought to be strictly preserved, and encouraged to increase by all available means, such as the woodpecker, starling, chaffinch, goldfinch, sparrow, wagtail, swallow, nuthatch, white throat, flycatcher, titmouse, blackcap, goatsucker, redstart, greenfinch, robin, tomtit, thrush, and wren, which devour multitudes of insects as their daily food, and are harmless to the trees; although some of them are, it must be allowed, too fond of seeds and fruit, when these are an object of cultivation.

Living, as foresters generally do, in sequestered parts of the country, far away from the busy haunts of men, they have excellent opportunities for studying some of the most interesting sections of natural history, and their spare hours could hardly be better employed than in gaining a knowledge of those branches which affect the welfare of the plants under their care. A few shillings judiciously expended in procuring a good rudimentary treatise on entomology,* a small pocket microscope, a sharp penknife, and a few small spill or tin boxes in which to carry home the insects for investigation, will enable any one to acquire sufficient knowledge of the nature and habits of forest insects, to be able to readily distinguish those that are injurious, and to quickly discover their presence and apply a remedy if possible, before they can multiply and do serious injury to the trees.

* Such as Duncan's "Entomology," Hardwicke & Co., London; or Stainton's "British Butterflies and Moths," Van Voorst, London; or Kollar's "Treatise on Insects Injurious to Gardeners, Foresters, and Farmers," translated by Loudon.

XX. *Brief Account of the Royal Forest School at Vallombrosa.* By HUGH CLEGHORN, M.D., Stravithie, St Andrews.

Italy, like other lands bordering the Mediterranean, has suffered from wasteful denudation of her formerly wooded tracts, to the detriment of the climate, to the poverty of the country, and to the marring of her beauty. But she is in advance of the adjoining countries of southern Europe, in having set herself to the task of repairing the damage done in previous centuries. The woodlands have long been looked upon by the people as common property, in which they were free to pasture their herds, and from which they might help themselves to wood *ad libitum.* Laws have now been enacted to compel, under penalty, the replanting of communal woods, and a code of forest laws is being prepared by the senate. To render these thoroughly effective, they must be applicable to private as well as to state forests, and for the administration of these laws throughout the kingdom, officers are being trained at the Royal Forest School of Vallombrosa, near Florence, an institution which promises to be successful in its work. A short account of its history, and of a visit paid to it, may prove interesting.

On the 14th May 1875, I left the Hotel de l'Europe, Florence, after early breakfast, and proceeded by the Arezzo Railway as far as Pontassieve, which is reached in an hour. Here I engaged a light one-horse vehicle (*biroccino*) for fourteen lires to Paterno and back. The driver was a pleasant companion, a good-humoured rustic, familiar with the surrounding country, who pointed out the localities of the district, and received a friendly greeting from all the cottagers we passed. The smooth, well-constructed road led upwards by a series of easy zigzags; dense cypress avenues were seen near the villas, and many rows of mulberry trees fringed the fertile fields; much cultivated for fodder is lupinello (*Onobrychis sativa*); and also a blue Iris, with a fragrant root. In waste ground two showy species of Genista were in flower. At every turn of the road, extensive views of the valley of the Arno lay below us. The vineyards and orchards exhibited a high degree of cultivation.

At the old castle of Paterno, a young forest officer, Alberto Helguero, informed me that the director, Cavalier Adolfo di

Bérenger, had been expecting me for two days, and that a posted mule had just been recalled. After hospitably entertaining me at luncheon, which consisted of wine, cheese, and bread, he procured for me a two-wheeled country cart, drawn by two large white bullocks, and passing through the village of Tosi, I soon reached a paved roadway (*Via crucis*), which, by a steep ascent of three miles, leads to the ancient monastery, founded in the eleventh century, and rich in poetic associations.

The road for about a mile passed through straggling groups of old chestnut trees, gnarled, and often hollow, and it afterwards entered a dense and shady pine forest (*Abies pectinata*, D. C.).* Here a number of men were preparing spars for shipbuilding, to be floated down the Arno. The trees belong to Government, and are sold standing for about forty lires each (or 33s.); the purchaser takes all risk, and bears all the expense. The fine silver fir forests surrounding the old convent, and which are seen below the crest of the Apennines in travelling from Florence to Rome, are an example of successful reproduction of this tree on a large scale, continued for centuries entirely by planting. These forests are now State property, and are attached to the Royal Italian Forest School. The stems are cylindrical, carrying their girth well up, and, being planted centuries ago, these superb and stately firs have a regular and symmetrical magnificence. The flowering plants observed in the wood consisted chiefly of species of *viola, campanula, anemone, crocus,* and *hyacinthus.* The water of the *Vicano*, a mountain torrent, is utilised in various ways. A meal mill is situated under the convent, and an agricultural establishment, of considerable extent, formerly belonged to the monastery. The land was well cultivated, and the monks introduced the potato into Tuscany—it grows well here.

Classical Allusions.—For centuries the fame of Vallombrosa, as a place of learning, piety, and natural beauty, has been widespread, and its charms have been celebrated by three great poets who have visited it—Ariosto, Milton, and Dante.

> "Thick as autumnal leaves that strew the brooks
> In Vallombrosa, where the Etrurian shades
> High over-arched, embower."
>
> —*Paradise Lost*, i. 303.

And again, in describing the approach to "delicious Paradise," Milton sings—

* The silver fir of Europe, *Abete, Abezzo*, Italy.

"And overhead up grew,
Insuperable height of loftiest shade,
Cedar, and pine, and fir, and branching palm,
A sylvan scene ; and, as the ranks ascend
Shade above shade, a woody theatre
Of stateliest view." *Ib.*, iv. 137.

Mrs Browning, speaking of Milton, says—

"He sang of paradise and smiled,
Remembering Vallombrosa."

Here also Dante loved to walk. A more magnificent scene is not to be found in Italy. The immense building, which formerly lodged one hundred Benedictine monks, reconstructed in 1637, and adapted to its present use in 1869, is a stately and commanding edifice, without any pretensions to architectural beauty. Over the doorway is a stone commemorative of the opening of the Forest School, on the 15th August 1869, bearing an inscription, recording that the institution was established in the ninth year of the united kingdom of Italy, when Victor Emmanuel was sovereign, Minghetti the Minister of Agriculture, and Ferraris the Minister of the Interior. The site was remarkably well chosen. It is sheltered on three sides from the cold winds, and though the snow lies deep for three months, it is a delightful climate for the eight months when the students reside there. The sheltered nook is surrounded with great masses of wood. Above the convent is the hermitage, called "Il Paradisino," situated on the point of a precipitous rock, whence the eye can trace the Arno winding through the fertile plains of Tuscany to Florence and the sea. Higher is a point whence I was told both the Mediterranean and Adriatic may be seen.

Origin of the Forest School.—The following sketch of the history and constitution of the Forest School is mainly condensed from the *Bollettino Forestale*, by the director, A. di Bérenger, 1872. The Royal Forest School of Italy has, within the last ten years, been established at Vallombrosa and Paterno, two estates obtained for the purpose by purchase, situated on the Apennines, about thirty miles from Florence. Paterno, 1215 feet above the sea, was formerly the castle of the Counts Guidi, and, from November to March (four months), is the headquarters of the Forest School, which, for the remaining eight months, is located at the higher elevation of Vallombrosa, 5556 feet above the sea. Vallombrosa existed as a monastery from the eleventh century up till 1865, when the duchy of Tuscany was annexed to the kingdom of Italy; and, among other changes, the sale of ecclesiastical property was determined upon by the State. Among the many strangers who, every summer, visited the monastery of Vallombrosa was Signor Commendatore Biagio Caranti, president of the council, administering the Cavour canal, who, struck with the regularity and vastness of the surrounding woods, conceived the idea of providing in them for the technical instruction of the numerous forest employés in the kingdom. No time was lost in carrying this project into execution; and having obtained the royal sanction in 1867, the present director, Cav. Adolfo di Bérenger (formerly in charge of the forests near Trieste, under the Austrian Government), was appointed to organise and superintend the undertaking. Two professors were at first associated with him; and with this staff, a course of instruction, extending over three months only, was begun in October 1867. It was not, however, till 1869 that all the necessary steps for the transfer of Vallombrosa and Paterno were completed.

Extent.—The extent of woodland attached to the Vallombrosa monastery was classified thus:

	Ettari (hectares).
Abetina (pine forest), . . .	245,147,040
Faggetta (beechwood), . . .	62,184,377
Marroneta (chestnut), . . .	150,724,695
	458,056,112

(2 hectares are equal to nearly 5 acres.)

As soon as the Minister of Agriculture assumed the direction of the lands, conservancy measures were introduced, the woods during previous years having suffered greatly from neglect. The various provinces of Italy were at the same time invited to contribute towards the expenses of the institution, according to the number of pupils educated, which all did, with two exceptions. The formal opening of the Forest School took place in August 1869, with the names of twenty-five pupils on the roll.

The institution, with its director and two professors (now increased to five), had many difficulties to surmount in the hitherto untried path on which they entered. These were overcome by the help and support given by the Department of Agriculture. At last the course of instruction was regularly established, and the institution began to acquire the scientific materials and appliances necessary for carrying it on.

These are gradually increasing, and comprise the following: the library, containing now over 2000 volumes of forest literature, including the official publications of the Forest Administrations in France and Germany; a chemical laboratory, well furnished with needful apparatus; a meteorological observatory, where the indications of the barometer, thermometer, pluviometer, anemometer, hygrometer, along with two different instruments for evaporation, and a compass and seisometer, are regularly recorded; a collection of instruments for surveying and tree measuring; arboricultural instruments; models of timber slides made in Germany; timber-carts and objects of natural history; sections of timber, indigenous and exotic; and two arboretums, one at Paterno, showing the vegetation of south Italy and tender exotics, the other at Vallombrosa, with the trees of the Alps and north Italy, and containing nurseries and plantations in which resinous trees are especially cultivated, for planting on the summits and slopes of the Apennines. Besides indigenous conifers, *Abies pectinata, Picea excelsa, Larix Europea, Pinus silvestris, P. Austriaca, P. pinaster, P. halepensis, P. brutia, P. laricio, P. pinea, P. cembra, Taxus baccata*, and *Cupressus sempervirens*, the following Himalayan plants, raised in quantity from seed sent by Dr Brandis, Inspector-General of Forests, India, are being cultivated to a considerable extent: *Abies Smithiana, A. Webbiana, A. Kutrow, Pinus excelsa, P. longifolia, P. Gerardiana, Cedrus deodara, Cupressus torulosa*, and *Fraxinus floribunda*.

Internal Organisation.—The management of the institution is vested in the Director and the professors or masters, who meet in council once a fortnight, or oftener, to deliberate on the progress of the establishment, and to plan the working of the annexed forests. The Director is in communication with the Government, and submits all disputed or doubtful matters to the minister of agriculture, industry, and commerce. The professors are appointed by the king, on the recommendation of the minister, and are selected by preference from the list of forest officers. The assistants are nominated by the minister, on the recommendation of the Director. The inspector of forests prepares a working-plan of forest economy to be approved by the Director, and sanctioned by the minister. The Council of Direction fix the text-books, the dates of execursions, etc., suggest changes in school management, and prepare the annual budget.

Publications.—The *Giornale di Economia Forestale* and the *Bol-*

lettino Forestale, edited by the Director, and published in Florence, are the official organs of the Forest School. Syllabuses of lectures and memoirs by the different professors printed in these are used as text-books by the pupils, along with the manuals employed in the forest academies of Münden and Tharand in Germany, and of Nancy in France.

Admission of Pupils.—The number of pupils admissible to the institution is 60; of these, 40 are regular pupils, from all parts of Italy, who aspire to a career in the Government Forest Service, and private pupils, the number of whom is not fixed. Each pupil must present a certificate of being over 18 and under 22 years of age; a second, of good conduct; and a third, of good health and strong constitution. Besides this, every candidate for admission must find security for the payment of 700 lires annually for three years for board, and 200 lires for uniform. The board is paid half-yearly, in May and November. The regular pupils are required to undergo a preliminary examination in the language and history of Italy, geography, natural history, arithmetic, algebra, geometry, physics, and chemistry.

The pupils assemble at six A.M. in summer, and at seven in winter. Breakfast is served at eleven, and dinner at six P.M., and at nine all are required to be in the institution, and to retire to their own rooms. The hours of instruction are, with some little deviation, from seven to eleven A.M., and from one to six P.M. The inmates of the institution are called together by the sound of a trumpet. When at Vallombrosa the senior pupils have separate apartments, but at Paterno they occupy a common dormitory. There is a suitable room in which invalids are located, and a store of medicines.

Discipline.—The pupils cannot leave the precincts without the written permit of the Director. They wear the uniform of the institution, which is that of a forest guard, with oak twigs of gold lace on the collar and cap. Insubordination is punished according to its degree, by admonition of the Director, by confinement, or by expulsion, under sanction of the Minister of Agriculture.

The *Course of Instruction* is as follows:

First Year.

Mathematics, including Arithmetic, Algebra, Geometry, and Trigonometry.

Chemistry.—Organic and Inorganic, with experiments.

Natural History.—Botany, Systematic and Vegetable Physiology.

Forestry.—Theoretic and Practical.

Languages.—Italian, German, and French, with Reading, Writing, and Translating of Forest Literature.

SECOND YEAR.

Mathematics applied.—Differential and Integral Calculus, Conic Sections, Measuring of Heights of Trees and Cubic Contents, Plan Drawing, Valuation Surveys.

Climatology and Forest Meteorology.

Natural History.—Botany, Dendrology, Forest Entomology, Geology, and Mineralogy.

Forest Economy.—History of Forest Science, Practical Sylviculture, Seasoning of Timber, etc.

Elements of Agriculture.—Improvement of Soils, Pasturage, Drainage, Agriculture, etc.

Languages.—Exercises in Italian, German, and French.

THIRD YEAR.

Mathematics applied.—Rates of Growth of Trees, Mensuration, Civil Architecture, Hydraulics.

Forest Administration.—Statistics of different Woods, Classification of Forests, Planting of *Dûnes, Maremma,* Marshes.

Forest Law and Jurisprudence.—Communal Rights, Pastoral Rights, etc.

Economy.—Political and National.

Languages.—Exercises in Italian, German, and French.

The first year is mainly devoted to scientific training, and in the second and third year the practical details of forest management are inculcated. For this purpose tracts of land are set apart bearing evergreen and deciduous trees of various ages, to be managed by the elder pupils. Each has also charge of a portion of the nursery, where he digs, waters, and prepares the soil, sows seeds, and performs all the needful operations with his own hand. As the design of the Forest School at Vallombrosa is to train able and skilled administrators, theoretical instruction is throughout combined with practical demonstration.

Excursions.—The pupils make frequent excursions, some with the Professor of Natural History, for the collection and classifying of natural products; some with the Professors of Mathematics and Surveying, when they make plans and elevations of the surrounding lands, calculate the amount of timber, and describe the management, according to the manner prescribed in the rules; those under the personal care of the Director, for other exercises in practical forestry. Each year a long excursion is made to some wooded district belonging to the State, or to a private individual.

On one occasion (1871) the excursion was to Naples, to visit the International Exhibition of Woods used in Shipbuilding, and afterwards to remarkable woods in South Italy, occupying altogether four weeks.

Examinations.—Every six months the progress of the pupils is tested, and there is a final examination at the close of the third year, when the professors in council declare the successful pupils to be "approved unanimously," or "approved unanimously, with commendation." Vacancies in the Forest Department are reserved for the passed pupils of the institution.

My time unfortunately did not allow me to remain more than one night at Vallombrosa, but I was much pleased with the good order prevailing in the establishment, and with the practical training out of doors. The director is a man of great ability, and brings learning and administrative talent to bear upon his work. He has availed himself of the experience of the best forest administrators in France and Germany in framing the regulations and curriculum of the institution under his charge, and strives to impart solid instruction in hydraulics, civil engineering, and the collateral branches, so as to equip the students thoroughly for useful service. Cavalier di Bérenger's published books and pamphlets, upward of thirty, show how well versed he is in the details of forest management, and all that relates thereto. Among these may be specially mentioned the *Archeologia Forestale*, 806 pp., Venezia, 1859-63, a work of great erudition, giving the history of forest jurisprudence in Italy, which had been brought to my notice by the Hon. G. P. Marsh, U.S. Plenipotentiary at Rome. Another memoir of great value is, "On the Absolute Influence of Forests on the Temperature of the Air," Florence, 1871. Both of these works received special medals at the International Exposition of Naples, 1871.

Director di Bérenger's duties require much tact, vigilance, and perseverance; and I am sure that if the Italian Government give him the support he deserves, the result of his labours, so far achieved, will bring much honour to the nation, and lasting benefit to the country.

XXI. *On the Best Method of Seasoning Timber.* By THOMAS WILKIE, Forester, Invergarry, Fort-Augustus.

The best method of seasoning timber at present in use is to fell the trees between the end of September and beginning of April, to have pine logs raised a foot above the ground, and exposed to light and air without shade. Having lain thus for two years, they may be sawn into boards or planks, and stored in a dry but airy shed for another year, before being worked up by the carpenter. Hardwoods ought to be stored in like manner till the bark falls off, when they should be sawn into planking for use. The sycamore, maple, and birch, however, soon become discoloured; the best method is to chip and saw them immediately after the sap is out of them, then store them in a dry shed as above. This process, however, costs much labour and expense. To avoid these, I recommend the adoption of the following method: Mark all trees which will be useful or saleable during summer, as sickly plants are then more easily observed. During September ring or girdle all trees marked $1\frac{1}{2}$ inches round the bole where they are to be cut, then allow twelve months to elapse before felling, during which time they will have died, and I believe will have lost nearly two-fifths of their weight, and be fit for sawing up at once. This would reduce the cost of transit, including dragging, carting, and railway carriage, by the above extent of two-fifths nearly. The result would be the enhanced value of the timber to the proprietor, which on a largely-wooded property would be considerable. For example, 150 acres of ground are to be cleared, upon which are growing 60 tons of wood per acre, making 9000 tons in all, at a distance of 110 miles from Glasgow per railway, and 6 miles from the nearest station; reckoning the cost of dragging and carting per ton at 7s. 6d., and railway carriage 12s. 6d., total 20s. per ton, the gross expense of transit would be £9000; calculating that nearly two-fifths can be saved by ringing the trees as above described, the cost will be reduced by say 6s. 6d. per ton, equal to £2925, and the gross expense to £6075. Thereby the seller would receive £2925 more for his wood, and, allowing £100 for the expense of ringing the trees, would save £2825. I recommend the above system to all interested in the sale or manufacture of timber, as the best means to get timber economically seasoned and ready for immediate use.

Where birch wood is being used for bobbins, this process of ringing would obviate the need of chipping, and by allowing the trees to stand nine months they would be ready for immediate use. If the wood is wanted for fence stobs, ringing would render them serviceable the next season, when they might be conveniently charred by their own tops or branches, which would cause them to last double the time in the ground.

The process of ringing, then, has two advantages—increasing the value of timber to the owner, and of seasoning it in the most economical way.

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VOL. VIII.—PART III.

EDITOR AND SECRETARY

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TRANSACTIONS

OF THE

SCOTTISH ARBORICULTURAL SOCIETY.

XXII. *Address delivered at the Twenty-fourth Annual Meeting.* By the Right Hon. W. P. Adam of Blairadam, M.P.

It was with many misgivings as to my own ability properly to discharge the duties of your President, but with none as to the importance of the office and the great usefulness of your Society, that I undertook to act in the distinguished position in which your kindness has placed me. I should, however, have been able much better to discharge the duties I have undertaken, and I should not have had to ask your forgiveness for the short stay I must make among you, had it not been decided to hold your meeting on this particular day. You are, most of you, aware that although politics have nothing to do with forestry, and although the forester lives happy, "procul negotiis ut prisca gens mortalium," still that I am not so free, and am obliged to be in the full whirl and vortex of party, and am tied by duties which admit of no excuse and have little cessation. In the performance of these duties I must be present this day at very different meetings* from that which we are now holding, and this must be my excuse if both my attendance here is curtailed, and if I fall short, as I fear I must, both in the length and the value of an address which has necessarily been prepared hastily and amid many interruptions. It has been a matter of much gratification to me, who have now been a member of your Society for some years, to observe the gradual, steady, and sure progress which the Society seems to be making, not only in the number of its members, but in the influence and authority with which it speaks to all connected with Arboriculture; and I would take this opportunity of

* Political meetings held in honour of Lord Hartington, Nov. 6, 1877.

urging on all landed proprietors interested in rearing woodlands, and on all foresters employed in that most interesting pursuit, to become members of the Society, and to assist in the only way at present open to them in the good work of promoting and extending the knowledge and practice of Arboriculture in the kingdom. It is not for me, who have come so recently among you, to point out all the advantages which arise from such a society as this. The printed *Transactions* which now extend over a number of years are sufficient to prove this, and to show what has been and is being accomplished among us. I have, as far as my time allowed, been looking over these *Transactions*, and I cannot fail to observe the number and usefulness of the articles contributed. There is scarcely a point of interest relating to the art of forestry which has not been touched upon; and while many of the papers are most valuable contributions to the literature of Arboriculture, there are none from which something may not be learned and in which valuable suggestions are not made. The Society effects this good—which to my mind is most valuable, and which, as years go on, will become more and more so—it induces practical foresters, men actually and every day engaged in the work, to come forward and put in writing their own practical experience. This is valuable in many ways, for it affords to those who are learning the art of forestry, and to those who are inquiring as to the best modes of conducting actual operations in planting, the most sensible and practical suggestions as to how work should be carried on, and it assists in making more accurate and more exact the knowledge which has been acquired through years of hard work and practical experience by those who contribute. Bacon says in his "Essays," "Reading maketh a full man; conference or speaking, a ready man; writing, an exact man;" and the quality of exactness is one that is rare, very rare, even among the more highly educated, and ought especially to be cultivated among those who have fewer opportunities of study, and whose life is passed in activity out of doors. It is, of all qualities, the most valuable to a man, whatever may be the nature of the work in which he is engaged; and the fact of putting in actual writing the experiences of everyday life makes a man sure and safe as to the knowledge that he has already acquired, and enables him with much greater confidence in himself, and much greater chance of interesting and instructing others, to go forward with that work of selfeducation which ought never to cease, and to press on to fuller knowledge and more enlarged views. This, I take it, is one of those useful ends which our Society proposes to carry out, and I am glad to see that ever since it was formed in 1854 the printed *Transactions* testify that this end has been kept steadily in view. The prizes annually offered by the Society for essays on subjects connected with Arboriculture call forth, and will, I doubt not, continue to encourage the production of those valuable articles which tend to foster that exactness of mind on which I have thought it right so strongly to insist, and to promote that taste for literary subjects among the members of the Society which day by day will produce fuller fruits.

No society, however, like ours, can exist without adequate funds and an adequate membership. These, as I have said before, have been and are steadily and surely increasing. Much, however, is still required, and I trust that the appeal which I and other members of the Society make to landowners and foresters throughout the kingdom will not be in vain, and that in both these respects we shall rapidly improve. When we look back to what the income of the Society was in 1858-59, to what it was in 1861-62, and compare it with our present position, we have much reason to be pleased.

In 1858-59 the number of the members was 168, and the amount of income £39, 10s. In 1861-62 the members numbered 158, and the income was £30, 18s. 6d. In 1866-67 the membership had increased to 284, and the income to £140, 6s. 10d. In 1874-75 the members numbered 726, and the income amounted to £304; and in 1876-77 the roll contained the names of 746 members, and the sum at the credit of the Society was £351. To-day the number of members will be still further increased, as over forty new names have been received for election. This advance we owe very much to the valuable services tendered to the Society by my distinguished predecessors in this chair—Professor Balfour, Dr Cleghorn, and Mr Hutchison of Carlowrie. To all of these gentlemen the Society is most deeply indebted. Professor Balfour has a European reputation which renders it an honour to any society to be presided over by him. The great experience that Dr Cleghorn has acquired by a lengthened and distinguished service in India, where he acted in a responsible and high position in the Forest Department, added to the great love which he bears to the science, and the deep interest which he has always shown for it since his return to this country, make his services most valuable. If I venture in another portion of my address to act somewhat egotistically and touch upon the planting and improvements which took place on my own estate at Blairadam, it is to him that I owe the suggestion that such an allusion might not be unpleasing to you. He made the suggestion because he was intimately acquainted in his early days with the plantations and improvements in that place, and with the great and intelligent interest which was taken in all that pertained to forestry by those who preceded me. As to Mr Hutchison, I may say that he has been the life and soul of the Society for many years, and I doubt very much whether, if it had not been for his great and continuous exertions and for his most valuable contributions to the literature of Arboriculture published in the *Transactions* of the Society, we should have been at this day in the vigorous existence which we happily enjoy. In connection with Mr Hutchison's name I cannot pass on without saying a word of praise and encouragement on the establishment of the *Journal of Forestry*, of which he is an able and assiduous contributor. That journal was established only this year, and was referred to at your meeting last year. I trust it may yet become the organ of the Society. It is creditable to the founders that it was established entirely independently, and has not in any way trenched on the funds of the Society. I would urge all the members and all those who are interested in the success of the science of forestry to read and subscribe to it. I am glad to see that peculiar facilities are offered to under-foresters and others for obtaining the journal at a reduced rate. I trust that advantage will be taken of its columns to make known to the public generally all that is interesting and instructive on the subject of Arboriculture, and I hope the staff and contributors may have all the success they deserve for having undertaken a useful, instructive, and possibly as yet a not very lucrative work.

I observe in the history of our Society that in 1871 the Queen was graciously pleased to become our patron. She has always evinced great interest in the rearing of woodlands, and on her own estate in the Highlands much has been done in this way. I observe also that about the same time we became affiliated to the British Association; this I consider was a great step in advance, and most useful and valuable for the Society. It should be an inducement to all who are interested in our success, to use greater endeavours to bring their powers of accurate observation to bear on the natural phenomena, of which so many come under the eyes of practical foresters, and so tender that assistance to the march of scientific progress and knowledge which it becomes us to do as members of that important body. These two additions to the dignity and importance of the Society ought to be followed by another, and in my opinion we ought to use our earliest and best endeavours to obtain a Royal Charter. I am not aware whether any and what steps have been taken towards the accomplishment of this object, but I can only say that if I can do anything towards furthering its attainment, you may command my services.

Now, gentlemen, as you have called me to the distinguished position of your President, I naturally asked myself what my claims were to such an honour. Those claims are not great; but I can at least claim that I am a practical woodman, accustomed from my earliest youth to the use of the axe, and delighting both in the exercise and the interest that it gives me; and I may add that I have brought up all my sons to the same employment, and that they have all acquired in their early years a thorough acquaintance with the use of that implement. In this you will recognise me as a faithful follower of my late distinguished chief and leader, Mr Gladstone. He is often derided for his partiality for woodman's work, but I am sure in this company, whatever our political opinions may be, and whatever we may think of him as a statesman and an orator, we can all appreciate this trait in his character. I am a humble but persistent follower of his in this as in other things, and my general admiration for his character is, as you may suppose, much increased by knowing his proficiency in my favourite exercise. My other claim is that I come of a race of planters and foresters. I am now the fifth proprietor in succession who has specially devoted himself to improving the estate of Blairadam, more by planting than by anything else; and I have this advantage over many other races of landed proprietors who have devoted themselves equally zealously to that occupation, in that the planting at Blairadam has become classical through a touch of the magic wand of that enchanter, Sir Walter Scott. To this I owe the record of what has been done at Blairadam since 1733, which, together with directions and instructions for future management of the woods, was embodied in a book which was written and printed in 1834 by my grandfather, William Adam, the Lord Chief Commissioner of the Jury Court in Scotland.

Blairadam in its original unimproved state before the planting was begun, was a wild, unsheltered moor, lying from 500 to 700 feet above the sea, with a certain amount of natural beauty and with fine views of the plain of Kinross, Loch Leven, the Lomond Hills, and Benarty Hill; but it must have been cold and bare: it was covered with heather and coarse grass, and had but few enclosures and only one tree—an ash—which, though it still grows vigorously, is far out-topped by the younger generation. It was in such a country and with such unpromising ground to work upon, where

> "Far as the eye could reach no tree was seen;
> Earth clad in russet scorned the lively green,"

and with this solitary instance of tree-like vegetation, that the then possessor of the estate entered upon his meritorious and arduous task with a spirit of enterprise and with forecast greatly in advance of the age in which he lived. I know of no instance in the improvement of waste land that more thoroughly illustrates the value and advantage of judicious, continuous, and persistent planting, than this estate; and it was for this reason that my friend Dr Cleghorn advised me in my address to-day, in spite of the seeming egotism, to mention my own case. It would take too long were I to go into the whole story of the planting and improvements of five generations, but, as I said before, these are recorded in a book which owes its origin to a suggestion coming direct from Sir Walter Scott. Any of you who have read Lockhart's "Life of Scott," may remember the interest with which he dwells on the formation and proceedings of a club called the Blairadam Club, which used to meet at Blairadam every summer, and was regularly attended by Sir Walter for many years. It was during one of those visits, as he himself mentioned to Lockhart, that the idea of "The Abbot" first occurred to him, and in that tale many of the localities in Blairadam are alluded to in a manner which was intended to convey delicately to my grandfather information as to the real authorship of the Waverley Novels. Lockhart, after quoting different passages from my grandfather's book on Blairadam, tells the story of its origin in the following words:

"Since I have obtained permission to quote from this private volume, I may as well mention that I was partly moved to ask that favour by the author's own confession that his 'Blairadam from 1733 to 1834' originated in a suggestion of Scott's. 'It was,' says the judge, 'on a fine Sunday, lying on the grassy summit of Benarty, above its craggy brow, that Sir Walter said, looking first on the flat expanse of Kinross-shire (on the south side of the Ochils), and then at the space which Blairadam fills between the Hill of Drumglow (the highest of the Cleish Hills) and the valley of Loch Ore, "What an extraordinary thing it is, that here to the north so little appears to have been done, when there are so many proprietors to work upon it; and to the south, here is a district of country entirely made by the efforts of one family, in three generations, and one of them amongst us in the full enjoyment of what has been done by his two predecessors and himself. Blairadam, as I have always heard, had a wild, uncomely, and inhospitable appearance, before its improvements were begun. It would be most curious to record in writing its original state, and trace its gradual progress to its present condition."' Upon this suggestion, enforced by the approbation of the other members present, the President of the Blairadam Club commenced arranging materials for what constitutes a most instructive as well as entertaining history of the agricultural and arboricultural progress of his domains, in course of a hundred years, under his grandfather, his father, and himself; and Sir Walter had only suggested to his friend at Kinross-shire what he was resolved to put into practice, with regard to his own improvements on Tweedside; for he began at precisely the same period to keep a regular journal of all his rural transactions, under the title of 'Sylva Abbotsfordiensis.'"

The result of this suggestion was the book of which I have spoken, and I regret that time does not permit me to go more fully into the different eras of planting as carried out on the estate, beginning first before 1733 with squares, straight lines, and the formal strips of that period, and followed by their conversion into clumps and the irregular and wavy lines of the next period as the taste in planting changed; but if I cannot enter into these just now, I can only say that if during your summer excursions any of my fellow-members would visit Blairadam, it would give me very great pleasure; and it might perhaps interest you now, and add to the inducement to visit the place, were I shortly to state the size and dimensions of some of the trees, especially of silver firs which were planted in the earliest era. The silver fir has always flourished luxuriantly, and is the most remarkable species of tree on the estate. There are four still living of which I have the dimensions in 1811, in 1851, in 1862, and in 1877.

	ft. in.		ft. in.		ft. in.		ft. in.	
No. 1 was	8 4	in 1811,	13 0	in 1851,	13 6	in 1862,	13 9½	in 1877.
No. 2 ,,	8 1	,,	12 1	,,	13 0	,,	13 3½	,,
No. 3 ,,	10 5	,,	12 11	,,	13 0	,,	13 0	,,
No. 4 ,,	9 2	,,	11 5	,,	12 0	,,	12 0	,,

These trees were planted about 1754. In addition to these there is one 15 ft. 3 in. in girth, one 15 ft. 1 in., one 14 ft. 8 in., five between 13 ft. and 14 ft., six or more between 12 ft. and 13 ft., and a great many others between 11 ft. and 12 ft., and between 10 ft. and 11 ft. These were all probably planted about the same time, between 1754 and 1757. There are also three very remarkable hemlock spruces, planted about 1757, of which I do not give the exact girth, as two of them divide into separate limbs near the ground, but one gives a girth of about 12 ft. before dividing, and another about 10 ft., and the third about the same. I do not go into any detail as to the size and girth of other sorts of trees planted about the same time, as they are equalled and exceeded by many other specimens probably known to most of you in different parts of the country. I might mention some very fine examples of the larch, the spruce, and the Scotch fir, as well as of beech and ash. But I confine myself to the special mention of the silver fir and hemlocks as constituting one of the most remarkable features of the place. I am afraid the figures that I have given above prove that these trees have almost ceased to grow, and that their gradual decay may now be looked for. I have dressed some of them with compost, but without producing any perceptible advantage.

I said in an earlier part of this address how strongly I would urge landowners, foresters, and all who are interested in the science and practice of rearing woodlands, to join this Society and to contribute to the journal which is the organ of the Society. I urge this so strongly because there is actually in this country no other way that I know of in which they can publicly assist the science of Arboriculture; and this brings me to a subject which is well deserving your attention, and on which I must say a very few words. I mean the necessity for something being done to establish a school of forestry in this country. Now this subject has been so well and so fully treated by your fellow-member, Dr J. C. Brown, and he has gone so thoroughly into the matter in all its bearings and details, that to you who have read his pamphlet there is little left for me to say. But I am anxious, with the authority which belongs to any one, whoever he may be, who occupies the post of President of your Society, to endorse and enforce what he has so well begun. I do not say that it will be an easy thing to obtain recognition from Government as to this necessity. I have been long enough connected with the Treasury to know that in this country where any demand on the public purse has to pass the ordeal of parliamentary criticism, and where the prevailing idea of the Government is to keep down the estimates, it is not till after many years of pressing application, and till public opinion is brought to bear, that the public purse-strings are drawn. This is one great difficulty in the way, and the other is, that whatever may be the case in India and the colonies, we have at home no great forests under the charge of Government as is the case in most continental countries, and that this makes it difficult to arrange for the practical education of foresters. Still, in spite of these difficulties and drawbacks, I cannot but think that in a country like this, with so many dependencies and colonies, where a knowledge of the science of forestry is necessary, not only for the protection of forests from destruction, but for the maintenance of that balance between woodland and open ground which is so necessary to preserve proper climatic conditions, it is essential that a school of forestry should be established. Sir Joseph Hooker, writing on this subject, says, that on the Continent forestry holds a distinguished place among the branches of a liberal education. Schools of forestry exist in Prussia, Saxony, Hanover, Wurtemberg, Bavaria, Austria, Poland, Russia, Finland, Sweden, France, Italy, and Spain. Although we have no great forests in this country, we require trained foresters in India and in many of our colonies. I need not, after the subject has been so exhaustively treated, go into further details, but merely say that it is the duty of this Society to endeavour to awake intelligent interest in this question, and I for one shall be glad to do all that I can in and out of Parliament to further so praiseworthy an object.

I could have wished further to illustrate the necessity for good schools for forestry by what is now taking place in India. The wanton destruction of forests in that country has been going on for years. This is a point which has been most ably and constantly treated in his addresses by Dr Cleghorn, than whom there can be no greater authority. I can myself, from my practical observation as a sportsman, confirm all that has been said as to this in Western India; and who can say that the terrible famine which is now devastating some of the fairest provinces of that country, may not be directly traceable to the improvidence of man in denuding the country of its natural vegetation, and so altering all the climatic arrangements of nature? This is a large and important question, into which I have neither the time nor the scientific knowledge to enter, but it all points clearly to what I have been already advocating, namely, the necessity for the establishment of schools of forestry, whereby skilled men may be produced for the service of Government in this most vitally important work.

In conclusion, I can only say that it has given me great pleasure to attend here to-day, and to testify by my presence the great and enduring interest which I take in this Society, and in all that pertains to the enchanting science with which it deals. I can use no other word to describe adequately my feeling for the woodlands—the charm, the rest, the solace, which they bring to mind and body, and the pleasant and varied occupation which they give. As Bacon says in his essay "Of Gardens," I would say of the woods: "They were first planted by God Almighty, and indeed they bestow the purest of human pleasures, without which buildings and palaces are but gross handiworks;" and not only in our own and in more modern times, but in all ages, we find poets, philosophers, statesmen, young and old, all vying with each other in describing these pure delights. Cicero says, "Num igitur eorum senectus miserabilis fuit qui in cultione oblectabant, mea quidem sententia haud scio an ulla vita beatior esse possit;" and again, "Nec ætas impedit quo minus arborum colendi studia teneamus usque at ultimum tempus senectutis." Fortified by this classical support to the dignity and delight of our science, I conclude by saying how much honoured I feel by your choosing me as your President, and how much I regret that the pressure of other duties must call me away.

XXIII. *The Movements of Fluids in Stems, considered in relation to the Felling and Seasoning of Timber.* By W. Ramsay M'Nab, M.D., F.L.S., Professor of Botany, Royal College of Science, Dublin.

Although at first sight the scientific vegetable physiologist may seem to have little in common with the practical forester, still we doubt not both may learn something one from the other. The scientific man may lay down rules for the guidance of the practical man, and often does so with great advantage; but we think that a humbler sphere may in some cases be a more useful one for the scientific botanist. We cannot ignore the vast amount of empirical knowledge, of knowledge derived from practical experience, that the forester can lay before us; and we can make ourselves useful by showing that the experience of able practical men is in accordance with what we know and have ascertained by experiment in the laboratory, thus placing the empirical knowledge on a scientific basis. By thus combining *practice* with *science*, by admitting that the *art* must be practised before the *scientific basis* of the art is settled, we may be doing some little service to Arboriculturists if we lay before the Arboricultural Society a short account of the modern physiology of the stem of trees, and thus supplement to a slight extent the important discussion that took place last year on seasoning timber.

I. The structure of the stem of the Dicotyledon and the Conifer.

It will be necessary to give a very brief outline of the structure of the stems of such plants as yield our ordinary forest trees before proceeding to the consideration of the physiology of the stem. The section of the stem of a seedling plant made below the cotyledons, and before the foliage leaves have developed, shows the epidermis externally, and surrounding a central mass of cellular ground tissue, in which are placed a few separate fibro-vascular bundles arranged in a circle. The individual fibro-vascular bundle is separable into two parts, namely, the wood portion or xylem of Naegeli, in which the wood-cells, wood-fibres, and wood-vessels are developed, and the bast portion or phloem of Naegeli, in which the bast-cells, bast-fibres, and bast-vessels are to be met with. Between these two parts, the xylem and phloem, there exists in Dicotyledons and Conifers a series of cells capable of dividing, and known to botanists as the cambium layer; the special function of the cambium being to form periodically new wood on the inner side and new bast on its outer side. By the activity of the cambium the originally separate fibro-vascular bundles are united into a ring, interrupted only by the medullary rays, primary and secondary, the special plates of cells which keep up a connection between the inner part of the ground tissue (now called the pith), and the outer part of the ground tissue which forms the primary cortex. This condition can be seen in a section of the stem of a young seedling plant above the cotyledons, or in the youngest shoot of a tree. After the first ring of wood and bast has been completed by the cambium, a rest occurs during the winter, and it is only in early summer that the cambium again becomes active, and begins to form new wood and bast. It will be evident that this mode of growth causes the separation between the simultaneously formed wood and bast portion to become annually greater and greater, so that in a thick stem the primary wood part is next the pith, while the primary bast portion is on the outside side of the stem, immediately below the corky layer of the bark. The epidermis lasts only for one year, and it is completely replaced in the second season (as may be seen on a second year shoot) by a layer of cork, known to botanists as the periderm. In the willows the corky layer arises from the epidermis itself, but in most plants it is produced by the cells of the ground tissue, either immediately, or at a short distance below the epidermis. After the formation of the periderm the cells (if any) external to it die and become thrown off. New cork cells are formed from a deeper seated layer of cells known as the cork cambium. In some plants repeated layers of cork are formed deeper and deeper in the tissues, giving rise to the complex covering known to botanists as the "bark" or rhytidome. In many plants, by the formation of the rhytidome, not only the whole ground tissue forming the primary cortex, but part of the bast portion of the fibro-vascular bundles, may be thrown off. The rhytidome, as above defined, differs from the bark in its ordinary popular sense, as the word bark is commonly used to mean all the part lying externally to the cambium layer, and therefore includes the phloem of the fibro-vascular bundles in addition to the ground tissue with the layers of cork.

II. The sap—what is it?

The use of the word sap is so entirely connected with the well-known but exploded theory of the ascent of crude, and the descent of elaborated sap, that it is as well to discard it at once as a scientific term, although we may continue to use it in a popular manner. It may be useful to give a popular definition of the word "sap," and it may perhaps be defined in the least objectionable manner, by saying that it is "*Water carrying constructive materials in solution or suspension.*" The movement of fluids in plants is a problem of great complexity, hence the still lingering longing after the simple theory of the ascent of crude and the descent of elaborated sap. Scientifically the sap is known as the *cell-sap*, that is, the water, with substances in solution and suspension which permeates and saturates the wall and protoplasm of the cell, as well as accumulates in drops, or forms a large mass in the vacuoles or central cell-sap cavity of the cell. When the cells lose their contents and become filled with air, a portion of cell-sap (in its widest sense) will remain in the wall, depending on the chemical and physical nature of the cell-wall. In such a plant as *Elodea Canadensis*, the common water-pest, the movements of fluid are comparatively simple. The plant takes in water from the external medium, the water containing mineral matters and gases in solution. These pass from cell to cell. Constructive matters are elaborated in the cells containing chlorophyll. They are modified in different ways, and carried to such parts of the plant as are in a state of growth and require the so-called constructive matters, or those necessary for the formation of new cell-walls and new protoplasm. The slow movements in such a plant are entirely determined by (1.) the position of the source of supply, and (2.) by the position of the parts requiring the nourishment. Thus a very young green leaf may supply matter for the growing apex of the stem, while leaves still further from the apex will supply matter for the growth of the youngest adventitious root. In such a simple water-plant no *wood* exists in the fibro-vascular bundles, the cells of the xylem retaining their cellulose walls, the walls not becoming ligneous; hence the complication in the movement of fluid introduced by the presence of wood is thus avoided. In plants with a hard massive trunk, in which the wood part of the fibro-vascular bundle is enormously developed, we have a special rapid current of water in the xylem of the fibro-vascular bundles alone, in addition to the slow movement of water from cell to cell in the other parts of the tree. This rapid current is of the greatest interest, and will require special consideration further on.

The fluid concerned in the rapid current in the xylem moves in one direction, upwards from the root to the leaves. The slow current on the other hand moves in any direction; the parts needing water take it from the parts in their immediate neighbourhood, and ultimately from some external or internal supply.

III. The movement of water in the stem.

From the description already given it will be evident that as the cell-walls are all more or less saturated with water (the cell-sap in its widest sense), and as all parts of the plant are cellular, there must be a continuous sheet of water from the tips of the roots to the extremities of the loftiest branches. In addition most of the cells contain cell-sap in the cavities of the protoplasm, or in the centre of the cell after the protoplasm has disappeared. The movement of the water is either slow or rapid, depending on certain external and internal conditions, and from experiments can be shown to move in any direction up or down or transversely. The water enters by the root, being absorbed chiefly by the root-hairs above the apex. The absorption is due to endosmose, and gives rise at the early part of the season to the *root pressure,* so long known for the surprising force it exerts, and from being the cause of the bleeding of trees from wounds or cut branches. The root pressure does not, however, last long (as shown by the cessation of bleeding), and after the leaves are in vigorous action it ceases altogether. Hence, although the roots are still absorbing water, yet it is so rapidly got rid of by the leaves, that no pressure is exerted. The root-pressure, as shown by the experiments of Hofmeister, varies in different plants. The following are some of Hofmeister's results:

Urtica urens, . . .	283 millimetres of mercury.
Vitis vinifera, . . .	804 ,, ,,

Through the xylem of the fibro-vascular bundles, and in the walls of the wood-cells, parenchymatous and prosenchymatous, the fluid of the rapid current moves. The vessels at this period contain air, and as has been shown by Hoehnel, the air is in a state of *diminished tension.* This is shown by the fact that mercury will rush into the vessels of a shoot when cut under that metal, and rise in the vessels of the stem to a height proportional to the diminished tension. The following are some of Hoehnel's results:

Quercus pedunculata,	24·5 c.m.
Æsculus hippocastanum,	37· c.m.
Syringa vulgaris,	24· c.m.
Ulmus campestris,	20· c.m.
Helianthus,	46· c.m.

These experiments show that the mercury will rise *in a few seconds* from 20 to 46 centimetres, from the diminished tension of the air in the vessels.

The water passing up through the xylem goes to the leaves, and is there transpired as watery vapour through the stomata, at least in great part. The conditions necessary for transpiration are light and heat, the light having a powerful influence in opening the stomata of the leaf and promoting transpiration. The rapidity of the upward current in the xylem is very great, the astonishing rate of 13 inches per minute having been observed by Pfitzer in the stem of *Helianthus annuus.* In other plants, transpiring more slowly, as in the cherry laurel, the fluid passes through the xylem at the speed (as observed by experiment) of 40 inches per hour, when the external conditions are favourable. The rapid current is a current of water running from the roots to the leaves *through the walls of the cells of the xylem, not in the vessels or cavities of the cells.* It is a variable current, begins when the leaves begin to unfold, and ceases when the leaves cease to be active a little before their fall. It also varies in accordance with the alternation of day and night, being active during the day, but slow or almost ceasing during the night. Then during the day the speed varies in accordance with the degrees of heat and light, increasing when the temperature and light are greatest, and slowing as they diminish.

In addition to the rapid current there is the slow current, a constant or nearly constant one, uninfluenced by external conditions, such as alternation of light and darkness, or variations in temperature and light. The determining cause of this current is *osmose*, the fluid moving to those cells that have the protoplasm dense, and thus require water, a fact clearly seen in the young parts of a shoot which retain their freshness, while the older parts wither and dry up. This slow movement is in the cavities of the parenchymatous cells, and conveys all the nutrient matters to and from growing and assimilating parts; and during their conveyance they undergo the changes in composition known as metastasis. The water concerned in the slow current may be derived directly from the surrounding water, as in *Elodea*, or may enter by the roots or root hairs, or may be taken from the water in the rapid current.

IV. The stem as a reservoir of nutrient matter.

The stem mainly serves as a channel for the conveyance of the rapid current concerned in transpiration, and in assimilation, and in the formation of new constructive materials from inorganic elements, namely, by the decomposition of the carbonic acid of the air, the fixation of the carbon by its union with the elements of water, and the formation of a carbohydrate, such as starch. In addition there is the slow current; the assimilated matter is carried to growing parts or to *reservoirs*, where the constructive matters are stored up until they are wanted during growth.

As the leaves unfold they are supplied with water, large quantities of water being an essential of growth. The water enters by the root and contains the necessary mineral ingredients of plant food in solution. By assimilation in the chlorophyll-bearing cells of the leaf, the leaf itself increases in size until full grown, hence anything interrupting or interfering with the process of assimilation will dwarf the growth of the leaf and young internodes. When the leaf is full grown, and most of the parts have ceased to grow in length, although circumferential growth still goes on in the stem, much of the nutrient matter formed by assimilation is produced only to be stored up in a reservoir. By the slow current this material is carried to the medullary rays of the wood to the wood prosenchyma, and also to much of the cellular ground tissue of the stem and shoots, and is there stored up. Hence when the leaves fall in autumn there is a large store of nutrient matter, such as starch, in the cells of the stem. During the winter the cells of the stem are full of fluid and reserve matter. Thus, if a branch be cut of in winter, and exposed to the alternations of sun heat and cold in the early mild days of spring, the sap, *i.e.*, water with constructive matters in solution and suspension, exudes, owing to the admixture of atmospheric air or gases with the fluid contents of the cell. The heat expands the air and forces the fluid out; the process, however, ceases whenever the temperature sinks. Then in the case of the bleeding of trees, in which sap exudes from injured portions of wounds in the stem, we have a slightly different process. It depends on the returning activity of the roots, when the temperature of the soil rises sufficiently to permit the absorption of water, and as no transpiration is going on, from the want of leaves, the "sap" is conveyed to the different parts where growth is going on, to the cambium layer and to the buds. When the substances exuded by trees when bleeding are examined, they are found to be, not pure water, but to be exceedingly rich in most important reserve materials, as starch, sugar, and other substances, such as salts of vegetable acids, all most important to the life of the plant. The material is soon used up, and the cells of the xylem become empty by the time the leaves are rapidly transpiring, and the rapid current in full action.

Modified stems, as rhizomes, bulbs, and tubers, are best known as reservoirs of starch and other nutrient matters, but the massive stems of trees contain much reserve matter, both in the xylem and phloem.

V. The growth of the stem.

It is unnecessary to say anything regarding the growth of young stems, hence we shall confine our remarks to the massive trunks of forest trees. Growth may be best defined as being an increase of volume and permanent change in the form of a plant or part of a plant, due to the intussusception of new nutrient materials, the increase in volume and the change of form occurring together. The circumferential growth of the stem depends on the activity of the cambium layer. Growth of the stem begins early in each season at the expense of the nutrient matters stored up in the stem, and after the exhaustion of this store the new constructive matters are supplied directly from the nearest leaves, the assimilated matters being thus partly used at once, and partly stored up for future use. The circumferential growth is characteristic of the stems of both Dicotyledons and Conifers. During growth the parts are rapidly supplied with water, as growth is as dependent on a proper supply of water as on a proper supply of nutrient matters. Hence, during growth the young cells in the new wood have abundance of protoplasmic contents, and the cell-walls are completely saturated with imbibed water, or by the cell-sap permeating the walls. Then, again, the less indurated parts of the stem, the so-called sap-wood, those conducting the rapid current of water, have the walls fully saturated with water. As a result of the growth in the cambium layer, and the tension of the cells from the water in the walls, great and increasing pressure is exercised on the bark, which, from its unyielding condition in the summer and autumn, renders the cells formed in the late summer smaller in size, and with greatly thickened walls, the microscopic examination of the stem exhibiting a marked contrast in the relative appearance of the early and late formed wood. These differences have been pointed out and fully described by Professor Kraus of Erlangen, and the cause demonstrated by experiment.

VI. The condition of the stem at different seasons of the year.

The different conditions of the stem at different seasons of the year are of great importance from an arboricultural point of view. Thus in winter the cells of the stem have their walls full of imbibed water, the cavities of many of them being also filled with reserve matters and water. Hence it is that in winter the pressure of the wood on the bark is very great, and it may be that during this time a certain amount of consolidation of the newly formed wood is going on. At the same time the cold is acting on the bark, which has now become very dry, and is therefore exercising a great deal of pressure on the wood, the wood and bark being mutually antagonistic, and by their action giving rise, to some extent, to the well-defined line of separation between the annual layers of wood. After a time the pressure of the wood overcomes the resistance of the bark, and gives rise to cracks and fissures in it, or the widening and deepening of cracks already formed. It is to be noticed that such cracks usually enlarge considerably in the early part of the year, as in February and March, from the wood pressure. The next stage is due to the improving weather and the increase in temperature and moisture. The bark swells up by imbibing water and the rise in temperature. This causes in its turn a relief of the tension on the wood, the bark being hardly, if at all, elastic. The effect of the swelling and loosening of the bark is to give the cambium free scope for developing. As the growth of the cambium goes on, and new xylem and phloem are formed during the summer and early autumn, the space thus formed by the swelling of the bark has been filled up and the tension again gradually increases. The wood cells now formed are smaller and smaller, and have thicker walls. As the weather becomes colder the bark contracts and becomes less watery, again increasing the pressure on the wood of the stem. We thus see that during the winter the bark is very tight, while the stem contains the maximum of water, as imbibed water in the walls of the cells, and is also full of reserve matters. A little later the bark cracks and expands, while the cambium begins to be active, hence the pressure is very slight, and the bark and phloem easily separable from the xylem at the cambium layer. When in full leaf the cells are empty, the walls full of imbibed water, transpiration being most active at this period, and the rapid current in full flow. Later in the season the reserve matters accumulate in the stem, filling many of the cells; the walls are full of imbibed water, and the bark tightly contracted on the wood.

Such, then, is a brief account of the varying conditions of the stem at different periods of the year.

VII. The felling and seasoning of timber considered physiologically.

Wood always contains a large quantity of water, hence the absolute necessity of seasoning timber by removing the water and leaving such substances behind as cannot be removed. The object to be secured should be to remove the water as rapidly as possible, and to prevent such changes in the reserve materials, that cannot be removed, as will render them injurious. Warmth and damp, with the absence of a free circulation of air, must be unfavourable to the seasoning of timber. By boiling and steaming the wood, most of the reserve materials will be decomposed, and many of them rendered soluble. If these can be removed, then no injury will be done to the wood if now dried; but if any of the matters are left behind, then moisture and warmth will again produce decomposition. There can be little doubt that natural drying in a free current of air is the best mode of seasoning; and such wood, if kept dry and exposed to the air, ought to keep well, even although much dried reserve matters, as starch, may be present in the cells.

When the bark is needed to remain on the stems, the proper time to fell is the winter, when, as already pointed out, the bark is tightest. Care must, however, be exercised, so as not to delay too long, as the cracking of the bark and the consequent relaxation of the tension will begin in February or March, according to the kind of weather, the locality, and latitude in which the plants are grown. Later in the season the bark can be most easily stripped off the trees, owing to the relaxation of the tension of the bark; and if the cambium has begun to grow, the soft, easily-broken-up new cells will afford the greatest facility for removing the phloem and bark from the xylem of the stem.

Still later the wood is soft from the new growth and the absence of pressure of the bark, but in a short time as the wood grows the tension increases. Lastly, the tension increases more and more as the cold weather sets in after the leaves have fallen, the bark contracting and exerting strong pressure on the wood, and to some extent consolidating it. At the same time the tension of the wood is increasing the combined effect.

By felling in summer, although there is little reserve matter in the cells, its absence is compensated for by the soft watery condition of the cells and the absence of tension, the wood being in a much worse condition than when there is the (even at the best) only comparatively small amount of reserve matters in the cells, as we find existing in winter.

We believe, therefore, that the results of the discussion held last year by the Arboricultural Society, detailing as they do the practical conclusions, will be found to be quite in accordance with physiological fact, as determined by experiment, and are therefore capable of being placed on a sound scientific, as well as on an empirical basis.

XXIV. *Report on the Forests of India.* By C. F. Amery, Forest Department, North-West Provinces, India.

I.—State Rights in Indian Forests.

The measure of control which a State can exercise over its forests is necessarily limited by the measure of rights of individuals or communities in those forests.

In India the general existence of such private rights is admitted, and legislation has now been set on foot by the Supreme Government to give permissive authority to local governments to investigate into all claims, and define for all time, the status, which, after due inquiry, they may hold it compulsory or expedient to award. The bill provides further for the commutation of admitted rights, but it makes no attempt to define the nature of the evidence which may be accepted as constituting a right, nor does it prescribe any data for the valuation of rights which it may be deemed expedient to commute.

The Supreme Government appears too fully impressed with the involved nature of these claims to prescribe any arbitrary method of dealing with them; and indeed the whole question of forest rights in India is beset with so many difficulties, that they can only be understood by a review of the position of the people of the country towards their native rulers, in respect of the land at a period anterior to the assumption of authority by the East India Company.

In the theoretical question as to whether the people at large were the proprietors of their several holdings, or whether the State was the universal landlord, speculation loses itself. Village communities divided the fields among themselves according to prescribed custom, and the State claimed its moiety (often a half) of the produce of each field, which was commonly paid in kind, but the right of ousting the cultivators—the crucial test of proprietary right—was never tested, because the culturable area was always vastly in excess of the cultivators—unoccupied land was valueless; and the State or middleman would as little have thought of ousting the cultivator, as the latter of ousting his bullocks. But whatever difference of opinion may prevail as to the status of the ryot or cultivator in respect of his holding, there can be none as to the middlemen. The jagheerdar held the free grant of *the revenues* of a given village or villages, but the resumption of jagheers was common. The zemindars and all other classes of middlemen were either direct agents of the State for the collection of its revenues, or responsible contractors, to whom the revenues were farmed out for a fixed sum; but under these middlemen we find evidences of a state of things which indicates the position of serf as the true status of the cultivator. Nothing was more common than for the cultivator, when suffering from oppression, or under the annoyance of some grievance, real or imagined, to threaten to leave his land; and we have abundant evidence that where this threat was carried into execution the middleman was generally successful in moving the Crown to have him brought back. Practically, then, the cultivator would appear to have been rather the object of proprietary rights than himself a proprietor; and we cannot correctly estimate the position of the ryot of to-day in comparison with the ryot of fifty years ago, without bearing in mind that the change is a natural consequence of the great social revolution which British rule has inaugurated in India. For ages before the advent of British rule the population was stationary in point of numbers, and as a consequence unoccupied land was valueless. Now population, apart from periodical drawbacks, such as the present famine in Southern India, is advancing numerically in nearly the English ratio; land is in demand, and has acquired a value *per se*, and the inalienability of the cultivator from the land, which under the old conditions made him a serf, required only to be enunciated under the new conditions to render him a proprietor. The Indian Government has laid down the law, that the cultivator cannot be ousted as long as he pays his rent, and in consequence he is co-proprietor in his holding to the extent of the difference between its market value and the capital value of his rent. The zemindar or middleman has become a co-proprietor to the extent of the difference in value between the Government assessment and the rents realised, and under the permanent settlement of Bengal his status is that of sole proprietor, with limited power in the matters of raising rents or ousting tenants. The State, except in Bengal, retains also one of the most important evidences of proprietary right over the land, viz., the power to raise the assessment at discretion at the lapse of each period of settlement, usually thirty years.

Since the establishment of British rule the cultivator, as from time immemorial, has had an interest in the forests and waste lands in his neighbourhood ; from them he has drawn his fuel and building material, and in them he has grazed his cattle—privileges for which he made no direct payment to the State, nevertheless he was always liable to be called on to cut and deliver building timber free of charge. The question now waiting solution is, "Has the cultivator in the course of his evolution from serf to part proprietor of his fields, acquired proprietary rights in the forests?" In some cases claims to absolute proprietary rights over local forests have been advanced, but only in rare instances, and such claims have been overruled; but the right to graze an unlimited number of cattle in the forests, and to supply themselves with building material and fuel free of charge, for home consumption, is generally advanced all over the country. There are also forest tribes in some provinces who, from time immemorial, have depended for their livelihood on the sale of forest products in the neighbouring towns; and more formidable still are those tribes of wandering cultivators, most numerous in Burmah, for whom custom has sanctioned the privilege of felling heavily-timbered forests, burning the timber on the ground, snatching a few crops from the rich forest soil, and then carrying their destructive labours elsewhere.

All these rights are customary rights, and the Government, while realising the incompatibility of their exercise with the permanent maintenance of its forests, shows no disposition to ignore any of them. The first-named class of rights is the most wide-spread, and perhaps one of the worst features connected with it is, that the claimants make no demand to have their rights of usage secured to them in perpetuity. On the contrary, with spread of population, the people regarding land for cultivation as the first necessary, never demur to one of their number acquiring an absolute right (for cultivation) over a portion of the forest in which the village heretofore exercised common rights. This right of the State to give its forests to private individuals, and extinguish all communal rights in such grants passes unquestioned. The claims of the people are limited to the demand to be allowed unrestricted rights in those forests in their neighbourhood, in which they have always enjoyed them, as long as such forests shall remain in the hands of the State. Let them all be given up for cultivation, and the people are content to pay for their fuel and timber requirements, and for grazing their cattle in distant forests.

A first-class forest will sometimes include a score or more of little villages, each with its few acres of cultivation and a claim to grazing rights over a twentieth part of the forest. The consequence is that any attempt to enclose a given area for the fostering of natural reproduction is opposed, on the ground that that is the grazing land of one village which has no grazing rights elsewhere.

But the State holds some forests free of all rights. This is generally due to the fact that their immediate neighbourhood was unsettled at a period shortly anterior to the constitution of the Forest Department, in which case the district officers levied grazing dues on cattle brought from a distance, in accordance with old native custom; and as cultivation encroached upon its confines, they gave each village what was thought a sufficient grazing area in the outside wastes, without encroaching on the better forest area. These wastes may have long since passed under the plough, compelling the people to resort to the forests for their requirements; but these requirements are paid for, and the forests continue free of rights, but the area of such forests is not very considerable.

II.—Condition and Area of the State Forests.

In all Indian social and economic problems, present and future, the most vital factor is the increase of population, inaugurated by British rule, and the problem of forest management is by no means an exception. The predominant feature of an Indian landscape while population was at a stand-still, was villages with their surrounding fields dotted all over a sparsely timbered jungle, with generally a dense mango grove near every village.

With spread of population the fields encroached upon the jungle. There was necessarily no lack of fuel and timber during this process, and the Government, free from anxiety that such a lack was threatening, and finding its revenues increased by every fresh acre broken up, stimulated the process, and kept far ahead of the wants of the people by holding out every inducement to capitalists, native and European, to take up the better timbered forests for cultivation. Land was valued in inverse proportion to the quantity of timber on it; and first-class forest, carrying timber which would now be worth £100 an acre standing, was, twenty years ago, given away at an annual assessment of sixpence an acre, payable only on the area which it was stipulated should be cleared annually. After supplying local requirements the timber thus felled was generally burned on the ground, and of course such forests as remained in the hands of the State were soon subjected to an increased drain—a drain increasing with spread of population and contraction of forest area; and it was not until the forest had almost disappeared from the settled districts that the Government was aroused to the necessity of conserving what was left; hence the formation of a Forest Department.

The new department, imagining that it had only to enter on a valuable State property and administer it to the best of its ability, soon found itself at loggerheads with the people and the district officers, who joined forces against the new power. The former demanded the exercise of customary rights, the latter supported them, and pooh-poohed the idea of closing the forests to the extension of cultivation, maintaining that the need for land for cultivation was a pressing and appreciable one, and that the argument that the remaining forest area was short of what was essential to the permanent well-being of the country was a mere hypothesis, supported by no reliable facts. The general outcome of this dispute was the allotment of the best forests, called "reserved," to the charge of the Forest Department, while the jungle lands, called "unreserved," were given over to the district officers. The reserved forests continued to be saddled with local rights, and various have been the devices resorted to to shake off the trammels, and acquire an unfettered if even much restricted State property.

In Bombay the people were assigned a proportionate area for each village, with absolute control over its management. They felled the timber at once and sent it to market, cultivated the land, and then demanded new forest grants, proportioned to the increased cultivated area; and elsewhere efforts in this direction have not generally been much more successful. The reserved forests have undergone considerable fluctuations in area since they passed into the hands of the Forest Department; but while, on the one hand, considerable areas have been given up to cultivation, still more considerable areas of previously unreserved forests have been constituted reserves. The last official published returns give the area of reserved forests for British India, exclusive of Madras and Bombay, but inclusive of the states of Mysore and Berar, as 12,000 square miles, or, roughly speaking, 2 per cent. of the area, which allows about one acre for every twenty head of population.

Ridiculously small as this proportion may seem, it must be borne in mind that not only is a large proportion of even this area in the mountains or other remote regions, whence only the most valuable timber can be sent to market, but that its condition as to standing stock is anything but what might be desired.

The principal timbers of India are the Deodar of the Himalaya; the Sal, extending over a considerable area in the North-West Provinces, Oudh, the Central Provinces, Bengal, Assam, etc.; and the Teak, the principal habitat of which is Burmah. The first is found in pure forests; the second also commonly exists as pure forests, or the sal is the preponderating tree; but pure forests of teak are unknown. Under native rule the sources of supply of the first and last of these were scarcely tapped, except for local requirements, and that to only a trifling extent; but long before the advent of the Forest Department, all these classes had been heavily drafted on for public works. There was no suspicion of the extent to which even, in those days, the forests were being overworked, the general verdict of the forest officers in respect to them all being "supply unlimited," but a few years' active operations sufficed to show that this verdict was based on very imperfect data. The Himalaya were supposed to be covered with deodar everywhere, between five thousand and ten thousand feet high; but as these forests became better known, it was found that they existed in narrow strips or circumscribed areas only, and it is not too much to say now that, but for the supplies drawn from native states, there would not be a mature deodar tree left standing in the Punjab Himalaya.

In the North-West Provinces, the only other source of supply of this valuable timber, the present rate of exportation will, I think, result in the withdrawal of every mature tree, from both British and native territory, within another twenty years; and this is a tree which is estimated to require two hundred years to reach maturity.

In the sal forests the ground is irregularly stocked; large areas are covered with trees decayed or passing to decay; large areas of close forests, cleared at a stroke, without any reference to natural reproduction, have been replaced by grass; and clearances effected in more open forests, the whole floor of which was covered with seedlings, get burnt over year after year, until the coarse long grasses of the country creep in and acquire the supremacy; and the growing forest is to a large extent being choked in the embraces of giant creepers.

Felling is for the most part carried on without any regard to the permanence of the supply, and sometimes prudently so. We may have a forest region carrying say twenty thousand fully-matured trees, and no other trees in the region which will reach maturity within fifty years. In these circumstances it would be prudent to fell only at the rate of four hundred trees a year, were it not that, on applying the axe, we find that decay is already beginning to show itself. In such case it would be wiser to utilise the timber while still sound, if it can be worked out at a profit. The sal goes on increasing in girth while it decays at the heart; but I know but of one case in which a forest officer succeeded in getting a forest of old hollow trees worked upon. Speaking within my own experience, wherever sal forests are situated near a market, the present rate of felling is in excess of the capacities of the forest to maintain permanently, but as long as the department postpones valuation surveys, there is always room to hope that the standing stock is in excess of the estimates of croakers.

The teak, as I remarked above, is not of gregarious habits, but seeks the companionship of other trees, and, although it is drawn from a large area, the yearly exportation is so large as to leave abundant room for the inference, that the drain is excessive, the more especially that, even in the reserved forests of British Burmah, it has not been thought advisable to suppress the firing of the forests by the wandering cultivators.

To sum up, the unreserved forests are every year perceptibly decreasing in area, and the standing stock on the reduced area as perceptibly diminishing, while from the reserved forests the deodar is fast disappearing, the sal in many places overworked, while there is reason to fear that this is the case with the teak also; but although these three are the most valued timbers, they are by no means the most general. The Himalaya carry enormous quantities of pine timbers, and an abundance of excellent timbers are found in the sal and teak regions, but at present the sole drain is upon the best timbers only.

III.—Labours of the Department—Results.

The Forest Department, as a first result of its labours, is expected to promptly meet the timber requirements of the Railways and Public Works Department, to bring timber within the reach of the people, and to execute all operations of felling, conversion, transport with intelligence and economy, so as to produce a fair revenue from the estates administered by it; and as a second result it is expected to provide for the permanent maintenance of the yield; but it will be readily conceived that, with the reserved forest, limited to 2 per cent. of the total area, and with the demand limited to timbers which occupy only a small percentage of the reserved forest area, the achievement of the second result may be incompatible with the achievement of the first.

The Government has not laid down the diction that the forests shall not be drained to an extent inconsistent with the permanent maintenance of the supply, and while it encourages it does not insist upon the department making valuations of its standing stock, without which it is impossible to ascertain in how far the current measure of exportation is justified; and although a Government resolution will sometimes qualify its approval of a good balance-sheet, by the remark that it would be more satisfactory if any evidence had been adduced to show that the forests were in a condition to meet the current drain upon them permanently, the general tenor of their resolutions with respect to financial results is such as to impress the department with the conviction that very satisfactory data would be necessary to justify any important diminution of revenue; the consequence is that, while the marketable stock is in a great number of instances undergoing rapid diminution, the revenues of the department are steadily increasing.

In the financial year 1864-65 the revenue of the department for the whole of India amounted in round numbers to £381,000, with an expenditure of £193,000; and for the next ten years there was a steady enhancement of revenue, which amounted in 1874-75 to £647,000; but meantime expenditure grew as rapidly as revenue, amounting in the latter year to £449,000, from which it will be seen that the net revenue remains nearly stationary; but this increase in expenditure is due largely to an important increase in the supervising staff, and to increased expenditure on account of plantations; for fostering natural reproduction by the exclusion of fires, for surveys, etc., all tending to the future well-being of the forests.

A net annual revenue of less than £200,000 is not a very considerable return from 12,000 square miles of forest, especially when it is borne in mind that no adequate efforts are being made to replace the timber exported by a fresh growth; but, as I have already remarked, the bulk of the forest revenues are realised from the sale of only a very few species of timber occupying but a small percentage of the reserved area. The general crop of the forests will not stand the cost of carriage to market, because timbers of equal quality are obtainable from local unreserved forests at a small cost, or when these fail, private forests and mango groves are cut down and sold at rates which, although yielding a fair return to the owners, would not cover cost of carriage from State forests. The general need of land for extension of cultivation encourages the continuance of the practice, and timber and fuel being necessarily plentiful as long as a large proportion of the capital stock of the unreserved forests is being annually exploited in addition to the annual increment, no one appears to foresee that the time is fast approaching when the remnant of the unreserved forests, denuded of their timber, will have to be divided between the people and the Forest Department, and the former be brought into complete dependence on the latter for all their requirements in timber and fuel.

The clearances effected by the Forest Department in the early years of its labours were followed by so irregular and imperfect a measure of reproduction, and such promise of reproduction as then was so frequently suffered destruction from jungle fires, that the attention of the department was early directed to the formation of plantations on suitable compact areas, where they could receive a measure of supervision which could not be accorded to large forest areas encumbered with rights; but although to the practised forester no branch of the profession is a more simple matter of routine, with familiar trees and under the conditions in which he has been trained, there is no branch of the labours of the Indian Forest Department in which absence of success is more apparent. The latest published estimates of the area and costs of the plantations in the several provinces of India, exclusive of Madras and Bombay, are as follows:

	Acres.	Cost.	Per Acre.
Bengal, ...	427	£3,082	£7 4 4
North-West Provinces, .	1,135	1,868	1 12 0
Punjab, ...	16,277	66,335	4 1 6
Oudh, ...	351	732	2 1 8
Burmah, ...	2,493	18,448	7 8 0
Assam, ...	313	1,428	4 11 3
Coory, ...	455	2,402	5 5 2
Mysore, ...	2,199	7,178	3 5 3
Berar, ...	2,338	2,508	1 1 5

The only considerable area that can be regarded as a practical success is the Punjab area, which has been twelve years in course of formation, and subject to an irrigation tax which has absorbed three-fourths of the outlay. The bulk of these plantations are along the railway in the arid region between Mooltan and Lahore, and are already giving an income from thinnings, the sowings of 1865-66 being now represented by trees upwards of 30 feet high and approaching 3 feet girth at base. These plantations, too, are situated in localities where their existence is a pressing necessity. The *Dalbergia sissoo*, a rosewood, is almost the only tree grown; and this is so valuable a timber for every conceivable purpose, that although the plantations were grown with the object of supplying railway fuel, they promise by-and-by to supply valuable timber for local requirements. But the heavy water-rates render the ultimate financial results of these plantations an open question. The subsoil water is at a depth of 60 feet from the surface.

The generally unsatisfactory results of plantations, the frequent necessity of sowing or planting the same area year after year, in the vain endeavour to stock it uniformly, together with the high costs of such results as were achieved, all tended to divert attention from artificial to natural reproduction. The annual jungle fires are the great obstacle, for although large areas of our high forests are sufficiently open to foster an almost uniform fresh growth, which appears only to need the removal of the old timber to spring into vigorous life, experience has shown that the removal of the old timber paves the way for the conversion of the forest into grass land, unless the jungle fires can be kept out. Strenuous efforts have been made in this direction—forest operations have been suspended in selected blocks, forest rights including grazing provided for elsewhere, broad fire lines 60 to 100 feet wide have been cut round and through the blocks, and sometimes fires have been excluded for two or three consecutive years; the young crop springs up vigorously—another year or two of conservancy would at least place it beyond the reach of actual destruction from fire, when some fine morning towards the close of the hot season the forest officer awakes to find the forest all in a blaze. There were rights of way through it which could not be closed, and a party of villagers passing through the previous evening with their lighted hookahs threw the hot ashes on the floor, or camped in the forest at night, lighting a fire, which spread as soon as they fell asleep, when, instead of trying to put it out before it had gained head, they picked up their traps and fled the place; or a native poacher fired at a deer, and the rag which he interposed between his powder and ball was fanned into a blaze as it left the gun, and the forest was on fire before he had time to make away with his deer.

Over 500 square miles of forest are under fire-protective rules, and costs up to date have been limited to about £2 per square mile; and although success is by no means general, the possibility of excluding fires has been so far practically demonstrated as to encourage to fresh efforts.

IV.—Future Prospects of the Indian Forests.

In laying bare the fact (presumption only in some cases) that the deodar, the sal, and the teak, the three principal timbers of India, are being annually exploited in quantities in excess of the permanent capacities of the forests, I am actuated by no captious spirit, nor with any desire to find fault with the forest administration. On the contrary, while admitting the full economic value of the axiom, that the annual increment is the true measure of material for exploitation, I am utterly opposed to the view, that as long as we have the needful timbers in the forests, railways or other important public works should be delayed in their execution for want of timber. There are many points to be considered in connection with the Indian forests, which will not readily suggest themselves to foresters accustomed to deal with forests that have long been under systematic management, as for instance the want of due proportion of age classes.

This want of just proportion may often result in our cutting towards a gap—*idesh*—a period at which we must either cease felling or reduce the age limit, even while our fellings are well within the limits of the annual increment. In many cases we are doing this in forests which, having been deprived of all their mature timber, will require only to be laid up for twenty or thirty years to be in a position to yield a permanent supply in excess of the present drain on them. This is of course when the final age class is below its just proportion. Even where the final age class is in excess, it must be remembered that fully mature timber makes little increment, while to fell it under proper provision for reproduction would be to raise the annual increment of the forest; and although it might not be generally desirable to plan operations on the basis of a big balance-sheet for the first ten years, to be followed by a total cessation of income for another thirty years, or by a serious reduction in the felling limit of girth, I conceive it justifiable to work off the mature timber promptly, when it is required for important public works, even if the demand should be in excess of the annual increment; but while I am disposed to make little demur to the extent to which exploitation is at present pushed, I think it a mistake that valuation surveys have been so long delayed, and that the department should be still working in the dark as to its resources.

In the immediate future the drain upon the reserved forests will be almost wholly as heretofore upon a few special classes of timber, and of these I am of opinion that the mature crop is rapidly tending towards exhaustion; and between the period of its exhaustion and the general exhaustion of the unreserved forests, the financial position of the department will be less flourishing than at present, excepting in one province, which I forbear to name, in which the conservator has kept his operations probably widely within the capacities of his forests, while he exerted himself to ascertain what those capacities really are. But the interval between the exhaustion of the supply of mature deodar, sal, and teak, and the exhaustion or extinction of the unreserved forests, will hardly be a long one. Hitherto the reserved forests have supplied but little timber, except for public works and European buildings; they will then be called upon to meet the whole wants of the empire in fuel and timber, and unless the unreserved forests be rapidly absorbed in the reserves, our forests will be quite unequal to meet the demand upon them.

That the bulk of the unreserved forests will be absorbed in the reserves without serious opposition I cannot believe, for population in many provinces of the empire is already trenching on the limits of soil capacity, and in this problem are involved considerations so vast that the importance of forest conservancy (indispensable as it is to the well-being of the people) sinks into insignificance in comparison.

I have treated the subject from a very general point of view, so as to afford a bird's-eye glance of the general condition and prospects of Indian forestry. A more detailed account of the labour of the department would doubtless be interesting, but justice could not be done to the subject in a brief report.

XXV. *On Forest Schools.* By Rev. J. Croumbie Brown, LL.D.*

In April last I addressed to the Right Honourable the Lord Provost, the Magistrates, and the Town Councillors of Edinburgh; to the office-bearers of the Scottish Arboricultural Society; to the promoters of the purchase of ground at Inverleith to be transferred to Government for the formation of an Arboretum, and all others whom it may concern, a letter supplying detailed information in regard to schools of forestry on the Continent of Europe, and advocating the creation of a school of forestry in connection with the Arboretum in Edinburgh.

It was extensively distributed among members of the Scottish Arboricultural Society. Had I had the means of doing so, the letter, or one somewhat similar, would have been sent to all; and I gladly avail myself of the permission which has been given to me to address you on the subject, in the hope that you may now, or at some future time, take part in discussing what may be the best means of securing for young foresters an education corresponding to that enjoyed by their brethren on the Continent of Europe.

In prosecution of this purpose I shall supply some additional information in regard to existing schools of forestry, and state some points on which desiderated information is solicited from the Association.

The schools of forestry on the Continent of Europe are educational institutions in which provision has been made for leading candidates for employment as foresters through a protracted course of study similar to what is required in Scotland as a preparation for the so-called learned professions of law, medicine, and divinity.

They may be considered as a necessary requirement of the system of forest management introduced on the Continent of Europe in the beginning of the present century, and also as a means of advancing the *Först-Wissenschaft* or Forest Science of the day, and of promoting its application to the treatment of forests, so as to secure the greatest benefit from the system of forest economy considered the best adapted to the circumstances and condition and requirements of any particular case.

Some three hundred years ago it was perceived by Sully, the distinguished minister of Henry IV., that France was being

* Read at the Twenty-Fourth Annual Meeting, 6th November 1877.

ruined by the destruction of her forests. I almost quote his own words; and a hundred years later there was passed in 1666 a famous ordinance to regulate the exploitation of these. The evil was not confined to France, and for a hundred and fifty years, in France and elsewhere, various measures were devised and adopted with a view to averting the catastrophe; but it was found that these could at best only retard the destructive process. At length Cotta and Hartig devised what is known in Germany as the *Fachwerke methode* of forest exploitation, the aim of which is to secure simultaneously, and without prejudice to each other, a sustained production of wood and timber, a progressive amelioration of the state of the forests, and a natural reproduction of these by self-sown seed.

To carry out this method of forest management, educated foresters are necessary; and I lay on the table for reference, if required, an account of the school of forestry in Vallombrosa, in Italy, by Dr Cleghorn, which appeared in the volume of *Transactions* of the Scottish Arboricultural Society for 1877; successive numbers of the *Journal of Forestry* for this year, containing programmes of study followed at Carlsruhe in the grand duchy of Baden, at Hohenheim in Wurtemberg, at the Escurial in Spain, and sheets provided in advance in view of this meeting containing an account of that at Evois in Finland; also the letter referred to by me in the outset, subsequently published by Messrs Oliver & Boyd of this city, entitled "The Schools of Forestry in Europe: a Plea for the Creation of a School of Forestry in connection with the Arboretum at Edinburgh," in which is given a detailed *resumé* of the programme of study followed at the school of forestry at Nancy, in France, a translation of the regulations issued by the King of Sweden for the management of the forest school at Stockholm, information in regard to the schools of forestry in Austria and Poland, and translations for the Forest Code of Russia in relation to the forest schools of Russia; and with these I lay on the table programmes of study followed at the schools of forestry at St Petersburg and at Lissino, at Neustadt Eberswalde in Prussia, at Münden in Hanover, at Tharand in Saxony, at Giessen in Hesse-Darmstadt, at Aschaffenburg in Bavaria, and at Stockholm in Sweden, most of them with translations in manuscript.

Statistics illustrative of the pecuniary benefit of these schools to the several countries in which they have been established cannot be introduced now, but the magnitude of this may be otherwise indicated.

In India, as in France and in Germany, it was found that the forests were being destroyed, that the destruction of these was entailing privations and sufferings upon the people, and that more disastrous consequences were looming in the distance. After careful deliberation, it was determined that a body of forest officials, educated at schools of forestry on the Continent of Europe, should be procured. The arrangements made are detailed in the letter to which I have referred.

The expense was considerable, and it may be considered that this was a bold measure, but the results have justified the steps taken. By progressive amelioration of their condition, forests have risen greatly in value and have been vastly extended, and the revenue from forests has been increased by *hundreds of thousands of pounds.* According to Resolution of Government of India, Financial Department, No. 2012, dated 11th March 1871, the latest to which I happen to have access, the estimated charges for the following year 1871-72, as settled in the Public Works Department, and as modified in the Financial Department, were 45,11,000 rupees (£451,100), and the receipts, 57,32,200 rupees (£573,220), showing a surplus of revenue over expenditure of 12,21,200 rupees (£122,120). I learn that in the year 1873-74 the forest revenue was £700,000, and the expenditure £414,000 odds, leaving a surplus of £285,000, both revenue and expenditure being about double what they were in 1864-65, ten years previously. It may facilitate recollection if I state that the expenditure one year was reported vaguely as £200,000, and the returns, £400,000. All which had been accomplished not by an impoverishing of the forests, but by a progressive amelioration of these and an increase of their pecuniary value in something like a corresponding ratio.

In illustration of this latter allegation, I cite the following statement, made by Captain Campbell-Walker in a paper on "State Forestry: its Aim and Object," read before the Otago Institute, Dunedin, 21st December 1876:

"The Chunga Munga plantation, in the Punjab, has an area of 7000 acres, commenced in 1865, contains chiefly Indian blackwood (*Dalbergia sissoo*). The expenditure up to end of 1873 had been £26,000, including £5000 spent during the first five years in unsuccessful experiments; £5000 had been received from petty thinnings (firewood and minor produce, grazing dues, etc.). From a careful valuation, and calculations made in 1873, it is estimated that the expenditure up to 1881, when the capital account closes, will be £97,000, and the value of the plantation be then £170,000. In considering the above results, it must be borne in mind that the rainfall in the district is under 15 inches, with great heat in the summer, and sharp frosts in winter. The whole plantation has to be irrigated from a neighbouring canal, being debited with a charge of 4s. per acre per annum for the use of the water alone. Another important fact must be mentioned, viz., that, whereas the land on which the plantation stands was formerly almost valueless, and would not fetch an annual rental of 2s. per acre; 12s., and even 20s. per acre is now readily obtainable, and the former has been offered for the whole or any portion when cleared. The rents mentioned, of course, include the water-rate of 4s. per acre per annum. This plantation is intended eventually to cover 30,000 acres, and will undoubtedly prove a great success, both as regards direct financial profit, a supply of timber or firewood, which is much required, improving the soil, and rendering it fit for cultivation with cereals, and ameliorating the climate. The Nelambur teak plantations, in Madras Presidency, cover 3000 acres, the oldest portion having been planted thirty years ago. The total expenditure, including purchase and lease of some 19,000 acres of land from a native raja, has been £30,000, and the receipts from thinnings, etc., £10,000. These plantations were valued last year at minimum rates at £150,000, and Colonel Pearson, lately officiating as Inspector-General of Forests in India, estimated their value, when mature, at no less than two millions sterling."

An examination of the programme of study laid upon the table will show that in most of the schools of forestry on the Continent of Europe the course of study is similar, most of the modifications being attributable to national or local conditions. It embraces, besides, matters pertaining specially to forest economy, studies which may be called preliminary or fundamental, and studies which may be called accessory or supplemental.

Amongst preliminary or fundamental studies are reckoned Mathematics, Natural Philosophy, Meteorology, Chemistry, and Rural Economy, etc. Amongst special professional studies relating to forest economy, Botany, the Structure and Physiology of Arborescent Vegetation, Agriculture, Technical Properties and Uses of

Woods and of Timber, Mensuration of Trees, Estimation of Forest Contents, Partition of Forests for Exploitation, according to the *régime* of management adopted, and the Practical Management of Forests, in accordance with the *régime* adopted, be it coppice-wood, timber forest, or a combination of the two; and the Exploitation of Forests in all its departments. Amongst accessory or supplemental studies are reckoned Agriculture, Road-making, Rural Architecture, Political Economy, Forest Law, Judicature, and Police, etc.

The instruction is communicated by prelections, by written exercises and examinations, and by illustrations in the class-room, in the museum, and in the forest; and the course of study extends in different schools from two to four years. The term generally adopted is two years and a half.

In the programme of study followed at Aschaffenburg, in Bavaria, which extends over two years and a half, we find that during the first summer session attention is given to Botany, Zoology, the Chemistry of Vegetation, Natural Philosophy, Mathematics, Chart Drawing, and Political Economy.

In the winter session following, instruction is given in Forest Economy, the Game Laws, Botany, Zoology, Chemistry, Mineralogy, Atomics, Hydrostatics, Pneumatics, Heat, Acoustics, Optics, Magnetism, Electricity, Meteorology, Trigonometry, Mensuration of Solids, and Plan Drawing.

In the second summer session there is continued the study of Forest Mensuration, Meteorology, Botany, Zoology, Chemistry, Land Mensuration, and Plan Drawing.

In the second winter course attention is given to the Systematic Management of Forests, according to different objects aimed at; and the Historical Development of Forest Economy, Forest Technology and Finance, the Timber Trade, the Management of State Forests, Entomology, Organic Chemistry, Geology, Road-making, Dam-making, and Bridge-building, and practice in Forest Mensuration in its every department.

In the concluding summer session attention is given to the practical application of all previous instruction, and instruction on excursions in the whole round of forest operations, instruction in Forest Administration, in Rural Economy and Agriculture, and in all works of Forest Engineering.

Facilities for the prosecution of field and forest studies abound in the vicinity of Aschaffenburg, but the excursions take in a wider range, and extend to the Black Forest, to the forests on the Rhine, and to the pine and fir forests of France. All of these are conducted by the professors or teachers.

There may be much in such a curriculum of study as this which is not deemed requisite as training for the management of British woods and Colonial forests. On this point I have no design to raise a controversy at this stage. The position which I take up is this: The Governments of almost every country on the Continent of Europe—Denmark, Holland, Belgium, and perhaps Greece, being apparently the only exceptions—under the influence of students of forestry, have deemed it expedient to make provision for the instruction of officers in their forest service in all of the subjects embraced in that curriculum. The British Government of India have deemed it expedient to do the same, in so far as existing arrangements permit of this being done, and have found their advantage in the result; and in view of this I raise the question, May not something similar, but adapted to meet the requirements of our conditions, be done by us?

In the location of the schools of forestry on the Continent, considerable diversity exists, and the knowledge of this may be of some importance in considering what may be done.

In some countries the schools of forestry are distinct separate institutions; in others they are connected with other educational arrangements, which in some, but not in all, are in part utilised, and, so to speak, made subservient to the education and instruction of the students of forest science.

Of these, in regard to which information is laid on the table, the schools of forestry at Stockholm in Sweden, at Evois in Finland, at Lissino in Russia, at Nancy in France, at Vallombrosa in Italy, and in the Escurial in Spain, are exclusively schools of forestry. The school of forestry at St Petersburg in Russia is located on the same grounds with a school of agriculture, but in separate buildings. Of the schools in Germany cited, those at Neustadt Eberswalde in Prussia, and at Münden in Hanover, are exclusively such. The same may be said of that at Aschaffenburg in Bavaria, but it has just been raised to association with the University of Munich. And that at Giessen in Hesse-Darmstadt is incorporated or embodied as one of the faculties in the University of that city. At Tharand in Saxony, and Hohenheim in Wurtemberg, the schools of forestry are connected with schools of agriculture and rural economy; at Carlsruhe, in the grand duchy of

Baden, the school of forestry is combined with a college of engineers in the Polytechnicum of that city.

One advantage of such combinations is that many subjects may be studied by students of different faculties under the same teacher, as is done in the arts classes of our Scottish universities by students contemplating the study of theology, of medicine, or of law; and one staff of instructors thus suffices for the whole, with only special instructors for special subjects of study pertaining to the different professional departments, who conduct their students through these in the same sessions in which they prosecute the studies required of all. In Spain the economical application of teaching power in the school of forestry in the Escurial is secured by an arrangement similar in some respects to that adopted in the theological colleges of the United Presbyterian Church and the Free Church in Scotland, but with a slight difference: candidates for admission to the school of forestry in the Escurial must pass an entrance examination, corresponding to the examination for the degree of Master of Arts in the universities of Scotland; but, contrary to the usage of ecclesiastical bodies to which I have referred, which requires evidence of the entrant student having studied at a university the subjects upon which he is examined, no inquiry is required as to how or where the candidate for admission to the school of forestry in the Escurial had acquired the information tested by the examination. There are many advantages found to be connected with the location of a school of forestry in the vicinity of a forest, in which from time to time illustrations of what is advanced in the class-room may be found. But this is not indispensable to the successful teaching of forestry. It may be said that one-half of the schools of forestry are not so situated, and, in those which are so, the students are taken to see actual forest operations at a distance. The students at the Laesnoi Corps, St Petersburg, are taken to Lissino, seventy versts, or nearly fifty miles distant. Those at Nancy, in France, are taken to study forest work in the oak forests of Central France, in the coniferous forests of the Vosges and the Jura, and in the perimetres of *reboissement* and *gazonnement* on the Alps. And the students at Aschaffenburg, in Bavaria, are taken, as has been stated, to the Black Forest, to the forests on the Rhine, and to the pine and fir forests of France. I cite only cases on which I have reported, but there are others in which advantage is taken of the facilities afforded by railways for taking students to study practical forestry in districts at a great distance from the locality in which the school of forestry is situated.

It seems to me that the facility for locomotion supplied by railways, combined with the fact that the local expense of board, etc., is very much the same everywhere, has somewhat modified the views once entertained in regard to the location of a school of forestry, in, I shall not say "a cottage," but a palace, "near a wood"—for in such some of the schools of forestry on the Continent have been located. I may be allowed to state in this connection that, on the publication of my plea for the creation of a school of forestry in connection with the proposed Arboretum, one of my correspondents, Professor Blomqvist, director of the school of forestry at Evois, in Finland, wrote to me on this point, calling my attention to views expressed at a convention of State foresters, etc., at Freiburg, when it was said to be unanimously agreed that a university was the proper place for the study of forest science.

It is in connection with the consideration of the requirements of our Colonies that I have moved in this matter; I look upon India as a dependency like in some of its requirements to a colony; and I should be glad if access to a highly remunerative career were opened up to working foresters in the forest service of that country, believing that what thus brought gain to them would bring corresponding gain to the countries obtaining their services. But it is natural that the national Arboricultural Society should look primarily to our national requirements. And anticipating as I do greater difficulties in securing from the first a body of students, than in securing the establishment of a school of forestry in the country, I would submit for consideration the expediency of the association selecting for discussion at the meeting of the Society in 1878, the following questions relating to points on which information is greatly desiderated and earnestly solicited:

1. What course of study at a school of forestry would best meet the requirements of young foresters intending to practise forestry in Scotland?

2. By what measures can students be procured to attend a school of forestry in Scotland for the prosecution of such studies?

3. In what way could students, at a school of forestry in Scotland, most efficiently spend the vacation in acquiring information from observations to be made by them in woods, plantations, and forests in Scotland?

XXVI. *On the Woods and Plantations of the Mackintosh Estate in Brae Lochaber.* By JAMES HUTTON, Sub-factor, Roy Bridge, Kingussie.

The Mackintosh's lands of Glenroy and Glenspean in Lochaber are situated in the wild and hilly district between Fort William and Kingussie, $10\frac{1}{2}$ miles from the former, and 26 miles from the latter. The length of the estate is about 14, and its greatest breadth 10 miles, and its area computed at 32,000 acres. Though its woodlands compare favourably with those of other properties in the district, they are of limited extent, and may be set down at 2500 acres. Except about 1000 acres of arable land in the low grounds, the estate is chiefly pasture land, stocked with sheep and black cattle. This may account in a great measure for the woods not extending over a greater portion of the land. The sheep and cattle brouse on the seedlings and young shoots, the young trees are thus destroyed, and the grown trees cut down are not succeeded by others. The woods consist chiefly of indigenous trees, the most common being the oak (*Quercus robur*), which here is only of medium growth. It occupies the low grounds, being seldom found at a greater elevation than 500 feet above the sea-level. The birch (*Betula alba*) is next, and occupies a higher elevation, appearing where the oak leaves off, and extends to about 1100 feet above the sea. These two species form the great bulk of the natural woods, but other trees are interspersed, as the ash, mountain ash, hazel, aspen, poplar, wild cherry, bird cherry, crab apple, hawthorn, alder, saugh or willow. In autumn the varied tints of their foliage give to the landscape a most pleasing appearance.

During the last and present centuries various other trees have been introduced, as the elm, plane, beech, lime, larch, Scotch fir, spruce, and silver fir, but except larch and Scotch fir, recently laid down on slopes and terraces, these are planted to a limited extent in hedgerows, in clumps, or by river-courses. They are all healthy and luxuriant, showing the suitableness of the soil and climate to their growth. A considerable portion of the low grounds are mossy, and being on an incline could be easily drained. As they do not anywhere extend to a great breadth, and are diversified with numerous knolls composed of clay, sand, and gravel, they might be successfully planted. The trees on the knolls would contribute to the success of the plantations by forming a shelter, and would conceal the more stunted growth of those on the mossy parts. No district in Scotland is more capable of improvement, and if the plantations were formed on a more extensive scale, and carried out in a skilled manner, few would be more remunerative.

I shall now refer briefly to the nature of the soil, before describing the trees and plantations. Geologists affirm that this part of the district was during the glacial period one large loch. The numerous hills ranging from 1160 to 1750 feet above the sea, formed so many islands, the highest of which would be about 590 feet above this glacial loch at its highest level. Evidence of this appears in the frequent accumulations of sand and clay found on the plains and hill-sides. The parallel roads of Glenroy furnish a still further proof. These singular witnesses of a past and totally different state of the country, consist of three distinct and well-marked lines, such as would be formed by the continuous beating of waves upon the shore of a loch. They run parallel to each other along the sides of the high hills and around the summits of the lower ones, and maintain a uniform height of 872, 1064, and 1150 feet respectively, above the present sea-level. These roads or water-marks show that there were three distinct periods during which the lake existed at different levels, and that the subsidence from one level to the next below must have taken place suddenly, so that those slopes on which sheep and cattle now browse were once the haunts of aquatic tribes.

I shall only refer to the consequences, leaving geologists to determine the manner, the cause, and the dates of these remarkable transformations. There are, as already stated, large accumulations of clay, sand, and gravel, found in the valleys and forming terraces on every hill-side. Like the three parallel roads, there are three principal terraces, in some places subdivided into smaller ones. The effect is picturesque from a distance, like so many steps leading up the hill-sides to a height of 300 to 500 feet above the sea-level. During each subsidence, a great quantity of *detritus* was probably drifted down the valley, which accumulated and formed these terraces. They seem to have been formed as each out-break took place, and the three terraces in the lower part of the valleys seem to correspond with the three parallel roads on the hills. These probably have been formed somewhat as may be seen on a small scale when a dam of water is let off; the suction of the water draws the loose muddy water down the slopes until the accumulations became too great for the diminishing force of the water to remove, and the *débris* is left in a sort of terrace. Then a similar process and another terrace is formed. The three terraces alluded to rise to a height of 60, 140, and 200 feet respectively, above the level of the plain that follows the course of the rivers Roy and Spean. The slopes are mostly covered with natural oaks, and while the flats of the first and second terraces consist chiefly of arable land portioned out in crofts and small farms, all three are formed almost wholly of clay, sand, and gravel, the proportions varying at different depths and in different parts of the district. For the parallel roads and the phenomena connected with them are not confined to Glenroy, but are more strongly marked there than in any of the other glens. These accumulations often assume the form of layers, which may be observed at several places, where deep ravines formed by the mountain torrents present a sectional view of the strata. The surface layer consists of sand and gravel mixed with clay of a loamy nature, and is about 3 feet in depth; the second is a sandy clay to a depth of 40 feet; the third has only a little clay and sometimes gravel mixed with the sand, and is about 20 feet in depth; and the fourth, which is embedded upon rock, is a bluish granitic gravelly clay, becoming more gravelly toward the base, and is about 8 feet in depth.

Climate.—This district is bounded on the south by the loftiest mountain range in the British Isles, including Ben Nevis to the south-west, 4406 feet. These high mountains attract the clouds carried from the Atlantic Ocean; hence the rainfall in the district is large and the climate generally is very moist and mild. In winter it is milder than in many places further south. The average rainfall during the last three years has been 50 inches, and the days on which no rain fell averaged about 1 in 3.

I now proceed to describe the trees and plantations.

Oak (*Quercus robur*).—This species constitutes the natural woods throughout the district, but is seldom found of a large size; perhaps this condition may have resulted from successive cropping when young. It grows rapidly till it attains a height of 30 feet, when it begins to assume a spreading form, and its growth is less perceptible. The oak woods grow in a manner similar to larch and Scotch fir plantations, for the trees stand singly, and unless protected no coppice succeeds after the trees are cut down, as the cattle and sheep destroy the shoots and young trees. The trees have in parts been allowed at one time to grow pretty thick, and there they are generally long and small. But wherever they have had room to expand they seldom grow to more than 30 feet; the largest attains a height of about 50 feet, with a girth of about 6 feet at 5 feet from the ground. On counting the concentric circles, they appear to be from 100 to 120 years of age; three-fourths of the wood being heart or red wood; the timber is very durable. The extent is computed at 1500 acres. The wood is generally used for farm purposes, and also for building houses, barns, etc., throughout the glens. But the chief purpose for which it is used is posts for wire fencing, for which (in the absence of larch) it serves well, and lasts from seven to ten years in fair order; if cut in winter and well seasoned, it will last some years longer. Owing to the moist climate, barking operations have not been successful. High wages and the cost of transit to the market leave but a small return for the trouble and expense, and few of the district proprietors have speculated in the business. Generally in a dry spring the oak caterpillar is very destructive to the foliage of the tree; many acres of wood may be observed quite leafless from the ravages of these voracious insects. They may be seen in hundreds suspended by the silk threads by which they shift from one branch to another. A day's heavy rain, however, proves fatal to them.

Birch (*Betula alba*).—This tree is interspersed amongst other trees in the low grounds and doing well, but it is not until it reaches an elevation of 500 feet that it spreads to any great extent. The stronger nature of the oak gains the ascendency over the birch in the low grounds, and as the oak here does not ascend to a higher elevation than 500 feet, the birch, which thrives on higher grounds, may at this elevation gain the ascendency over the oak and other trees. It is found covering the hill-sides from 500 feet to 1100 feet, and its extent is computed at 800 or 900 acres. For many years a bobbin factory has been working in the district, and many hundred tons of birch have been converted into bobbins. The price obtained was 5s. per ton as it stood. Lately the price has advanced to 7s. 6d. per ton. The distance to the nearest shipping port is 6 miles, and to the nearest thread factory about 150 miles. For a number of years the caterpillar has done great havoc among the birch. The larvæ come into existence at the time the leaves appear, and they often strip the trees on which they are hatched of their entire foliage. The principal respiratory organs of the trees are thus impeded, and their whole system gets deranged; soon after this fresh shoots burst forth on the bole and branches of the trees; the original branches die, and in the course of a year or two the trees succumb. The caterpillar has many enemies; the greatest is the jackdaw, which may be seen in hundreds feeding upon these voracious creatures.

Hardwoods.—Growing in hedgerows, in clumps, and by the river-courses. They are the ash, plane, elm, beech, lime, etc.; of these the most abundant is the ash, which is indigenous, and is found mixed among the other trees, and frequently associated with the alder by the river banks. The largest of these stands about 70 feet in height, with a girth of 11 feet at 5 feet from the ground. There are so few of the other hardwood trees mentioned that I need not describe these separately. The tallest I noticed attains a height of about 80 feet. One plane-tree has a girth of 14 feet at 5 feet from the ground. The girth of the others ranges from 5 to 9 feet at 5 feet from the ground, and are from 60 to 80 feet in height. They are all on the lowest terrace, already described, and are healthy and growing well.

Larch.—At Keppoch there are 124 very old and remarkable trees of the red flowering variety. In the year 1753 Ranald Macdonald, son of Alexander Macdonald of Keppoch, who fell at Culloden, returning from the Continent after having finished his education in France and Italy, brought the plants home with him as two-year seedlings. They were planted about 6 feet apart around the policies as hedgerows and in clumps, etc., at an elevation of from 10 to 30 feet above the rivers Roy and Spean, and from 300 to 320 feet above the sea. They grow on the slopes of one of the lowest terraces referred to, the surface soil being that described in the first layer, and the subsoil a mixture of clay, sand, and gravel to a considerable depth, resting on granitic rock. They cover an area of about 8 acres. They have attained an average height of about 90 feet, and contain on an average 152 cubic feet, or altogether 18,848 cubic feet of timber. To give a better idea of these larches, I measured four of the largest and give their dimensions in a table.

No. 1 stands on an elevation of 10 feet and 15 feet from the water's edge. The surface soil is dry, but the tree's roots are near enough the water to receive sufficient moisture. The tree maintains its conical shape, but begins to appear slightly rounded at the top. The branches on one side had been partially stripped off by other trees falling during a gale in 1860, but the tree still has a very graceful form. For size, etc., see table *infra.* No. 2 stands on a plain about 13 feet above the level of the river Spean and 50 yards from the water's edge. Its top was broken off some time ago and the tree has formed leaders from the upper lateral branches which are still healthy and growing. A large arm was cut off which had grown out in a horizontal direction about 4 feet from the ground; the wound has considerably healed over, but the place is marked on the same side by a large swelling. The soil and subsoil are the same as described under No. 1.

No. 3 stands about 14 feet above the level of the river Roy, and derives much the same advantages therefrom as No. 1. It appears from the leading shoot becoming decayed, to have attained its full height, but is still fresh and healthy looking. No. 4 stands about 7 yards distant from No. 3, and 13 feet above the river Roy. It also participates in the same advantage as Nos. 1 and 3. It was difficult to determine this tree to be superior to a number of others growing on a terrace 20 feet higher; it is healthy and still growing.

TABLE SHOWING THE DIMENSIONS OF THESE TREES.

No.	Girth at 1 foot.	At 5 ft.	At 10 ft.	At 20 ft.	At 45 ft.	Height.	Spread of branches—diameter.	Cubic contents.
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
1	16 8	12 2	11 10	9 11	8 2	108 6	40 0	355 0
2	19 2	14 7	11 0	10 11	7 2	86 0 (top off.)	57 0	358 0
3	11 10	9 3	8 7	8 0	6 6	101 0	38 0	196 0
4	11 6	8 6	7 11	7 3	5 11	100 4	33 0	175 0

During a gale in 1860, upwards of forty similar trees were blown down, and on examining the blocks recently I only found one affected with heart-rot; traces of an old road were observed near the spot on which this tree stood. The root from which the rot proceeded stretched across the road, and the rot no doubt was caused by an external injury to the root. This rot does not appear in the heart of the tree, but considerably to that side on which the root grew, and judging from the concentric circles, it seems about seventy years since it began to affect the tree; this old road was closed about sixty years ago. All these old trees are remarkably free from lichen, and retain most of their original branches, the lowest of which bends close to the ground.

Scotch Fir and Larch Plantation.—This is situated about half a mile from the old larch trees just described. It is a small plantation of seven acres planted in the spring of 1855 on the flat of the lowest terrace. The soil is of a clayey sandy nature, and is damp and cold. The larches interspersed through this plantation have grown well. The tallest is 46 feet in height; the tallest Scotch fir is 38 feet in height.

Muirlaggan Plantation.—This is situated two and a half miles to the east of that last mentioned, and is about 30 acres in extent. The plantation was formed in the spring of 1870 on the slopes of the second and highest terraces, and ranges from 462 to 670 feet above the sea. The larches planted on the highest terrace are not thriving so well, but the Scotch firs grow luxuriantly at that elevation. I have seldom seen a finer and healthier plantation than this. These trees are now seven years of age. The tallest larches are 20 feet in height, and the tallest Scotch fir 13 feet. The plantation was thinned out in 1877, and the young larches were sold for stob fencing purposes. It has a southern exposure and grows on a steep hill-side.

Glenspean Plantations.—In two other plantations of Scotch fir and larch of more recent date, having an extent of about 30 acres, some larches have an annual growth of about 3 feet, and Scotch firs from 18 to 24 inches. These plantations range from 440 to 600 feet above the sea, and have a southern exposure.

Scotch Fir Enclosures.—The extent is about 90 acres. The earliest was planted in 1871, and the others a year or two after. These plantations were made in soil supposed to be unfavourable to the growth of larch, and owing to the inequality of the soil, some of the plants are making good progress, while others are not. All planted on knolls are growing well. Preparations are being made for additional plantations of Scotch fir and larch on a larger scale. This season the Scotch fir plantations have been affected for the first time by a caterpillar (*Tenthredo pini*), the larva of the well-known pine saw-fly, and a beetle (*Hylurgus piniperda*). The caterpillar destroys the foliage of the preceding year's growth; it begins at the top of such growth and eats downwards, leaving the current year's growth untouched, and with this exception the tree is often rendered leafless. It also pierces the bark and sucks the sap from the tree. It attacks the plantations only in certain places and commences its ravages in June or July.

The beetle attacks the pith of the young shoots, which in a few days hang down in a withered condition. The two insects do not attack the same tree, or the result would be very destructive to the plantations.

Judging from the size and healthy condition of the old larches and from the rapid growth of the young plantations, it is evident that larches thrive best on soils of alluvial formation similar to that found in the terraces referred to. It is also clear that the mild and moist nature of the climate is favourable to the healthy development of the plantations. I am also of opinion that the larches grown on such soils are more free from disease than those on grounds having a light surface and hard subsoil which in my judgment is the origin of most of the diseases to which the larch is subject, especially those that affect the roots.

XXVII. *On the Use of Dynamite and Tonite in Forestry.* By D. F. M'Kenzie, Forester, Murthly Castle, Perthshire.

When pitting, trenching, breaking up large boulders, and removing large tree roots are necessary previous to planting, these operations will be done most expeditiously by means of an explosive substance. For this purpose *Dynamite* and *Tonite,* two of the most powerful blasting powders yet known, are beyond doubt the safest and most economical. Their utility has only to be made known in order that they may come into general use for clearing land of obstructions, etc. The writer having used these agents largely, and under various circumstances, wishes to bring them under the notice of the Scottish Arboricultural Society.

Two of the most important uses of these explosives in forestry are, *preparing the soil* to receive large plants instead of the old method of pitting, and the *breaking up of moorband pan.* The bad effects of pan on the roots of trees are already too well known. These explosives break it up, and shatter and mix it with the soil so effectually that it disappears, and a free passage is left for the roots several feet around and below the charge. They can also be used with economy in ditching, road-making, and fencing; also in well-sinking, and in places where the use of the pick is necessary but not convenient.

Before proceeding further, it is needful to describe the properties, and the caution required in the handling of these safe (but under careless management dangerous) explosives. The safety of dynamite in use and transit is now proved beyond doubt, as "the documents placed in the hands of the secretary to the Railway Clearing House, London, at the meeting of goods managers, on 25th October 1871, and the very severe tests made at Glasgow, by Professor Bischof, on 20th November of that year, before the sub-committee of goods managers, who were appointed to investigate and report as to the 'safety of dynamite in transit,' as well as subsequent tests by the War Office, and other competent authorities, prove that it is unquestionably much safer than gunpowder under all conditions of transport."

The properties of dynamite are: "When set fire to with a match or fuse in an open space, it burns without exploding, and under confinement it only expends itself more rapidly; in either case it gives out nitrous fumes; when fired with one of Nobel's patent detonators, it explodes with enormous power, giving out no noxious fumes or smoke; water does not destroy its explosive properties; it is somewhat poisonous and gives off poisonous fumes; when in its proper condition it is a soft pasty substance; in cold weather it hardens and freezes, but resumes its pasty condition when warmed; and, to secure its full explosive effects, must always be in the pasty state when being used in blasting operations."

The chief advantages of dynamite over gunpowder are: great economy of labour in boring; saving of tools and fuse; no tamping required; perfect immunity from accidents in stemming boreholes; will blast under water and in water-bleeding rocks; is quite free from smoke; perfect safety in the handling, transporting, and storing, as long as the company's printed instructions are observed. Dynamite is made into cartridges of from one ounce to several pounds' weight, and special instructions for its use are sent with every package.

Tonite or *Cotton* powder is claimed to be the explosive of the future. Its safety is equal at least to that of dynamite under the same circumstances, and it is in every way as economical and wrought in the same way, except that it requires no thawing. At present its cost is equal to that of dynamite; but a writer in the *Mining Journal* states that *cotton powder* will be in a short time supplied at a price defying all competition. Though the powders are of different natures, they are practically of the same value as regards price and economy in working. There are two points in favour of tonite over dynamite—it leaves no poisonous fumes, and is at all times ready for use. The same instructions apply to both, and therefore they are treated together.

These explosives are preferable to the usual method of preparing and loosening soils for planting, on account of their cheapness, the complete manner in which the soil is mined and loosened, leaving no walls to hamper the roots as in pit planting, and making no receptacles for water, as do the pits. The effect is the opposite, producing a thorough drainage of the surrounding surface, loosening the adjacent soil, and leaving way for the tap root of the plant to descend to the substratum in search of food. At first the effect is little seen; but, on probing the soil, an ordinary walking-stick can be easily forced down through the part loosened. In hard soil, and even in fissured rock with very little soil, sufficient room is made for a plant to grow well. It is its peculiar action that so thoroughly breaks up moorband pan; the action of the explosive is downwards and horizontal, and in very few cases (except a slight cracking of the soil around the spot where the powder exploded) does it come to the surface. Experiments prove that on land prepared to receive plants in the manner described, the surface drainage is greatly assisted in all soils resting on a retentive subsoil, especially on pan and hard clayey bottoms. It is in such soils that the explosives will be found to be more economical than any other method yet tried.

The cost of planting by this method is at first considerable; but taking into account that ordinary trenching is not half so beneficial for the after-growth and development of the roots, it will be found cheap, indeed only a fraction of the cost of trenching. To plant an acre of standard or ornamental trees at 20 feet apart, 108 spaces are required, and the preparation of them in all soils alike, would cost 44s. 6d., including the whole outlay for explosives, detonators, and fuse, and labour of preparing and firing the charges. With the necessary implements, one man and a boy can prepare an acre in a day; but in wet weather the fuse is apt to get wet at the end. The implements required for the operation are a round iron bar about 5 feet long and $1\frac{1}{4}$ inches in diameter, with a ball on the upper or striking end, and a point on the other similar to the point of the bar used by shepherds for their net stakes, the bar to have a slit below the ball, 1 inch wide by $\frac{3}{8}$ of an inch, to receive a key (used for withdrawing the bar when it becomes body fast); an iron hammer or a mallet from 10 to 12 lbs. weight to drive the bar to the required depth; a small pair of nippers to squeeze the detonator on to the fuse as directed by the companies who supply the powder; and a small wooden stemmer to pack the tamping. Any careful person can perform the work, which is as follows: Exactly where a plant is to be placed, a hole should be made by driving the bar about 18 inches into the soil, exclusive of the tapered point; the vacancy caused by the point to be filled up previous to charging. If in a dry soil, thirty to fifty, or even more holes, should be pierced before charging; but if under water, or in a wet soil, each bore should be charged immediately on withdrawing the bar, and so soon as a few are charged they should be exploded. The reason is that when dynamite is used in a cold situation it freezes in a short time. Under water no tamping is necessary, but in other cases dry fine sand is the proper material. Sand fills every small cavity without hard driving with the stemmer, and in this way prevents accident. All other instructions are given with each package of the powder, and should be rigidly adhered to.

To trench land by this process would be too expensive under ordinary circumstances, but in extraordinary cases it could be profitably done. Basins formed by a thick formation of moorband pan, on which scarcely stunted grass will grow, may be caused to yield good timber, or even grain crops, at a moderate expense. By exploding a 2 oz. charge at 8 or 10 feet apart, any bar will give way, and be internally mixed with the soil and subsoil, and in such a manner as not to reunite again. The charges should be placed about 8 feet apart and about 2 feet below the surface, which would trench the soil about 5 feet deep, with scarcely a trace at the surface. A single trial will illustrate this better than a volume written on the subject.

When large ditches have to be run through hard soil, rotten rock, or other material which needs the pick, the work can be performed at half the usual cost by these explosives. The same remark applies to the running of roads through rock or hard soils. Pits for straining posts can be made in half the time, and at one-third less cost than by mattock and pick. To clear land from which a crop of timber has been lately felled is a difficult process, even with these applications, and they cannot be used with profit to clear the whole surface; but it may be advantageous to use the powders under the largest roots. These would be blown out, and the soil prepared to receive a plant. In most cases, however, unless some of the roots are previously cut, the charge will expend its power only below the root, and lay the roots bare. But they can be easily cut out afterwards.

The most profitable uses to which these explosives are applicable are: the planting of standard and ornamental trees and the breaking up of pan and such places as require a great amount of picking. A single trial will convince those who are most doubtful of its utility; and any person with ordinary intelligence will work it after having read the instructions. As already stated, full instructions are sent with every package, and so long as these are attended to, no accident can happen. But the least mistake is attended with evil, and often with fatal consequences. None of these powders are so dangerous as gun or ordinary blasting powder, and few persons are afraid to use the latter.

The prices of dynamite, etc., are:

No. 1 dynamite, in cartridges of any size, .	2s. 0d. per lb.
No. 2 dynamite, ,, ,, . . .	1s. 4d. ,,

Terms:

Orders for dynamite under a quarter ton, . . .	Net.
A quarter ton and under half a ton, . .	2½ per cent. discount.
Half a ton and under one ton, . . .	5 ,, ,,
One ton and under five tons, . . .	7½ ,, ,,
Five tons and upwards, ...	10 ,, ,,

Furnishings:

Percussion cap treble charge detonators, . .	£1, 15s. per 1000, net.
Gutta percha fuse for hot climates, . .	2s. per coil of 48 ft., ,,
,, ,, for blasting under water, .	1s. ,, 24 ,, ,,
Tape fuse for wet ground, . . .	7d. ,, 24 ,, ,,
Common fuse for dry ground, . . .	4½d. ,, 24 ,, ,,
Nippers for squeezing the detonators upon the fuse,	1s. per pair, ,,
Warming-pans for dynamite, . . .	15s. each, ,,

The above prices include all packages except indiarubber bags, which are charged extra. All sales of dynamite, etc., by district agents, are subject to settlement in cash on or before the 14th of each month for goods delivered during the previous month.

XXVIII. *On the Best Kinds of Wood for Charcoal, and the Process of Charring.* By Robert Baxter, Forester, Dalkeith Park.

Good useful charcoal can be produced from almost every kind of wood that grows. The Wych elm, Spanish chestnut, and lime-tree require, however, to be peeled, as the bark of these woods offers great resistance to the charring process. Indeed, the quality of the charcoal would be much improved if the bark was stripped off all woods used for the purpose. It is seldom, however, that time can be afforded for this; and those woods that can be used without being peeled, no doubt will be preferred. Beech, plane, ash, thorn, oak, birch, alder, and laurel, can all be used with perfect freedom as charcoal producers. The holly and yew, the latter particularly, make a very superior charcoal; it is heavy, holds well together, and has lasting qualities as fuel. There is a traditional antipathy to fir being used for this purpose, especially larch, owing to a belief that it emits sparks; but I have seen larch frequently tested, and it emitted no sparks. The resinous nature of these trees, however, renders them not so safe as the hardwoods, with which they should be well mixed when being charred.

Every forester has at his command a supply of wood that will make good charcoal, suitable for all cooking purposes, and, as already noticed, its quality will be much improved if the wood is peeled before charring. A good means of preserving the heavier charcoal from crumbling, is to split instead of sawing the wood when preparing it for the kiln.

The usual process of charring is to make a kiln in the open air; a central post, about 6 feet long and 6 inches in diameter at the thickest part is driven into a level piece of ground, slightly raised in the middle. Around this centre are arranged thirty pieces of the same length, and nearly the same thickness, all inclining inwards a little at the top. A similar circle of wood of $4\frac{1}{2}$-feet lengths is next added, carrying it out at least another foot. Before proceeding further it is necessary to fill up the space intervening between the top of the $4\frac{1}{2}$-feet lengths and the centre with good billets from 1 foot to 18 inches in length. The same process has to be repeated again, with shorter lengths, in widening circles, until a gentle slope has been produced all round, the size of an ordinary kiln being from 15 to 18 feet in diameter at base. To fill up inequalities in the surface of the slope, all the small wood is chopped into 9-inch lengths, and laid round and round until every crevice is filled up. In fact, from first to last, it is of great importance to pack the wood close, as it gives the kiln greater stability during the charring process; if it is loosely thrown together, there is sure to be a collapse somewhere, destroying not only the conformation of the kiln, but bringing down a quantity of turf or sand amongst the burning mass, that will perhaps extinguish a great part of the fire. The kiln must now be covered with turf, beginning at the bottom and working upwards, care being taken to fit the turfs close together, in order to prevent undue ventilation. A large round turf is required to cap the whole; but before putting on this bonnet, it is necessary to light the kiln. This is done by placing some old charcoal, shavings, and dry split wood, into a basin-shaped cavity on the top, which must be left when the kiln is built. After the fire is kindled, the round turf is put on lightly, and when the fire gets a firm hold, it is pressed closely down. These operations at the top must be done from a short ladder, with iron spikes at the bottom to prevent it slipping. At this stage one would think that the worst was past, and that it would be comparatively easy to watch the fire silently doing its work. But of all fires that ever burned, that in a charcoal kiln is the most capricious, requiring at times the greatest amount of coaxing to draw it in one direction, while it burns with vigour in another.

When the smoke begins to tell that the fire is doing its work, holes have to be made in the turf with a pointed stick at intervals round the top; these are intended to draw the fire downwards, and have to be made daily further down the sides until the fire reaches the ground. Another duty requiring attention is feeding. In four or five hours from the time of lighting, the turf bonnet must be lifted, and wood put in to fill up the waste that has already taken place. This feeding has to be carried on for three or four days, and is generally done from the top. Sometimes, however, a sudden depression takes place in the side, necessitating the removal of the turf, and a good feed has to be administered there as well.

Day and night the closest watch must be kept on the movements of the fire, checking it in one place, and encouraging it in another, until the close of the eighth or ninth day, when all the volatile constituents will have been expelled from the wood, leaving about 250 bushels of good charcoal.

The measuring and picking must now be proceeded with; one man with a shovel begins at the outskirts of the kiln to remove what remains of the turf, as it generally gets well charred with the intense heat. Another man with an iron rake draws out carefully the outer circle of the charcoal, and spreads it on the ground a short distance back, after which both men take their shovels, and with the pulverised turf and sand cover up the exposed portion of the kiln. This process is necessary to cool the charcoal. The exposed charcoal is now minutely examined, and all doubtful pieces thrown aside. Any sparks of fire that may be detected amongst the rest are quenched with a few drops of water; that, however, is a rare occurrence. In order to insure the safety of the charcoal and the comfort of those who may use it, it is absolutely necessary that every bit of it should pass through the hands of the men, who must be competent as well as trustworthy. The rest of the kiln has to be treated in a similar way, uncovering so much of it at a time, then drawing out the cooled charcoal, then covering up again until the whole is safely stored; if the weather is favourable, this cooling process ought never to be hurried. This plan is perfectly safe and practicable, and has been carried out for more than fifty years at Dalkeith, the charcoal giving general satisfaction.

But this year we have given it up, for the following reasons: In the first place, it is killing work for the men. In this variable climate, they have frequently to contend with rain and wind—the former drowns the fire, the latter makes it burn too strong. They are constantly harassed by the thought that at any moment it may burst out and reduce their work to ashes. With this anxiety pressing on a man's mind he cannot sleep, and it is a common experience that when he lies down to take a short nap, his sleep does him no good. The result is that in three months a strong man is often brought to the verge of physical prostration. Another reason is, it has to be done in summer, when the days are longest; and this is also the oak-peeling season, when men can be ill spared. Thirdly, it entails great waste of material. Every kiln takes a heaped load of turf to cover it, very little of which can be used a second time. Then, for every ton of charcoal produced, there is a loss of two tons of wood, which either disappears in combustion or is reduced so small as to be unfit for use. It has been proved that four tons of wood when charred on a correct principle will yield one ton of good charcoal. This system, however, requires six tons to produce the same quantity, so that the waste occasioned by it is a very serious item; and, as I have hinted before, there is a constant risk of the fire breaking out beyond control, and doing irreparable damage. We have therefore abandoned the open air system, and adopted that of charring the wood in two large cylinders or retorts, similar in every respect to those used at powder works. These retorts are 7 feet long by 3 feet 6 inches in diameter. For filling them the wood is cut in two lengths, averaging from 2 to 6 inches in thickness, the smaller size being laid in the bottom, and the heavier at the top, where the fire first strikes the retort. As in the old method, it is necessary to pack close, with this difference, that all the wood put in here is certain to come out, and well charred. The retort is closed by two doors or lids, raised and lowered by block and tackle, the inner one rests loosely on a flange about 9 inches from the mouth; the outer one covers the entire front of the retort, and is held firmly in position by six iron keys. It is also necessary, the more effectually to exclude air, to fill up with clay any inequalities between the two surfaces.

This being done the furnace underneath is set agoing, the coal used for this purpose costing 5s. a ton. On an average the process of charring takes sixteen hours; it is completed when, after drawing out a wooden stopper in the lid, and holding a lighted taper to the gas, it is ignited; the fire underneath is then drawn out, and the retorts allowed to cool for five or six hours. The two lids are then removed, and the charcoal is drawn smartly out into large iron pans; as each pan is filled it is shut with a close-fitting cover, which quickly extinguishes the fire. At some places the vapour expelled from the wood is condensed and forms the basis of useful products; but with us the gases are brought by a return pipe into the back of the furnace and consumed in the fire. It is not necessary to point out the obvious advantages of this system. The labour involved is not heavier than any forester's daily work, and it can be done at any season of the year; indeed, in the event of a snowstorm preventing other employment, this work can be carried on as briskly as in midsummer. I regret that I cannot yet state the exact cost of production, as compared with the old system, but it will certainly be considerably less.

XXIX. *Cryptogamic Plants Injurious to Forest Trees, and their Treatment.** By Malcolm Dunn, the Palace Gardens, Dalkeith Park, Edinburghshire.

The subject which I have to bring under the notice of the meeting is of such a comprehensive nature, and has so many minute but important ramifications, that, to do it anything like justice, we would require a whole day for its discussion instead of the very limited time at our disposal; and even then we could only notice in detail some of its more prominent and characteristic features. The class Cryptogamia forms a very numerous section of the vegetable kingdom, and includes all those genera the flowers of which are either absent or formed on a plan different from that of ordinary flowering or phænogamic plants, and the reproductive organs of which are not true seeds, containing an embryo, but mere cells enclosing a granular matter, which, by germination, produces a thread, or mass of threads, a cellular body, a membrane, etc., as the case may be, which either at once gives rise to the fruit or to a plant producing fruit; but to enter upon a botanical definition of all the differences and distinctive features of the various orders and genera into which the class Cryptogamia is divided, is not necessary for the elucidation of the object we have in view, and, in fact, can only be followed out in a satisfactory manner by those who have an intimate knowledge of plant life in all its varied phases, and of the structure and functions of all parts of plants throughout the vegetable kingdom.

Plants, like animals, are subject to numerous diseases, both functional and organic, and they arise from various causes, some being constitutional and hereditary, but frequently, on the other hand, many of them are induced by bad food, imperfect nutriment, a vitiated atmosphere, want of light, the attacks of cryptogams, and other causes, for which in many cases effective remedies are known, and in all of which some likely remedy can be suggested. The study of the diseases of trees is essential to their good cultivation, for although in many instances perhaps but little can be done toward arresting disease in any individual tree, much may be done by proved experience and the judicious use of rational means in preventing the spread of those which are infectious or contagious,

* Read at the Annual General Meeting, 6th November 1877.

and much more by guarding against those conditions and contingencies which induce disease in plant organisms.

To return to the subject for discussion, we know that many of the numerous genera of cryptogams are more or less injurious to plant life, and one very important class of diseases amongst trees and timber arises from the attacks of parasitic fungi. To illustrate the dangers arising from the attacks of fungi upon trees, I will describe an instance or two which have come under my own notice of the fatal injuries inflicted by them, and which, I hope, may interest the meeting and promote discussion as to the nature and amount of the damage perpetrated by them upon forest trees, and the best methods that are known and available for their prevention or cure. I will first describe a notable instance of a serious attack of fungus upon some fine young trees of *Wellingtonia gigantea*, which were under my care in the year 1865, and the plan I adopted to remedy the evil. In the summer of that year a row of about twenty Wellingtonias, which were growing in a light loamy soil, on an open, dry, gravelly subsoil, in a moderately well sheltered situation, began to show unmistakable signs of failing health, and upon examining the roots I found them to be completely swathed in the mycelium or spawn of a fungus, which had worked its way under the bark of the roots and stem in several of the trees, so as to completely choke up the alburnum or sap-wood, rupturing its tissue, and entirely preventing the circulation of the sap, and thereby causing the death of the tree. From this cause two of the trees were killed outright before the end of August; and another was so badly infested with the spawn, and so ruptured and injured at the base of the stem, that I considered its recovery hopeless, and therefore destroyed it.

When examining the roots of the Wellingtonias, I found the ground in which they were growing to be full of old tree roots in all stages of decay, forming a perfect nursery of fungus spawn. Upon inquiry, I learned that about twelve years previously there had been a row of large old elms growing upon the same ground, which were all blown over or so seriously damaged during a severe gale of wind as to necessitate their removal. To save trouble in clearing them away, the trees had been sawn off at the base of the stem, and the stumps and roots buried in the ground where they had formerly grown, some of them being so slightly buried that the earth placed on the top of them was scarcely 3 inches deep. The stumps having been thus put out of sight, the surface of the ground was levelled and laid down with fine grass as a lawn. In the course of the following year the Wellingtonias were planted, without any further preparation being made than digging a small hole for each, and filling it with a barrow-load of fresh soil, into which the young trees were stuck in regular order, no care or thought having been taken whether or not they were placed on the top of an old stump, as in reality some of them were. For a few years they made moderate progress, and all went fairly well till they had reached a height of from 8 to 12 feet in the year 1865, when I took charge of them. The summer of that year was very hot and dry from the beginning of June to the early part of August, and it was during that period that the trees began to show decided symptoms of declining vigour, by the young growth becoming yellow, then brown, and dropping off from the effect of the roots being overrun with the fungus spawn, which, as it penetrated its way under the bark and up the stems, caused two of them to succumb to its attacks, as I have already stated, before the end of August. Early in that month a considerable amount of rain fell, and in a few days afterwards numerous fungi began to appear all over the ground in which the trees were growing. In the course of a fortnight afterwards they had increased to such a multitude that a person's foot could not be set down anywhere throughout the whole area in which the old elm roots were buried, a space of about 300 yards long by 12 yards wide, without treading upon fungi. Seeing the fatal effect the mycelium of the fungi had upon the Wellingtonias, I suggested that the whole of them should be lifted, and the ground thoroughly trenched to get out the decaying roots of the elms, which I believed to be the principal cause of the enormous production of fungi. This was agreed to, and in the middle of September the work was begun, by taking out an opening at one end of the ground and trenching it over regularly to a depth of 30 inches, or more where the elm roots descended to a greater depth; being careful to pick out every chip of decaying wood and root that was met with while the operations were proceeding. All the Wellingtonias, except the two that were dead and the one which I considered hopelessly gone, were lifted, as they were come to during the process of trenching, with as much care as possible, and the roots which were found to be injured or badly infested by the fungus spawn were cut clean away. The trees were then taken to a pond near by where the remaining roots were carefully washed as clean as possible from all traces of the spawn. Immediately afterwards, and before the roots got dry, they were taken and replanted on the trenched ground, which was prepared for them as the work proceeded. Every tree received two cart-loads of good, sound, fresh loam, in which its roots were carefully laid out to their full extent so as to give the tree a good start. As each tree was planted it was securely staked, and received a thorough watering to settle the soil about its roots.

The old roots taken out of the ground during the trenching were carted away, the surface levelled, the turf relaid, and all finished off before winter set in. Since that time, scarcely a fungus of any kind has ever appeared on the ground that was previously so badly infested with them. After such severe treatment, the Wellingtonias made little growth the first year, but with occasional watering in dry weather all were kept alive and gradually assumed their usual healthy green appearance, and during the following seasons they have thriven well and have quite recovered from all symptoms of having suffered so severely from the attacks of fungi. Neither has there been any sign of the reappearance of the fungus, although several seasons since 1865 have been quite as favourable as that year was for its production; hence the removal of the decaying elm roots, which furnished a favourable medium for the production and growth of the fungus, has saved the Wellingtonias from being further molested by the insidious inroads of its mycelium or spawn.

Again, to give another instance (which happened under my own observation) of the destructive power of fungi upon young forest trees. In a small mixed plantation of ash, Spanish chestnut, hornbeam, poplar, willow, and hazel, which was planted in 1857-58, upon ground that had been cleared two years previously of a crop of heavy oak, ash, elm, and beech, and in which all the old stumps and roots were allowed to remain, the ash, poplar, and willow began to fail in 1861, and by 1863 there was scarcely a plant alive of any of them upon an area of about six acres, which was felt to be a serious loss, as they were specially planted with the view of producing a crop of hop-poles, which were much in demand and brought remunerative prices in the district. On pulling up and examining the dying plants, I found the roots were covered with the spawn of fungi, which permeated the bark and alburnum with a perfect web of white threads, and as the plants decayed penetrating their wood and hastening its rapid decomposition. The mycelium in many cases reached a height of from 2 to 3 feet up the stem of the young tree before the top was quite dead; and it could often be seen bursting the bark at the base of the stem, and displaying a complete network of white threads of spawn inserted between the bark and the wood. A few of the hazels were affected with the fungus and died, but none of the Spanish chestnut or hornbeam appeared to suffer in the least, although they were intermixed throughout the plantation with the other kinds that were killed by the fungi; hence it would appear that some species of trees are proof against the attacks of certain fungi, which are fatal to others.

Some of the most fatal diseases of trees are attributed to the ravages of the more minute genera of parasitical fungi, in the form of mildew, rust, mould, rot, etc., the species of fungi producing these effects being generally of microscopic proportions. However, their destructiveness under favourable circumstances quickly assumes an alarming visibility, indicating their presence to the most obtuse observer, and their devastating inroads upon vegetation probably equal those of the larger genera of fungi, although their presence may not be so easily detected. Some of these minute fungi attack plants *internally*, and only become visible when they break through the surface of the plant to shed their spores; others are *superficial*, rooting, living, and fructifying upon the epidermis. The various species of *Æcidium*, *Erineum*, *Puccinia*, *Sclerotium*, and *Uredo*, belong to the internal class, and are the cause of much disease in the leaves and wood of trees and shrubs. Very often it is the most vigorous plants which are first affected by these fungi; while on the contrary the attacks of superficial fungi, such as *Acrosporium*, *Botrytis*, *Erysiphe*, etc., appear always to be brought on by the debility of the plant attacked. A long period of drought, followed suddenly by a heavy fall of rain and a close, moist atmosphere, is a prolific cause of mildew or mouldiness in its various forms; and it is supposed by some that when the plants are in a debilitated state from the long continued dry weather, they become more easily the prey of fungi or mildew, which, as soon as the rain falls, and the air is saturated with moisture, grow with great rapidity, and soon overrun the plants.

To prevent the ravages of *internal* mildew, precautions should be taken to destroy it by every available means, burning when possible all plants, or parts of plants, affected by it, taking care that none of the spores are allowed to escape into the soil, from which they will again attack succeeding crops. The attacks of *superficial* mildew may in general be prevented by due attention to the wants of the plant, watering, manuring, etc., so as to keep it in a healthy and vigorous state. When trees are attacked by these parasites, an application of sublimed sulphur, if properly and perseveringly applied, is in almost every case a certain remedy, the sulphurous (not sulphuric) acid which always more or less accompanies the use of flowers of sulphur, being fatal to all those minute fungoid organisms of the nature of mildew. I am aware that such remedies as these can only be applied to a limited extent in our forests and plantations; but they can always be applied in the nursery, and ought to be rigorously put into force amongst all young trees, so as to ensure a clean, healthy, and vigorous stock of plants for the formation of future plantations.

Of the various genera of fungi which attack the heartwood of living trees, causing *heart-rot* or "pumping," the primary cause of their attacks is generally ascribed to exhaustion or weakening of the vital force of the tree, from the poverty or ungenial nature of the soil, the severity of climate, or the neglect of timely thinning and consequent overcrowding, all of which are injurious and debilitating in their effects, and render plantations suffering from them more liable to become the prey of fungoid diseases. The only cure known for the attacks of heart-rot fungus, is to cut down and clear away every infected tree, burning all diseased parts so as to prevent as much as possible the spread of the fungus spores. Careful and judicious selection of the trees suitable for the locality, and which are known to suit certain soils and climate, a due and proper preparation of the ground before planting, efficient shelter and protection where such are necessary, and a regular and systematic attention to the pruning, thinning, and other operations necessary for the health of the trees, are the best preventives of heart-rot.

I might go on, if time permitted, to give you many more examples of the pernicious nature of fungi when growing upon trees and vegetation in general, and which are either the cause or effect of disease and decay, and all the varieties of "rot" to which trees in a living state are liable, as well as the *dry-rot* which plays such havoc amongst them when they are converted into timber. Wherever fungoid life finds a suitable pabulum, in either live or dead vegetable matter, there it will fasten itself, and under favourable atmospheric conditions will quickly spring into vigorous action and consume the substance it lives upon until it is so decomposed as to no longer afford any sustenance to fungoid organisms.

When vegetable matter arrives at such a stage of decomposition, it in general furnishes a safe and valuable manure for the growth of other plants, without any risk of producing fungi deleterious to vegetation.

Of the many different species of ferns, lichens, mosses, and other cryptogamic plants which infest trees, we have no time left to speak in detail, but as few or none of them are true parasitical plants like fungi, there is less occasion to say much about them. Where such growths abound upon forest trees, it is generally caused by peculiarities of soil or atmosphere, such as cool, damp soil, and a close, moist atmosphere, both conditions being highly conducive to the growth of cryptogamic plants. In the case of forest trees infested by them, drainage and judicious thinning, and exposure to air and light, is generally found to be the best preventive.

In conclusion, I would recommend a thorough preparation of the ground before planting, and the removal of all dead or decaying wood likely to produce fungus, with careful attention to drainage, and timely and judicious pruning and thinning, as the best general means of preventing the attacks of cryptogams on forest trees. When the trees are once attacked, especially by fungoid cryptogams, the best and safest plan is to root them out and burn them at once, to prevent the disease spreading to other healthy trees.

XXX. *Report on the Meteorological Observations made at Carnwath, Lanarkshire, in connection with the influence of Forests on Climate.* By ALEXANDER BUCHAN, M.A., F.R.S.E., Secretary of the Scottish Meteorological Society.

In the Report of the Committee submitted to the Annual General Meeting on 1st November 1876,* it was proposed to remove the Louvre-boarded box with the thermometers from the station outside the wood at Gallowhill to a new position inside the wood, where the thermometers would be completely shaded by the trees, but at the same time in as close proximity as possible to the station inside the wood, at which the thermometer box is fully open to the influence of solar and terrestrial radiation; and to add at each of the two stations a set of underground thermometers at depths of 3, 12, and 22 inches, to be observed daily with the other instruments.

The object kept in view in making these changes and additions was to determine whether there might not be a very considerable difference in the mean temperature of the air and of the ground at two stations in the same wood within a very short distance of each other, and under precisely the same conditions, as regards height above the ground and the sea, slope of surface, etc., but differing in the important particular, that while the one station is completely shaded by the trees from direct solar and terrestrial radiation, the other station is open to these influences, and the instruments placed over grass just as in the case of ordinary observing meteorological stations.

Two sets of underground thermometers were accordingly procured, compared, and got ready by the end of the year; but it was impossible to carry out the arrangements at Carnwath till 8th March. Since a short time before my visit to Carnwath on that day, the trees had been cut down in considerable quantities immediately all round the old station of Winterlaw in the heart of the wood, and the thermometer box thereby exposed fully to the sun for nearly the whole day, no shadows from the trees falling on it, it was resolved to adopt *simpliciter* the Winterlaw station, as now altered by the cutting down of the trees, as one of the two new stations, seeing that it entirely fulfilled the required conditions. Immediately adjoining this fine plot of grassy sward,

* Vol. viii., p. 169.

at the same height, and with the same slope, exposure, soil, subsoil, and state of natural drainage, was a plot so densely shaded by the trees that all direct solar and terrestrial radiation was completely obstructed. Here the second thermometer box was placed, the distance between the two stations being only 30 yards. At both stations the underground thermometers were placed in situations and positions exactly similar to each other.

The observations, which involved a long walk over rough ground, were made twice a day by Mr Fotheringham, under the well-directed superintendence of Mr Hector M'Lean, W.S., and Mr Currie.

The observations for the year ending 31st October 1877, embrace two sets, the first set being a continuation of the previous observations at Gallowhill outside the wood, and at Winterlaw inside the wood from October to February, the results of which are given in Table I. The second set embraces the observations made under the new arrangements, beginning with March, the results of which are given in Table II.

TABLE I.—Showing the Results of Meteorological Observations near Carnwath at two Stations—one at Gallowhill, outside a Wood, and the other at Winterlaw, inside the same Wood, from October 1876 to February 1877, as described in previous Reports.

Registering Thermometers.	Gallowhill.					Winterlaw.				
	Oct.	Nov.	Dec.	Jan.	Feb.	Oct.	Nov.	Dec.	Jan.	Feb.
Highest in month,	64°·1	54°·2	49°·2	49°·2	50°·3	63°·3	53°·7	49°·2	49°·7	51°·2
Lowest ,, .	32·0	8·0	25·0	15·0	12·0	32·0	8·0	25·0	16·0	12·5
Difference, .	32·1	46·2	25·2	34·2	38·3	31·3	45·7	24·2	33·7	38·7
Mean of all the highest, . . .	53·1	43·2	42·1	41·9	42·9	53·3	42·6	42·1	41·8	42·9
Mean of all the lowest, . . .	44·7	31·5	34·3	32·3	32·0	44·1	31·1	34·4	32·0	32·0
Range, ...	8·4	11·7	7·8	9·6	10·9	9·2	11·5	7·7	9·8	10·9
Mean temperature,	48·9	37·4	38·2	37·1	37·5	48·7	36·9	38·3	36·9	37·5
Hygrometer.										
Dry bulb, 9 A.M.,	49·0	37·0	38·8	35·3	37·9	48·7	37·0	38·8	35·6	37·9
Wet bulb, ,, .	47·5	36·5	38·3	34·5	37·0	47·7	36·4	37·9	34·6	37·0
Dry bulb, 9 P.M.,	48·1	37·7	39·2	36·4	36·5	47·7	37·5	39·4	36·5	36·8
Wet bulb, ,, .	47·1	37·1	38·9	35·5	35·9	46·8	36·9	38·6	35·7	35·9
Winds.										
N., ...	0	3	0	1	0	0	3	0	1	0
N.E., ...	4	7	6	3	1	4	7	6	3	1
E., ...	7	5	7	4	1	7	5	7	4	1
S.E., ...	9	6	7	6	1	9	6	7	6	1
S., ...	2	1	1	4	1	2	1	1	4	1
S.W., ...	4	4	8	11	14	4	4	8	11	14
W., ...	4	2	2	2	7	4	2	2	2	7
N.W., ...	1	1	0	0	3	1	1	0	0	3
Calm, ...	0	1	0	0	0	0	1	0	0	0

TABLE II.—SHOWING THE RESULTS OF METEOROLOGICAL OBSERVATIONS MADE NEAR CARNWATH, AT TWO STATIONS INSIDE A WOOD—THE ONE BEING COMPLETELY SHADED BY OVERHANGING TREES, AND THE OTHER COMPLETELY OPEN TO THE SUN'S RAYS, FROM MARCH TO JULY 1877.

	EXPOSED.						UNDER SHADE OF TREES.						
REGISTERING THERMOMETERS.	Mar.	Ap.	May.	June.	July.	Means and Extremes.	Mar.	Ap.	May.	June.	July.	Means and Extremes.	Dif. bet. Exposed and Shaded Ther.
Highest in month, . .	50°·2	56°·2	59°·3	76°·4	68°·2	76°·4	50°·7	55°·8	58°·4	73°·7	63°·5	73°·7	—2°·7
Lowest ,, . .	19·0	25·0	25·1	35·0	39·1	19·0	18·3	25·7	24·0	36·1	40·1	18·3	—0·7
Range, ...	31·2	31·1	34·2	41·4	29·1	57·4	32·4	30·1	34·4	37·6	23·4	55·4	—2·0
Mean of all the highest,	42·0	46·2	52·2	61·8	60·3	52·5	41·8	45·4	51·5	60·4	59·0	51·6	—0·9
,, ,, lowest,	28·5	33·0	35·7	45·2	48·1	38·1	28·6	33·3	35·4	44·8	48·4	38·1	—0·0
,, range, ...	13·5	13·2	16·5	16·6	12·2	14·4	13·2	12·1	16·1	15·6	10·6	13·5	—0·9
,, temperature, .	35·3	39·6	44·0	53·5	54·2	45·3	35·2	39·4	43·5	52·6	53·7	44·9	—0·4
HYGROMETER.													
Dry bulb, 9 A.M., . .	35·4	40·6	46·1	55·7	55·8	46·7	35·3	40·3	45·9	55·2	55·0	46·3	—0·4
Wet bulb, ,, . .	34·5	38·4	42·9	52·9	53·2	44·4	34·3	37·7	42·6	53·1	52·9	44·1	—0·3
Elastic force of vapour,	·190	·209	·241	·366	·373	·276	·187	·200	·238	·376	·372	·275	— ·001
Relative humidity, . .	91	85	78	83	84	84	91	80	77	87	86	84	+1
Dry bulb, 9 P.M., . .	35·1	38·0	42·2	50·6	52·1	43·6	35·2	37·9	42·0	50·5	52·0	43·5	—0·1
Wet bulb, ,, . .	34·1	36·8	40·3	49·8	50·8	42·4	34·2	36·1	40·5	49·7	51·3	42·4	+0·0
Elastic force of vapour,	·185	·204	·229	·348	·355	·264	·186	·193	·235	·347	·369	·266	+ ·002
Relative humidity, . .	90	89	86	94	91	90	90	85	89	94	95	91	+1
UNDERGROUND THERS.													
Highest obs. temp. 3 in.	41·0	42·2	51·0	58·4	59·0	59·0	37·5	42·0	50·0	57·0	56·3	57·0	—2·0
,, ,, 12 ,,	42·0	42·1	50·0	57·0	57·0	57·0	38·4	40·8	47·9	56·2	56·6	56·6	—0·4
,, ,, 22 ,,	42·2	42·4	48·0	56·2	55·5	56·2	39·1	40·4	46·2	54·0	53·0	54·0	—2·2
Lowest obs. temp. 3 ,,	33·2	36·1	37·4	46·0	50·0	33·2	33·1	34·6	35·4	46·2	46·4	33·1	—0·1
,, ,, 12 ,,	35·8	39·5	40·9	46·8	50·5	35·8	34·6	37·1	37·1	45·5	46·9	34·6	—1·2
,, ,, 22 ,,	37·2	40·2	41·8	46·2	51·9	37·2	36·6	38·9	39·0	44·0	47·0	36·6	—0·6
Mean temp. . . 3 ,,	36·3	40·2	43·8	53·4	54·7	45·7	35·3	38·1	42·1	51·8	51·5	43·8	—1·9
,, ,, . . 12 ,,	37·7	41·1	44·2	52·0	54·4	45·9	36·6	38·7	41·7	50·9	50·9	43·8	—2·1
,, ,, . . 22 ,,	38·9	41·6	44·0	50·7	53·9	45·8	37·8	39·6	41·8	49·9	49·9	43·8	—2·0
WINDS.													
N., ...	2	1	2	2	1	8	2	1	2	2	1	8	
N.E., ...	1	11	4	1	0	17	1	11	4	1	0	17	
E., ...	7	4	8	2	3	24	7	4	8	2	3	24	
S.E., ...	2	11	4	1	0	18	2	11	4	1	0	18	
S., ...	11	0	3	2	5	21	11	0	3	2	5	21	
S.W., ...	3	2	3	5	8	21	3	2	3	5	8	21	
W., ...	5	1	6	4	12	28	5	1	6	4	12	28	
N.W., ...	0	0	1	2	0	3	0	0	1	2	0	3	
Calms and var., . . .	0	0	0	2	2	4	0	0	0	2	2	4	

In the last column of Table II. are given the differences between the various temperatures observed at the exposed and shaded stations respectively, the sign "minus" indicating that the temperature at the shaded station was the lower of the two, and the sign "plus," that it was the higher. The most important of these results are those which refer to the mean temperatures of the soil, from which it appears that the soil under shade was for the period 1°·9 colder than that fully exposed to the rays of the sun at a depth of 3 inches, 2°·1 at 12 inches, and 2°·0 at 22 inches. The differences for each of the months are as follows:

	March.	April.	May.	June.	July.	Mean.
Depth of 3 inches, . .	1°·0	2°·1	1°·7	1°·6	3°·2	1°·9
,, 12 ,, . .	1·1	2·4	2·5	1·1	3·5	2·1
,, 22 ,, . .	1·1	2·0	2·2	0·8	4·0	2·0

It is evident from the figures for the different months that caution is necessary in deducing any general conclusions from the results obtained during such very exceptional weather as prevailed from March to July 1877, which, for the earlier portion of the period, had a temperature much under the average, and was characterised throughout by a great want of sunshine. This, however, is plain, that soil, closely shaded by trees from the sun, has a temperature greatly lower than soil exposed to the sun; and looking at the results in the light of the observations now being made at Forest Stations in Germany, the deficiency in the temperature of the soil shaded by trees is greatest in the summer months. During July 1877 we have seen that the temperature of the soil in shade was about 4°·0 lower than that of the soil exposed to the sun, the distance between the two places where this great difference obtained being only 30 yards. Particular attention will be paid to this point in the discussion of next year's observations, together with the influence of extreme temperatures, great changes of temperature, and changes of weather from clear to clouded, wet to dry, and *vice versâ*. The whole question with regard to the lowering of the underground temperature, according to the degree in which it may be screened from the sun's rays, is a vital one as affecting certain departments of practical arboriculture, such as the thinning trees, as was pointed out by Mr M'Corquodale at the meeting. In all probability this lowering of the temperature of soil shaded by trees extends as far down at least as the roots of the trees penetrate, the degree at considerable depths to which the temperature is lowered being equal to the mean annual difference between the underground thermometers in exposed and shaded soils.

As regards the air, the mean temperature deduced from the maximum and minimum thermometers at the exposed station was 45°·3, and at the shaded station 44°·9; and the mean temperature, as deduced from the dry bulb thermometers at 9 A.M. and 9 P.M. at the exposed station was 45°·2, and at the shaded station 44°·9. The results, as determined by these two methods, closely agree, and they give a mean temperature of the air about half a degree lower under the shade of the trees than outside that shade. It is probable that further in the wood, at places to which the wind has little access, the lowering of the temperature of the air would have exceeded half a degree, but additional observations would be required to show this point, which has important bearings on the question of the influence of forests on climate.

XXXI. *On Tree Measurements.**

Sir R. Christison suggested that the members of the Society might with great advantage undertake a systematic series of observations on tree measurements, with the view of obtaining a more trustworthy estimate, than is now accessible, of the rate and limit of growth, under various circumstances of soil, elevation, exposure, etc., of the principal species of forest trees cultivated in Scotland. His attention had been turned to the want of information on this subject in the course of an inquiry which he had from time to time attempted, to test the validity of De Candolle's theorem as to the growth of trees; which, that eminent authority maintains, increase the radius of their trunk after the first forty or fifty years, with great uniformity, if measured by decades instead of annually, so long as they flourish, even for several centuries. Repeated opportunities of examining the trunk sections of old trees grown in Scotland and in Canada prove that De Candolle's theorem is totally inapplicable to the forest trees of this country and those of North America, and indeed render this very convenient theorem extremely doubtful anywhere except in rare exceptions. In all instances yet examined the width of the annual layers of wood was found to decrease materially at intervals, till at last it was sometimes reduced to a third, or even a fourth only, of the width at the fortieth or fiftieth year, though the wood was everywhere sound, and the trees ascertained in some cases to have been healthy and vigorous to appearance before being cut down.

Desiring to obtain other information from the ascertained rate of increase in girth of living trees in a given time, it appeared that very little information of the kind now exists, and that which is available is untrustworthy, owing to the loose irregular way in which the measurements have been taken. But for this neglect of method, the extensive set of measurements of forest trees, collected by the Highland Society in 1867, might now furnish valuable results by comparative measurements. A few data are available for the purpose. But by far the greater number are useless, because the measurements have been taken in their instances too low, or at irregular heights from the ground, or without

* Remarks made by Sir Robert Christison, Bart., at the Annual General Meeting, 6th November 1877.

mention being made whether the place of measurement was free from the fallacy arising from the conoidal base of large trees on the one hand, or the swelling on the other hand below the giving off of the first great branches. It is plain, for example, that if a tree be measured at 3 feet from the ground, just above its basal swelling, a measurement, say twenty years later, at the same height, when the upper end of the swelling may have attained the height of 4 or even 5 feet, will give a very exaggerated account of the growth, in the same period of time, of all the comparatively cylindrical part of the trunk above. To avoid this source of fallacy, it is well to record the measurements at 3, 4, 5, and 6 feet from the ground; but when only one measurement is taken, it should be at 5 feet—unless when the tree branches low, in which case the narrowest part of the trunk ought to be the place of comparative measurements. It is seldom that the summit of the conoidal swelling at the base rises higher than 5 feet, unless occasionally in trees of very great age. In the yew alone there is usually no basal enlargement as it attains great age. In all the old yews I have seen, and in every drawing but one, the girth at the ground at 200, 500, and even 1000 years, is not greater, but on the contrary rather less, than at any place higher up.

What seems to be wanted therefore is, the measurement of trees, young, middle-aged, and old, at 5 feet from the ground, except in the case of the yew, which may be taken at 1 foot only. Mention should also be made of the elevation to which the basal swelling reaches, and also at what height the swelling begins which supports the lowest considerable branches. It is certain that in the course of five years comparative measurements made under these conditions would yield important information, provided the soil, elevation above the sea, particular exposure or protection, and other circumstances known to affect tree life, be at the same time accurately recorded.

APPENDIX (A.)

Scottish Arboricultural Society.

PATRON.
HER MOST GRACIOUS MAJESTY THE QUEEN.

1.—ABSTRACT OF THE ANNUAL ACCOUNT for the Year 1874-75.

CHARGE.

I.	Balance from last account,				£4	19	$7\frac{1}{2}$
II.	Amount of arrears received,	£47	15	6			
	Amount of subscriptions for 1874-75 received,	124	15	6			
					172	11	0
III.	Sums received for Transactions, Life Membership, Compositions, and Donations,				46	19	6
IV.	Sum in deposit-receipt and interest thereon,				79	16	4
V.	Interest on Bank account,				0	9	6
					£304	16	0

DISCHARGE.

I.	Balance due to National Bank paid,	£13	18	2			
II.	Prizes paid in money,	19	10	0			
III.	Salary to Secretary,	25	0	0			
IV.	Sum allocated to Sinking Fund per deposit-receipt,	125	2	6			
V.	Accounts for advertisements, medals, printing, postages, and incidental expenses,	99	1	1			
VI.	Sum of subscription returned to Life Member,	0	10	6			
					283	2	3
	Balance at credit of Society,				£21	13	9
	Consisting of—						
	Balance at credit of Treasurer in National Bank,	£24	17	4			
	Deduct due to him per book,	3	3	7			
					21	13	9

EDINBURGH, 13*th October* 1875.—I have examined the account of Charge and Discharge between the Scottish Arboricultural Society and Mr George Crichton, their Treasurer, for the period from 1st November 1874 to 30th September 1875, and find the same accurately stated and sufficiently vouched. The Abstract shows a balance in Bank due to the Society of £24, 17s. 4d., and a balance due by the Society to the Treasurer of £3, 3s. 7d. The Sinking Fund now amounts to £125, 2s. 6d.

John Ord Mackenzie, *Auditor.*

2.—LIST OF MEMBERS.

Corrected to January 1876.

The Names of Members whose present Address is not known to the Secretary are printed in italics.

All Subscriptions are payable at the Annual General Meeting in November. Members whose Subscriptions are Two Years in Arrears are not entitled to receive the Transactions.

HONORARY MEMBERS.

Balfour, John Hutton, M.D., A.M., F.R.SS.L. and E., Professor of Medicine and Botany in the University of Edinburgh (also a *Life* Member by composition),—*President.*

Brandis, Dietrich, Ph.D., Inspector-General of Forests to the Government of India.

Bullen, Robert, Curator of the Botanic Garden, Glasgow.

Hutchison, Robert, F.R.S.E., of Carlowrie, Kirkliston.

Lawson, George, LL.D., Ph.D., Professor of Natural History and Chemistry, Dalhousie College, Halifax, Nova Scotia.

M'Corquodale, William, Forester and Wood Surveyor, Jeanie Bank, Perth.

M'Nab, James, F.B.S.E., Curator of the Royal Botanic Garden, Edinburgh.

LIFE MEMBERS.

Acland, Sir Thomas Dyke, Bart., M.P., of Killerton, Exeter.

Adam, The Right Hon. W. P., M.P., of Blairadam, Kinross-shire.

Barbour, George F., of Bonskeid, Pitlochry, Perthshire.

Bell, William, of Gribdae, Kirkcudbright.

Bertram, William, Ellengowan Villa, Newington, Edinburgh.

Bosanquet, Rev. G. H., Broom-y-Close Court, Llanwarne, Ross, Herefordshire.

Bruce, Hon. T. C., 24 Hill Street, Berkeley Square, London, W.

CLEGHORN, Hugh, M.D., F.R.S.E., of Stravithie, St Andrews, Fife.
CRAIG, William, M.D., C.M., F.R.S.E., 7 Lothian Road, Edinburgh.
CRAWFORD, William Stirling, of Milton, Glasgow.
DEWAR, Colonel A., of Vogrie, Ford, Dalkeith.
DUNCAN, Alexander, of Knossington Grange, Oakham, Leicestershire.
DUNCAN, James, of Benmore, Kilmun, Greenock.
DUNDAS, Robert, of Arniston, Gorebridge.
FISH, D. T., Hardwick, Bury St Edmunds.
FITZWILLIAM, The Right Hon. the Earl, K.G., Wentworth, Rotherham, Yorkshire.
GORDON, John, of Cluny Castle, Aberdeenshire.
GOUGH, William, Wood Manager, Wykeham, York.
GRANT, John, Forester, Bridge of Weir, Renfrewshire.
GRANTHAM, George, Barcombe Place, Lewes, Sussex.
GRIMMOND, Alexander D., of Glenericht, Blairgowrie.
HERBERT, H. A., of Muckross, Killarney.
HOPE, H. W., of Luffness, Drem.
HUTH, Louis, of Possingworth, Hawkhurst, Sussex.
HUTTON, James, Sub-Factor, Roy Bridge, Kingussie.
INNES, James, of Wroxton, Banbury.
KINNEAR, William Balfour, Foo-Chow, China.
LESLIE, Charles P., of Castle-Leslie, Glasslough, Ireland.
LOVELACE, The Right Hon. the Earl of, East Horsley Towers, Woking Station, Surrey.
LUTTRELL, George F., of Dunster Castle, Dunster, Taunton, Somersetshire.
MACDONALD, Ronald, Factor, Cluny Castle, Aberdeenshire.
MACKENZIE, Colin J., of Portmore, Eddleston, Peebles.
M'GREGOR, John, Ladywell, Dunkeld, Perthshire.
M'Tier, Alexander Walker.
MAXWELL, Wellwood H., of Munches, Dalbeattie.
METHVEN, Thomas, Nursery and Seedsman, Edinburgh.
MINTO, The Right Hon. the Earl of, Minto House, Hawick.
MOORE, Thomas, F.L.S., Curator, Botanic Garden, Chelsea.
PORTSMOUTH, The Right Hon. the Earl of, Eggesford, North Devon.
RAMSDEN, Sir John, Bart., 6 Upper Brook Street, London, W.
RIDLEY, G., 2 Charles Street, Berkeley Square, London, W.
ROSEBERY, The Right Hon. the Earl of, Dalmeny Park, Edinburgh.
ROSSLYN, The Right Hon. the Earl of, Dysart House, Fife.
SADLER, John, F.R.P.S., Experimental Cottage, Edinburgh, *Secretary.*
STAIR, The Right Hon. the Earl of, Lochinch, Castle Kennedy, Wigtownshire.
TALBERT, Peter, Forester, Glenericht, Blairgowrie.
THOMSON, John Grant, Wood Manager, Grantown, Strathspey.
TROTTER, Colonel, R.A., The Bush, Edinburgh.
URQUHART, B. C., of Meldrum, Aberdeenshire.
WAVENEY, Lord, Flixton Hall, Bungay, Suffolk.
WEMYSS, Randolph Gordon Erskine, of Wemyss and Torry, Fife.
WILD, A. E., Assistant Conservator of Forests, Punjaub, India (6 George Street, Sheffield).
WILSON, John, F.R.S.E., Professor of Agriculture, University, Edinburgh.

ORDINARY MEMBERS.

ADIE, Alexander J., Rockville, Linlithgow.
AIRLIE, The Right Hon. the Earl of, Cortachy Castle, Forfarshire.
AITCHISON, William, Forester, Workington Hall, Cumberland.
Alder, Robert, Assistant Forester, Dunse Castle, Dunse.
ALEXANDER, James, Nursery and Seedsman, Edinburgh.
ALEXANDER, James, jun., 1 Waterloo Place, Edinburgh.
Alexander, John.
ALEXANDER, William, Ragmai Tea Estate, Upper Assam, India.
ALLAN, Andrew, Rankeillor, Cupar-Fife.
ALLAN, John, Forester, Dalmeny Park, Edinburgh.
ANDERSON, Alexander, Forester, St Fort, Newport, Dundee.
ANDERSON, Alexander, Forester, Hensol, Castle-Douglas.
ANDERSON, Alexander, Manager, Dennybane, Rathdrum, County Wicklow.
ANDERSON, Alexander, Gardener, Oxenford Castle, Dalkeith.
Anderson, Hugh, Assistant Forester, Hawkhead, Paisley.
Anderson, James, Bangholm Nursery, Edinburgh.
ANDERSON, James, Meadowbank, Uddingston.
ANDERSON, John, Nursery and Seedsman, Perth.
ANGUS, George, The Gardens, Kincardine Lodge, Torphins, Aberdeen.
ANNAND, Charles, Forester, Cromar Estates, Tarland, Aberdeenshire.
ANNANDALE, Robert Burns, The Gardens, Fonthill, Tisbury, Wilts.
ARCHER, James, Assistant Forester, Culzean Castle, Maybole.
ARCHER, John, Assistant Forester, Culzean Castle, Maybole.
ARCHIBALD, Thomas, Forester, 41 Channel Street, Galashiels.
ARNOTT, Alexander, Hedger, East Wemyss, Fife.
ASHDOWN, Samuel Harding, Land Agent, Uppington, Wellington, Salop.
AUSTIN & M'AUSLAN, Messrs, Nursery and Seedsmen, Glasgow.

Baigrie, Andrew, Forester, Mote Park, Ballymurry, County Roscommon.
BAINBRIDGE, C. M., of Dissington Hall, Newcastle-on-Tyne.
Baird, Joseph, Assistant Forester, Drumpellier, Coatbridge.
BALDEN, James, Forester, Lennoxlove, Haddington.
BALDEN, Joseph, Overseer, Houghton Estate, Preston.
BALDEN, Peter G., Forester, Vaenol Park, Bangor, North Wales.
BALDEN, William, Appleby Castle, Appleby.
BALLANTYNE & SON, Messrs John, Nursery and Seedsmen, Dalkeith.
BALLINGALL, Robert, Factor, Eallabus, Islay, by Greenock.
BARRIE, David, Forester, Herdhill, Kirriemuir.
BARRIE, James, Forester, Stevenstone House, Torrington, Devonshire.
Barter, Frederick, Assistant Gardener.
BARTON, James, Assistant Forester, Lynedoch, Perth.
BATY, David, Forester, Lowther Castle, Penrith.
BAXTER, Robert, Forester, Dalkeith Park, Dalkeith.
BAXTER, William, The Gardens, Riccarton, Currie.
BAYNE, Lewis, Forester, Kinmel Park, Abergele, North Wales.
BEGG, John, jun., Factor, Durris, Aberdeenshire.

BELL, James, Strathfieldsaye, Winchfield, Hants.
BELL, James, Forester, Newcastleton, Carlisle.
Bell, Robert, Assistant Forester, Dunse Castle, Dunse.
Bennett, Alexander, Forester.
BERRY, George, Longleat, Horningsham, Warminster, Wiltshire.
BIGGE, Matthew, Marsham Hatch, Ashford, Kent.
BIRCH, John, Assistant Gardener, Tinnchinch, Enniskerry, Co. Wicklow.
BIRNIE, John, Normanby Park, Brigg, Lincolnshire.
BISSETT, David, Land-Steward and Forester, Alva House, Stirling.
BISSETT, William S., Land-Steward and Forester, Moncrieffe House, Bridge of Earn, Perthshire.
BLACK, Robert, The Lawson Seed and Nursery Company, Edinburgh.
BOA, Andrew, Land-Steward, Dalton House, Newcastle-on-Tyne.
BOA, Andrew, jun., Land-Agent, Marton, Middlesboro'-on-Tees.
BOA, James S. M., Agent, Fettercairn, Fettercairn.
BORTHWICK, William, Forester, Dunnichen, Forfar.
Boston, Thomas C., Nurseryman, Liverpool.
BOTTOMER, Frederick, The Gardens, Mackree Castle, Ballisodare, Sligo.
BOYD, Alexander, Assistant Forester, Castle Grant, Grantown.
BOYD, J. B., of Cherrytrees, Yetholm, Kelso.
BRODIE, James, Land-Steward, Glasslough, Armagh, Ireland.
BROUGH, James, Assistant Forester, Cluny Castle, Aberdeen.
BROUGH, Robert, Forester, Durris, Aberdeen.
BROWN, Andrew, Assistant Forester, Portmore, Eddleston.
BROWN, J., Bretby, Burton-on-Trent.
BROWN, James, LL.D., Nurseryman and Wood-Surveyor, Easingwold, Yorkshire.
BROWN, James, Carnwath House, Carnwath.
BROWN, John E., Easingwold, Yorkshire.
Brown, William, Land Valuator and Estate Agent (N. America).
BROWN, William, Nursery and Seedsman, Stamford, Lincolnshire.
BROWN, Wishart, Carlowrie, Kirkliston.
BRUCE, T. R., of Slogarie, Lauriestown, Castle-Douglas.
BRYAN, F. G. D., Factor, Drumpellier, Coatbridge.
BRYDON, John, Forester, Somerford, Wolverhampton.
BUCHAN, Alexander, A.M., F.R.S.E., Secretary of the Scottish Meteorological Society, Edinburgh.
BUCHAN, George, Forester, Bakewell, Derbyshire.
BUCHANAN, Robert R., Forester, Dunse Castle, Dunse.
BURGESS, William, Assistant Forester, Drumpellier, Coatbridge.
Burnett, James, Assistant Forester, Durris, Aberdeenshire.

CAIRD, Jr., Alexander M'Neil, Factor, Benmore and Kilmun Estates, by Greenock.
Calder, Frederick, Farmer, Brucklay, Aberdeenshire.
CALLOGHIN, John, Assistant Forester, Houston, Paisley.
CAMERON, Alexander, Forester, Countlich Lodge, Ballinluig, Perthshire.
CAMERON, Angus, Assistant Forester, Altyre, Forres.
Cameron, Henry, Assistant Forester, Linkwood, Elgin.

Cameron, Hugh, Assistant Forester, Novar, Evanton, Ross-shire.
CAMERON, John, Assistant Forester, Fowlis Wester, Crieff, Perthshire.
CAMERON, Robert, Forester, Pale, Corwer, North Wales.
CAMPBELL, Alexander, Forester, Gray House, Liff, Dundee.
CAMPBELL, James, of Tillichewan Castle, Dumbartonshire.
CAMPBELL, John, Forester, Aboyne Castle, Aberdeenshire.
CAIRNDUFF, Andrew, Forester, Abbeyleix, Queen's County, Ireland.
CARLISLE, John, of 49 Hanover Street, Edinburgh.
CARMICHAEL, John, The Gardens, Glen Tulchan, The Cairnies, Perth.
Chambers, William, Haford, Aberystwith, Wales.
CHAPLAIN, George, Assistant Forester, Glamis Castle, Glamis, Forfarshire.
CHAPMAN, James, Assistant Forester, Grinkle Park, Saltburn-by-the-Sea, Yorkshire.
CHAPPLOW, John, Glencoin Cottage, Patterdale, Penrith.
CHRISTIE, A. D., Foreman, Heaton Park Gardens, Manchester.
CHRISTIE, David, Forester, Abington House, Lanarkshire.
CHURNSIDE, Francis, Forester, Ladykirk, Berwickshire.
CHURNSIDE, Robert, Forester, Edlingham, Alnwick.
CLARK, David, Forester, Elie House, Elie, Fife.
CLARK, George, Liberton, Edinburgh.
CLARK, J., Nursery and Seedsman, Messrs Fowler & Co., Glasgow.
CLARK, J., Forester to the Earl of Kintore, Keith Hall, Aberdeenshire.
CLARK, James, Forester, Balvaird Cottage, Strathmiglo, Fife.
CLARK, John, jun., Forester, Esslemont, Ellon, Aberdeenshire.
CLARK, Thomas, Beechwood Gardens, Bortly, Hants.
CLARK, William, Assistant Forester, Hawkhead, Paisley.
CLEETON, Edward, Curator, Albert Park, Middlesboro'.
CLEGHORN, William, Forester, Ayton Castle, Ayton.
CLERK, Sir George D., Bart., Penicuik House, Penicuik.
COBBAN, John, Wood Agent, Wentworth Woods, Rotherham.
COCKBURN, William, Forester, Willowbank, Penicuik.
COCKER, James, jun., Nursery and Seedsman, Aberdeen.
COOKES, Rev. W. H., Astley Rectory, near Stourport.
COOPER, George, Messrs Hurst & Son, Leadenhall Street, London.
CORBET, James, Forester, Underley Hall, Kirkby, Lonsdale, Westmoreland.
COWAN, James, Forester, Bridgend, Islay.
COWE, John, Luffness, Drem.
COWIE, John, Assistant Forester, Mount Stewart, Rothesay.
COWPER, R. W., Assistant Agent, 81 High Street, Sittingbourne.
CRABBE, David, Assistant Forester, Glamis Castle, Glamis.
CRABBE, James, Forester, Glamis Castle, Glamis, Forfarshire.
CRAIG, James, Bailiff, Weston, Shifnal, Salop.
CRAIG, Nathan, Cherry Cottage, Anowe Park, Birkenhead.
CRAIG, Richard, Forester and Gardener, Carlowrie, Kirkliston.
CRANSTON, Alexander, Assistant Forester, Linthaugh, Jedburgh.
CRANSTON, G. C. Trotter, of Harvieston, Gorebridge.
CRICHTON, George, 18 Princes Street, Edinburgh—*Treasurer*.
CROSBIE, John, Forester and Ground Officer, Ballindalloch Castle, Ballindalloch, Banffshire.

CROSS, David G., Forester, Kylisk, Nenagh, Ireland.
Cruickshanks, Robert, Forester, Ballykilcavan, Stradbally, Queen's County.
CUMMING, Alexander, Forester, Arndilly, Craigellachie.
CUMMING, Donald, Assistant Forester, Newbattle, Dalkeith.
CUNNINGHAM, D., The Gardens, Darnaway Castle, Forres.
CUNNINGHAM, John, Forester, Ardross Castle, Ross-shire.
CURRIE, James, of Halkerstone, Gorebridge.
CURRIE, John, Gardener, Salisbury Green, Edinburgh.
Cutler, D., Forester, Darnaway Castle, Forres.

DALGLEISH, John J., of Ardnamurchan, 8 Athole Crescent, Edinburgh.
DALRYMPLE, Charles, Forester, Mitchelstown Castle, Mallow, County Cork.
DANIELS, Peter, Forester, Slindon Hall, Arundel, Sussex.
DARIEN, James, Assistant Gardener, Erskine.
DARLING, John, Forester, St Martins, Perthshire.
DAVIDSON, George, Land-Steward, Carriden, Linlithgow.
DAVIDSON, James, Coonoor, Neilgherries, S. India.
DAVIDSON, John, Forester, Aldbar, Brechin.
DAVIDSON, John, Land and Wood Bailiff, Greenwich Hospital Estates, Haydan, Bridge-on-Tyne.
DAVIDSON, Richard, Scottish Colour Works, Leith.
DAVIDSON, W., Leager House, Chuseburn Grange, Newcastle-on-Tyne.
DAVIES, John, Forester, Garnstone Castle, Weobley, Herefordshire.
DAWSON, James, Forester, Kilmun, Argyleshire.
DEAN, Richard, Ealing, London.
DEMPSEY, Charles, Assistant Forester, Powerscourt, Enniskerry.
DICK, Joseph, Assistant Forester, Scone, Perth.
DICKSON, George, Stronvar, Lochearnhead.
DICKSON & SONS, Messrs James, Nursery and Seedsmen, Chester.
DICKSON & SONS, Messrs James, Nursery and Seedsmen, Edinburgh.
DICKSON, Thomas, Nursery and Seedsman, Chester.
DODDS, George, Overseer, Hawkhead, Paisley.
DON, John, Assistant Forester, Ardgowan, Greenock.
DONALDSON, William, Forester, Panmure, Carnoustie.
DOUGLAS, F., M.D., Woodside, Kelso.
DOW, Thomas, Forester, Idvies, Forfar.
DOWNIE & LAIRD, Messrs, Nursery and Seedsmen, Edinburgh.
DOYLE, James, Land-Steward, Heywood, Ballinakill, Queen's County.
DRUMMOND BROTHERS, Messrs, Nursery and Seedsmen, Edinburgh.
DRUMMOND & SONS, Messrs William, Nurserymen, Stirling.
DUFF, James, Factor, Blackwood, Lesmahagow.
DUFF, James, Freeland, Bridge of Earn, Perthshire.
DUFF, James, Wood Manager, Bayham Abbey, Tunbridge Wells.
DUGAN, Charles, Assistant Forester, Cally House, Gatehouse.
DUNCAN, Charles, of Woodend, Rothesay.
DUNCAN, James, Land-Steward, Glack, Old Meldrum.
DUNCAN, John, Forester, Blanepant, Llandyssil.
DUNCAN, Thomas, Assistant Forester, Meldrum House, Old Meldrum.
DUNCAN, William, Forester, Ardgowan, Greenock.

DUNLOP, Alexander, Factor, Luffness, Drem.
DUNN, David, The Gardens, Heaton Park, Manchester.
DUNN, Malcolm, The Palace Gardens, Dalkeith.
DURWARD, Robert, Manager, Blelack, Aberdeenshire.
DYKES, John, Nursery and Seedsman, Kilmarnock.
DYKES, Thomas, Factor, Maybole, Ayrshire.

Earnshaw, L., Forester.
EASTWOOD, James, The Gardens, Bryn-y-Newadd, Bangor, North Wales.
EDEN, The Hon. R. Henley, Estate Agent, The Coigne, Minchinghampton.
ELLIOT, Robert, Forester, Blairquhan, Maybole, Ayrshire.
EWING, David, Assistant Forester, Urie House, Stonehaven.

FERGUSON, A., Gossfield Hall, Hallstead, Essex.
FERGUSON, James, Forester, Belmore and Kilmun Estates, Greenock.
FERGUSON, John, Forest Department, Madras.
FERGUSON, Joseph, Assistant Forester, Lambton Park, Fence Houses.
FERNIE, Robert, Forester, Balcarres, Colinsburgh, Fife.
FETTES, Francis, Forester and Gardener, Forneth, Blairgowrie, Perthshire.
FINGLAND, J., Forester, Drumlanrig, Thornhill, Dumfriesshire.
FINLAY, James, Assistant Forester, Abernethy, Strathspey.
FINN, P. W., Forester, Borris House, Borris, County Carlow.
FISHER, William, Forester, Wentworth Castle, Barnsley, Yorkshire.
FLETCHER, Joseph, Superintendent of the Meadows, Edinburgh.
FORBES, Andrew, Forester, Stracathro, Brechin.
FORBES, William, Assistant Forester, Castlecary, Denny.
FORGAN, James, Gardener and Overseer, Bonskeid, Pitlochrie.
Forrest, William, Melfort Cottage, Lochgilphead.
FOULIS, Robert, M.D., Cairnie Lodge, Cupar-Fife.
FOULIS, Robert, Forester, Fordel, Inverkeithing, Fife.
FOWLER, Archibald, The Gardens, Castle Kennedy, Stranraer.
FRANCE, Charles, Nursery and Seedsman, Lanark.
FRANCE, C. S., Overseer, Penicuik House, Penicuik.
FRANCE, George, Overseer, Glenelg, Lochalsh.
FRANCE, James, Nursery and Seedsman, Lanark.
FRASER, Archibald, Forester, Skipness Castle, Tarbert, Greenock.
Fraser, Duncan, Forester.
FRASER, Hugh, Leith Walk Nurseries, Edinburgh.
FRASER, James, Forester, Cabairdy, Huntly.
FRASER, James, Assistant Forester, Drumpellier, Coatbridge.
FRASER, P. Neill, of Canonmills Lodge, Edinburgh.
FRASER, Simon, Forester, Haddo House, Aberdeenshire.
FRAZER, Thomas, Forester, Killarney House, County Kerry.
Freeman, Timothy.
FROST, Philip, Gardener, Dropmore, Maidenhead.

GALLOWAY, George, Park Hall, Oswestry, Shropshire.
GANDY, Captain George, Agent to the Marquis of Waterford, Curraghmore, Portlaw, Waterford.

Gardiner, James, Forester, Hawkstone Park, Salop.
Gardiner, R., Wenalt House, Crosswood, Aberystwith, South Wales.
Gardner, George, of Carrington Barns, Lasswade.
Gargan, James, Land-Steward, Kells, Moynally, County Meath, Ireland.
Garner, John, Assistant Gardener, Cantley Hall, Doncaster, Yorkshire.
Geikie, P. M., Factor, Cortachy, Kirriemuir.
Gerrish, Edward, Wood Overseer, Maiden Bradley, Bath.
Gibb, John, Assistant Forester, Dunse Castle, Dunse.
Gibson, William, Nursery and Seedsman, 14 Lower Ormond Quay, Dublin.
Gilbert, James, Forester, Ardverikie, Kingussie.
Gilchrist, Andrew, Forester, Urie House, Stonehaven.
Gilchrist, Daniel, Messrs Main & Co., 25 George IV. Bridge, Edinburgh.
Gilchrist, William, Forester, Cluny Castle, Aberdeen.
Goad, William Lewis, The Lawson Seed Company, 54 Bishopsgate Street Within, London.
Goodfellow, Andrew, Forester, Wolfelee, Hawick.
Goodier, George, Assistant Gardener.
Gordon, James, Forester, Rossdhu, Luss, Dumbartonshire.
Gordon, John, Forester, 17 Bon-Accord Street, Aberdeen.
Gorrie, Archibald, Forester, Holkham Hall, Holkham.
Gorrie, William, Rait Lodge, Trinity, Edinburgh.
Gossip, James, The Nurseries, Inverness.
Gow, James, Forester, Camperdown, Dundee.
Gow, John L., Factor, Raith, Kirkcaldy.
Gow, John, jun., Agent, Grinkle Park, Saltburn-by-the-Sea.
Gow, Peter, Assistant Forester, Lynedoch, Perth.
Gracie, Thomas, Assistant Forester, Drumpellier, Coatbridge.
Graham, Andrew, Agent, Ormesby House, near Middlesboro'.
Grandison, James, Assistant Forester, New Scone, Perth.
Grant, Colonel James A., C.B., C.S.I., 7 Park Square, Regent's Park, London.
Grant, Donald, Forester, Drumin, Ballindalloch.
Grant, Henry, Assistant Forester, Drumpellier, Coatbridge.
Grant, James, Assistant Forester, Abernethy, Strathspey.
Grant, James (Secundus), Assistant Forester, Abernethy, Strathspey.
Grant, John C., Manager, Eilan Shona Salen, Fort William.
Green, Alexander, Lanark Nurseries, Lanark.
Green, William, Assistant Forester, Charleston, Malmesbury, Wilts.
Greer, Robert, Assistant Forester, Ardgowan, Greenock.
Greig, Gavin, Forester, Parkhill, Aberdeen.
Grieve, George, Estate Office, Old Warden, Biggleswade, Bedfordshire.
Grieve, James, Messrs Dickson & Co., Nurseries, Leith Walk, Edinburgh.
Grigor, John, Nurseryman, Forres.
Guthrie, Colonel, Carlogie House, Carnoustie.

Hall, Peter, Forester, Huntly Lodge, Huntly.
Hamilton, David, Forester.
Hamilton, John B. Baillie, of Arnprior, Cambusmore, Callander.
Handasyde & Davidson, Messrs Thomas, Nurserymen, Musselburgh.

HARDIE, A., Manager, Monboddo, Fordoun.
HARDIE, Walter, The Hall, Norwell, Newark, Notts.
HARLEY, Andrew, Penybout, Radnorshire.
HARROLD, George, Gardener, Mount Henrie, Queen's County, Ireland.
HARROWER, William, Forester, Glenapp, Ballantrae, Ayrshire.
HART, Thomas, Assistant Forester, Yester, Haddington.
HARTLAND, Richard, The Lough Nurseries, Cork.
HAVELOCK, Thomas, Forester, Raby Park, Staindrop, County Durham.
HAVELOCK, William, Forester, Dilston, Corbridge, Newcastle-on-Tyne.
HAYMAN, John, jun., Overseer, Dumfries House, Old Cumnock.
HEALE, William, Great Western Nurseries, Glasgow.
HELMAN, George, Upton Nurseries, Chester.
HENDERSON, Alexander, The Gardens, Dalziel, Motherwell.
HENDERSON, Archibald, Forester, Clonad Cottage, Tullamore, King's County.
Henderson, John, Forester, Cardoness, Gate House, Kirkcudbrightshire.
HENDERSON, John, Overseer, Vogrie, Ford, Dalkeith.
HENDERSON, Robert, Assistant Forester, Dalmeny Park, Edinburgh.
HENDRY, David, The Knowefield Nurseries, Carlisle.
Hepburn, James, Forester.
HEPBURN, William, Assistant Forester, Altyre, Forres.
HERDMAN, Thomas, of Southside, Ford, Dalkeith.
HERMISTON, James, Assistant Forester, Floors Castle, Kelso.
HETHERTON, Walter, Forester, Heanton, Satchville, Bedworth, N. Devon.
HILL, John, Land-Steward, Whitehill, Lasswade.
HILSON, John, Assistant Forester, Floors Castle, Kelso.
HODD, William, Gardener, Glasslough, Armagh, Ireland.
HOGARTH, James, Forester, Duthill, Strathspey.
HOGG, Thomas, Forester, Hampton Court, Leominster, Hereford.
HOOD, James, Assistant Forester, Langlee, Jedburgh.
Home, Edward, Assistant Forester, Dunse Castle, Dunse.
HOME, George, Assistant Forester, Bellstane, Drumlanrig, Thornhill.
HORSBURGH, James, Forester, Yester, Haddington.
HOWIE, Charles, Eden Cottage, Largo, Fife.
HUBBARD, Egerton, M.P., of Addington Manor, Winslow, Bucks.
HUME, Andrew, Forester, Wansford, Peterborough.
HUNTER, Patrick, Forester, Gray Abbey, County Down.
HUSSEY, Samuel M., Estate Office, Tralee.
HUTTON, John Pears, 34 Princes Street, Edinburgh.

INNES, James, Assistant Forester, Lynedoch, Perth.
IRELAND, John, Seed Warehouse, 15 Princes Street, Edinburgh.

JACKSON, Magnus, Photographer, Marshall Place, Perth.
JEFFREY, John, of Balsusney, Kirkcaldy, Fife.
JEFFREY, John, Forester, Craighall, Blairgowrie.
JOHNSTON, George, The Gardens, Glamis Castle, Glamis.
Johnston, James.
JOHNSTON, William, Fencer, Lee, Lanark.
JOHNSTONE, Alexander, Assistant Forester, Arniston, Gorebridge.

JOHNSTONE, Alexander, Forester, Lee Castle, Lanark.
JOHNSTONE, William, Bangholm House, Ferry Road, Edinburgh.

KAY, James, Forester and Hedger, Bute Estate, Rothesay.
KEDZIE, Walter, Forester, Arundel Castle, Arundel, Sussex.
KEIR, David, Forester, Blair Athole, Perthshire.
KEMP, John, Assistant Forester, Midmar, Aberdeenshire.
KENMARE, The Right Hon. the Earl of, Killarney House, Killarney.
KENNEDY, Duncan, Assistant Forester, Underley, Kirby, Lonsdale.
KENNEDY, G. G. Allan, Forester, Moy, Forres.
KENNEDY, John, Forester and Ground Officer, Glen Urquhart, Drumnadrochit.
KENNEDY, William, Overseer, Carradale, Greenock.
KERR, William F., Wood Manager, Lindrish, Kingussie.
KIDD, James, Forester, Culzean Castle, Maybole, Ayrshire.
KINGHORN, Adam, Forester, Rochsoles, Airdrie.
KINGHORN, James, Assistant Forester, Dunse Castle, Dunse.

LAING, James, Assistant Forester, Penicuik House, Penicuik.
LAMBERTON, Hugh, Forester, Orwell Park, Bucklesham, Ipswich.
LAMONT, John, Inverleith Nurseries, Edinburgh.
LANDRETH, Burnet, of Bloomsdale, near Philadelphia, U.S.
LAUDER, William, Messrs Carr & Co., Timber Yard, Walker-on-Tyne.
LAURISTON, Alexander, Assistant Forester, Meldrum House, Old Meldrum.
LEGGAT, Alexander, Assistant Forester, Kebbaty, by Cluny.
LEIGH, William, of Woodchester Park, Stonehouse, Gloucestershire.
LEISHMAN, Richard, Forester, Muncaster Castle, Ravenglass, Cumberland.
Lemon, Thomas, The Gardens, Convamore, Ballyhooly, Ireland.
LENOX, William, Forester, Keir, Dunblane.
LESLIE, The Hon. George Waldegrave, Leslie House, Leslie, Fife.
LIDDELL, Rev. J. R., The Manse, Kirkliston.
LINGEN, Rev. C. N., Penlanole, Rhayader, Radnorshire.
LITTLE, Alexander, Forester, Relugas, Dunphail, Morayshire.
LORAINE, Edward, The Riding Mill, Northumberland.
LOTHIAN, The Most Hon. the Marquis of, Pinnelheugh House, Jedburgh.

M'AINSH, Robert, Forester, Castle Menzies, by Aberfeldy.
M'ALISTER, Alexander, Orchill House, Blackford.
MACBETH, J., Land-Steward, Stobhall, Perth.
M'CALLUM, James Thyne, Nursery and Seedsman, 60 Buchanan Street, Glasgow.
M'CALLUM, G. K., of Braco Castle, Braco.
M'COLL, James, Forester, Clifton Park, Kelso.
M'CORQUODALE, Donald, Forester, Dunrobin Castle, Golspie.
M'CORQUODALE, D. A., Assistant Factor, Panmure, Forfarshire.
M'CORQUODALE, William, Forester and General Wood Surveyor, Jeanie Bank, Perth.
M'CREATH, Hugh, Assistant Forester, Culzean, Maybole, Ayrshire.
M'CUTCHEON, Robert, Assistant Forester, Cawdor Castle, Nairn.
M'DONALD, Alexander, Forester, Balnagown, Ross-shire.

M'Donald, Charles, Superintendent, Phœnix Park, Dublin.
M'Donald, Donald, Assistant Forester.
M'Fadyen, Duncan, Forester, Dunmore, Stirling.
M'Grath, Patrick, Assistant Forester, Galtie Castle, Mitchelstown, County Tipperary.
M'Hardy, Charles, Forester, Castle Newe, Strathdon.
M'Hattie, John, Seedsman, Northgate, Chester.
M'Intosh, Angus, Forester.
Macintosh, Richard, Assistant Forester, Yester, Haddington.
Mackay, John, West Dean Estate, Chichester.
M'Kay, James, Forester, Whittinghame, Prestonkirk.
Mackay, John, 16 Caledonian Road, Edinburgh.
M'Kay, Thomas, Forester, Bowood Park, Calne, Wilts.
Mackenzie, Alexander, Warriston Nurseries, Edinburgh.
M'Kenzie, Donald F., Forester, Meldrum House, Aberdeenshire.
Mackenzie, James, 1 George IV. Bridge, Edinburgh.
Mackenzie, J. Ord, W.S., of Dolphinton, 7 Royal Circus, Edinburgh—*Auditor.*
Mackie, John, Assistant Forester, Ballogie, Aboyne.
Mackintosh, R. T., Nursery and Seedsman, Edinburgh.
M'Lagan, John, Forester, The Cairnies, Methven, Perthshire.
M'Laren, John, Ballencrieff, Drem.
M'Laren, John, Forester, Hopetoun House, South Queensferry.
M'Laren, John, Forester, Darnhall, Eddlestone, Peebles.
M'Laren, Peter, Forester, Lilleshall, Newport, Salop.
M'Laren, Peter, Wood Manager, Altyre Estates, Forres.
M'Lean, Andrew, Assistant Forester, Rutherford, Kelso.
M'Lean, John, Forester, Ashengrove, Swainston, Newport, Isle of Wight.
M'Lean, Malcolm, The Gardens, Gosford, Drem.
M'Lean, William, Forester, Eglinton Castle, Irvine.
M'Lellan, Duncan, Superintendent of Parks, Glasgow.
M'Leod, Alexander, Forester, Holkham Hall, Wells, Norfolk.
M'Leod, Angus, The Gardens, Newbattle Abbey, Dalkeith.
M'Leod, J., Nurseryman, Crieff, Perthshire.
M'Millan, Samuel, Assistant Forester, Dunse Castle, Dunse.
M'Nab, Malcolm, of 59 North Hanover Street, Edinburgh.
Macnaughton, Alexander, S.S.C., 10 Gloucester Place, Edinburgh.
M'Naughton, Archibald, Forester, Williamwood, Cathcart, Glasgow.
M'Neill, James, Forester, Abercairney, Crieff.
M'Neill, James, Forester.
M'Rae, John, Forester, Coplawhill Nursery, Glasgow.
M'Rae, Robert, Assistant Forester, Cullen House, Cullen.
M'Ritchie, T. E., W.S., 4 Gayfield Square, Edinburgh.
Main, John, Forester, Bryan Hall, Ferrybridge, Yorkshire.
Main & Co., Messrs A. & J., Wire Fence Manufacturers, 7 Renfield Street, Glasgow.
Maitland, Sir A. C. R., Bart., M.P., Clifton Hall, Ratho.
Maitland, William, Assistant Forester, Keith Hall, Aberdeenshire.
Malcolm, George, Bangholm Nursery, Edinburgh.

MANSON, Robert, The Nurseries, Kelso.
Manton, William, Assistant Forester, Dunse Castle, Dunse.
MARR, John, Assistant Forester, Darnaway Castle, Forres.
MARSHALL, J., Forester, Lambton Park, Fence Houses, Durham.
MARSHALL, James, Forester, Preston, Dunse.
MARSHALL, James, Assistant Forester, Scone, Perth.
MARSHALL, Robert, Forester, Horton Manor, near Epsom.
MARSHALL, Robert, Assistant Forester, Ardgowan, Greenock.
MARTIN, George, Forester, Dunecht Honse, Aberdeen.
MARTIN & SONS, Messrs, Nurserymen, Cottingham, Hull.
MATHIESON, Donald, Meikleour, Perth.
MAXTON, Robert, Forester, Strathallan Castle, Auchterarder.
Melrose, John, Wood Merchant.
MENZIES, George, Agent, Trenthem, Stoke-on-Trent.
MENZIES, William, Forester, Craigton Cottage, Causewayhead, by Stirling.
METHVEN, John, Nursery and Seedsman, Edinburgh.
MICHIE, Christopher Young, Forester, Cullen House, Cullen, Banffshire.
MICHIE, James, Forester, Wemyss Castle, Kirkcaldy.
MIDDLEMASS, Archibald, Forester, Dunans House, Colintraive, Greenock.
MILLER, John, Forester, Ochtertyre, Stirling.
MILLIGAN, James, S.S.C., 5 Royal Terrace, Edinburgh.
MILNE, James, Manager, Invereshie, Kingussie.
MILNE, James, Land-Steward, Kemnay, Aberdeen.
MITCHELL, David, Nurseryman, Edinburgh.
MITCHELL, Forbes, of Thainstone, Kintore.
MITCHELL, Garlies, Nurseryman, Stranraer.
MITCHELL, James, Aldie, Kinross.
MITCHELL, James, Forester, Knossington Grange, Oakham, Leicestershire.
MOFFAT, Adam, Forester, Hindlip Hall, Worcester.
MOFFAT, Henry, Forester, Monkray, Whitehaven, Cumberland.
MOFFAT, James, Forester, Newbattle Abbey, Dalkeith.
MOFFAT, John, Forester, Kimmerghame, Dunse.
MORGAN, Hugh, Wood Merchant, Crieff.
MORRISON, John, Coney Park Nursery, Stirling.
MORRISON, R., Nurseryman, Elgin,
MUIR, William, of Inistrynich, Inveraray, Argyleshire.
MUIRHEAD, John, Forester, Bicton, Budleigh, Salterton, Devonshire.
MUNRO, James, Forester, The Ark, Stanhope, Darlington.
MUNRO, James, Assistant Forester, Darnaway Castle, Forres.
MUNRO, John, Assistant Forester, Cluny Castle, Aberdeen.
MURDOCH, Robert, Assistant Forester, Elie House, Elie, Fifeshire.
MYLES, James, Overseer, Harburn, West Calder.

NEIL, Archibald, Forester, West Grange, Culross.
NEWBIGGING, Alexander T., Nurseryman, Dumfries.
NICOL, W. R., Forester, Loudoun Castle, Galston.
NICOL, William, Forester, Pitcaple, Aberdeenshire.
NICOLL, Alexander, The Gardens, Clova, Lumsden, Aberdeenshire.
NOTMAN, David, Nursery Foreman, Dean Park Nurseries, Edinburgh.

Ollier, John Clement, of Beauchamp House, Enfield, Middlesex.
Ormiston & Renwick, Messrs, Nursery and Seedsmen, Melrose.

Page, Andrew Duncan, Assistant Forester, Myregornie, Kirkcaldy.
Palmer & Son, Messrs John, Nurserymen, Annan.
Parker, James, Forester, Belvoir Castle, Grantham.
Parker, Robert A., Nursery and Seedsman, Lanark.
Paterson, Andrew, Surveyor, Exton, Oakham, Rutland.
Paterson, Charles, Factor, Castle Menzies, Aberfeldy, Perthshire.
Peebles, Andrew, Highclere Castle, Newbury, Berks.
Pender, John, M.P., 18 Arlington Street, London, S.W.
Pendreigh, John, Assistant Forester, Port Bannatyne, Rothesay.
Philip, John, Wood Merchant, Bonnyrigg, Lasswade.
Pierson, Joshua, Forester, Old Shields, Airdrie.
Pirie, John, Forester, Blackhall, Aberdeenshire.
Platt, Major, Gorddinag, Langairfechan, near Bangor.
Powner, George, Forester, Willey Hall, Broseley, Shropshire.
Powner, Thomas, 6 Queen Street, Carmarthen, South Wales.
Preece, J., Forester, Garnstone Castle, Weobley, Hereford.
Pressley, D., Gardener, Knockmaroon, Chapelizod, Dublin.
Purves, Alexander Paterson, W.S., 102 George Street, Edinburgh.

Rait, James, Forester, Castle Forbes, Whitehouse, Aberdeen.
Rankine, Thomas, Nurseryman, Hamilton.
Rattray, Thomas, Forester, Westonbilt House, Tetbury, Gloucestershire.
Ravenscroft, Edward, *Farmer* Office, 13 Salisbury Square, Fleet Street, London.
Rawlence & Squarey, Messrs, Salisbury.
Rea, Archibald Henry, Assistant Forester, Urie House, Stonehaven.
Reid, George, Nursery and Seedsman, Aberdeen.
Reid, James, Assistant Forester, Dalkeith Park, Dalkeith.
Renton, James, Forester and Land-Steward, Cleghorn, Lanark.
Richardson, Adam, Assistant Forester, Arniston, Gorebridge.
Richardson, Alexander, Land-Steward, Arniston, Gorebridge.
Righy, William, Messrs King & Co., 45 Pall Mall, London.
Rintoul, Henry, The Gardens, Hawick Hall, Alnwick.
Ritchie, Walter, Forester, Doldowlod, Rhayader, Radnorshire.
Robertson, Alexander, Assistant Forester, Duthill, Carr Bridge.
Robertson, D., Albert Hotel, Hanover Street, Edinburgh.
Robertson, David, Estate Manager, Curraghmore, Portlaw, Waterford.
Robertson, George, Overseer, Plean, Bannockburn.
Robertson, George, jun., Assistant Forester, Thirlstane Castle, Lauder.
Robertson, James, Forester, Drummond Castle, Crieff.
Robertson, John, Skielton Abbey, Arklow.
Robertson, John, Forester, Minto House, Hawick.
Robertson, John, Assistant Forester, Dalmeny Park, Edinburgh.
Robertson, Robert, Forester, Markree Castle, Collooney, County Sligo.
Robertson, Peter, Gordon Castle, Fochabers, Morayshire.
Robertson, P. S., Nursery and Seedsman, Edinburgh.

ROBERTSON, William W., Forester, Blinkbonny, Earlston.
ROBSON, Alexander, Duchfour Woods, Lochend, Inverness.
ROBSON, David, Forester, Ashmore and Persie, Bridge of Cally, Blairgowrie.
ROBSON, John, Forester, Everleigh, Pewsey, Wilts.
ROBSON, Ralph, Nursery and Seedsman, Hexham.
RODGER, Hugh, Factor, Cleland, Motherwell.
ROSS, Archibald, Overseer, Skipton Castle, Skipton-in-Craven, Yorkshire.
ROSS, D., Forester, Letham, by Nairn.
RULE, John, Forester, Monymusk, Aberdeenshire.
RUSSELL, John, Craigie, Ayr.
RUSSELL, Robert, Forester, Mostyn, Holywell, North Wales.
RUST, Joseph, The Gardens, Eridge Castle, Tunbridge Wells, Kent.
RUTHERFORD, Andrew, Forester, Bowmont Forest, Kelso.
RUTHERFORD, James, Forester, Linthaugh, Jedburgh.
RUTHERFORD, James, Agent, Kirkleatham, Redcar, Yorkshire.
RUTHERFORD, John, Assistant Forester, Linthaugh, Jedburgh.
RUTHERFORD, Robert O., Manager, Leinster Estates, Athy, Ireland.
RUTHERFORD, Thomas, Hotfield, Ashford, Kent.

SAMSON, John, Forester, Abernethy, Strathspey.
SANDBACH, Henry R., Hafodunos, Abergele.
SANG, Edmund, Nursery and Seedsman, Kirkcaldy.
SCARTH, T. W., Land-Agent, Keverstone, Staindrop, Darlington.
SCOTT, Adam, Forester, Southwick Park, Fareham, Hants.
Scott, Andrew, Assistant Forester.
SCOTT, D., Wood Manager, Darnaway Castle, Forres.
SCOTT, David, Forester and Land-Steward, Broadford, Limerick.
Scott, John, Forester.
SCOTT, John W., Delgany, County Wicklow, Ireland.
SCOTT, Walter, Forester, Oxnam, Jedburgh.
SCRIMGEOR, James, Under Forester, Altyre, Forres.
SEATON, Allan, Assistant Forester, Curraghmore, Portlaw, Waterford.
SEDGWICK, A. O., of 38 High Street, Watford, Herts.
SERVICE, George, Assistant Forester, Dunse Castle, Dunse.
SERVICE, James, Assistant Forester, Dunse Castle, Dunse.
SERVICE, Robert, Assistant Forester, Dunse Castle, Dunse.
SHAND, James, Gardener, Meldrum House, Aberdeenshire.
SHANKS, John, Forester, Kildrummy Castle, by Mossat.
SHAW, William, The Gardens, Banff House, Alyth.
SIM, William, Nurseryman, Forres.
SIME, John, Timber Merchant, Rafford, Forres.
SIMPSON, J., Forester, Alloa Park, Alloa.
SIMPSON, Peter, Assistant Forester, Daughty Mill, Kirkcaldy.
SIMPSON, Thomas, Forester, Glenferness, Nairnshire.
SINTON, David, Assistant Forester, Charlton, Malmesbury, Wilts.
SINTON, James, Forester, Stourhead, Bath.
SINTON, John, Forester, Charlton, Malmesbury, Wilts.
SKELDON, John, Assistant Forester, Dunse Castle, Dunse.
SKIRVING, Archibald, Forester, Duncombe Park, Helmesley, York.

SKIRVING, John Finlay, Assistant Forester, Duncombe Park, Helemsley.
SKIRVING, William, Nursery and Seedsman, Liverpool.
SLATER, Andrew, Forester, Loftus, Saltburn-by-the-Sea, Yorkshire.
SLATER, Andrew, jun., Upton Nurseries, Chester.
Smart, A. H.
SMITH, A., Factor, Douglas Castle, Lanarkshire.
SMITH, G.B., Wire Fence Manufacturer, 56 West Regent St., Glasgow.
SMITH, James, The Gardens, Mentmore, Leighton-Buzzard, Buckinghamshire.
SMITH, John, Hansworth Nurseries, Sheffield.
SMITH, John Crombie, Assistant Forester, Drummond Castle, Crieff.
SMITH, Thomas, Nurseryman, Stranraer.
SMITH, W. Baxter, Messrs Little & Ballantyne, Nursery and Seedsmen, Carlisle.
SMITH & SIMMONS, Messrs, Nursery and Seedsmen, Howard St., Glasgow.
SMITH & SON, Messrs William, Nursery and Seedsmen, Aberdeen.
SMYTH, John B., Forester, Duff House, Banff.
SOLLY, Professor Edward, F.R.S., Park House, Sutton, Surrey.
Spence, Charles, Assistant Forester, Drumpellier, Coatbridge.
Stalker, Donald, Assistant Forester.
STAPYLTON, Major, Myton Hall, Borobridge, Yorkshire.
STARK, John, Assistant Forester, Woodhall, Airdrie.
STEELE, David, Forester, Skene House, Aberdeen.
Stephen, James, Forester, Dochfour, Inverness.
STEPHEN, John, jun., Assistant Forester, Cluny Castle, Aberdeen.
STEVENSON, Alexander, Forester, Cahir Estates, County Tipperary.
STEVENSON, David, Forester, Kelly, Wemyss Bay, Greenock.
STEVENSON, James, Forester, Cobham Park, Surrey.
STEWART, Alexander, Messrs Hill, Thomson, & Co., 45 Frederick St., Edinburgh.
STEWART, Alexander, Agent, Bodnaut Estate, Conway, N. Wales.
STEWART, D., Manager, Dalnavart, Aviemore.
Stewart, James, Assistant Forester, Drumpellier, Coatbridge.
STEWART, John, Forester, Tummel Ferry, Ballinluig, Perthshire.
STEWART, John, Forester, Woodneuk Cottage, Denny.
STEWART, John M., Assistant Forester, Yester, Haddington.
STEWART, William, Land-Steward, Dalhousie Castle, Lasswade.
STEWART, William, Nurseryman, Dundee.
STEWART, William, Assistant Forester, Underley Hall, Kirkby, Lonsdale.
STRANG, Alexander, Forester, Rendlesham Hall, Woodbridge, Suffolk.
STRANG, William, Assistant Forester, New Scone, Perth.
STUART, John, Forester, Castle Grant, Strathspey.
STUART, Lewis A. G., Forester, Galloway House, Garliestown, Wigtownshire.
Stuart, William, Forester.
STUART & MEIN, Messrs, Nurserymen, Kelso.
SUTTIE, James, Evington, Ashford, Kent.
SWAN, R. G., Auctioneer, Dunse.
SWINTON, A. Campbell, LL.D., F.R.S.E., of Kimmerghame, Dunse.
SYME, David, 1 George IV. Bridge, Edinburgh.

SYMON, John, Forester, Cawdor Castle, Nairn.
SYMON, Peter, Forester, Forres.

TAIT, David, Forester, Owston Park, Doncaster, Yorkshire.
TAIT, Walter, Seedsman, 45 Chapel Street, Dublin.
TAYLOR, David, Barskimming, Mauchline.
TAYLOR, George, Forester, Monymusk, Aberdeenshire.
TAYLOR, George, Nursery and Seedsman, Inverurie.
THOMSON, James, Assistant Forester, Penicuik House, Penicuik.
THOMSON, James Scott, Strathallan Castle, Auchterarder.
THOMSON, Lockhart, S.S.C., 22 Coates Crescent, Edinburgh.
THOMSON, Thomas, Forester, Gelston Castle, Castle-Douglas.
THORNTON, Thomas, Heatherside, Frimley, Surrey.
THOMLINSON, Wilson, Assistant Forester, Belvoir Castle, Grantham.
TIVENDALE, William, Forester, Houston, near Paisley.
TURNBULL, James, Nurseryman, Hawick.
TURNBULL, William, Assistant Forester, Bowmont Forest, Kelso.
TURNER, James, Assistant Gardener, Blithefield Hall, Rugeley, Staffordshire.
TWEEDIE, John, Forester, Dunglass, Cockburnspath, Berwickshire.

VEITCH, John, Nurseryman, Falkirk.
VEITCH, William, Hedger, Arniston, Gorebridge.

WADDINGTON, David, Crosshouse, Airdrie.
WADDS, Philip, Gardener, Moore Abbey, County Kildare.
WALKER, George, Forester, Balgonie, Markinch, Fife.
WALKER, William, Assistant Forester, Penicuik House, Penicuik.
WALL, G. Y., jun., Exchequer Office, Durham.
Wallace, Andrew, Assistant Forester, Drumpellier, Coatbridge.
WARD, James, Forester, Mains of Garton, Abernethy, Strathspey.
WATERER, Anthony, Nurseryman, Knaphill, Woking, Surrey.
WATERS, Denis, Forester, Kelburn Castle, Largs.
WATERSON, A., Wood Manager, Glenark Castle, Arklow, County Wicklow.
WATSON, John, Gardener, Stravithie, St Andrews.
WATSON, William, Assistant Forester, Peth, Longtown, Cumberland.
WATSON, W. J., Nursery and Seedsman, Newcastle-on-Tyne.
WATT, James, Messrs Little & Ballantyne, Nurserymen, Carlisle.
WATT, William, Forester, Nisbet House, Dunse.
WEBSTER, Angus D., Assistant Forester, Penicuik House, Penicuik.
WEBSTER, David, Golden Acre Cottage, Edinburgh.
WEBSTER, J., The Gardens, Gordon Castle, Fochabers.
WEBSTER, John Blaikie, Verner's Bridge, Moy, Ireland.
WELSH, Duncan, Gardener, Mount Merrion, Dublin.
WELSH, James, Nursery and Seedsman, Edinburgh.
WELSH, William M., Nursery and Seedsman, Edinburgh.
WEST, Charles Elis, Land-Steward, Cartoon, Maynooth.
WHILLIS, Alexander, Assistant Forester, Penicuik House, Penicuik.
WHITE, George, Seedsman, Paisley.
WHITEFORD, Robert, Assistant Hedger, Bute Estate, Rothesay.

WILKIE, Thomas, Forester, Invergarry, Fort-Augustus.
WILLIAMS, B. S., Paradise Nursery, Upper Holloway, London, N.
WILLIAMS, Robert, of Bodelwyddn, St Asaph, North Wales.
WILSON, John, Land-Steward and Forester, Borthwickbrae, Hawick.
WILSON, John, Forester, Greystoke Castle, Penrith.
WILSON, John, Forester, Auchendolly, Castle-Douglas.
WILSON, John, Assistant Forester, Arniston, Gorebridge.
WILSON, John, Forester, Sudbourn Hall, Wickham Market, Suffolk.
WILSON, Peter, Forester, Carnwath House, Carnwath.
WILSON, Robert, Farmer, Bathcarty, Clackmannan.
WILSON, Stephen, 132 Union Street, Aberdeen.
WILSON, Thomas, Royal Botanic Garden, Edinburgh.
WISHART, Edward, of Hermitage House, Laverock Bank Terrace, Trinity, Edinburgh.
WOOD, John, Gardener, Hatton Castle, Aberdeenshire.
Wylie, James, Assistant Forester, Douglaston, Milngavie, Glasgow.
WYLLIE, George, Estate Overseer, Ballogie, Aboyne.

YELLOWLEES, George, Wood Merchant, Selkirk.
YOUNG, James, of Durris, by Aberdeen.
YOUNG, John, Messrs Imrie & Son's Nurseries, Ayr.
YOUNG, William, Assistant Forester, Lennoxlove, Haddington.

3.—SUBJECTS OFFERED FOR COMPETITION DURING 1875–76.

I. For a full and complete account, from published descriptions (with authorities distinctly quoted), personal observation and experiment, of the history and present state of the cultivation in Great Britain and Ireland of *Cedrus Deodara*. (Special Medal, value Three Guineas, offered by Dr Cleghorn.)

II. For the best and approved Report on the most effectual and economical method of clearing ground intended for plantation from natural brushwood, such as whin, broom, and bramble; also the best mode of keeping down such undergrowths in plantations.

The reporter to state the cost per acre of clearing the ground previous to its being planted. (*A Medal.*)

III. For the best and approved Report on the most extensive, complete, and judiciously arranged Arboretum. (*A Medal.*)

The author must describe the positions as to soil, exposure, elevation, etc., of the respective species and varieties of trees reported on, and state their ages, treatment, cost, and mode of planting adopted.

IV. For the best and approved Essay on the present state and future prospects of Arboriculture in the county in which the competitor resides. *This is a standing subject.* (*A Medal.*)

V. For the best and approved Report on the Old and Remarkable Trees on the estate on which the competitor resides; correct measurements of the circumference of the trunks, at 1 foot and 5 feet from the ground, must be given; also height of tree, spread of branches, etc. Photographs are desirable. (*A Medal.*)

VI. For the best and approved Report on the Summer operations most beneficial to plantations and woodlands.

The Report to embrace such subjects as pruning, thinning, transplanting, draining, etc., with special reference to the effects produced by them while the trees are in full growth and leaf, compared with similar operations performed while nature is dormant. (*A Medal.*)

VII. For the best and approved Report on Plantation Enclosures, and their management, cost, and durability for various situations.

The Reporter will detail the various modes of protecting plantations, their comparative costs and expense of maintenance, whether live fences, palings, or walls. (*A Medal.*)

VIII. For the best and approved collection of Cones exhibited from and grown in the county in which the competitor resides. (*A Medal.*)

Each cone (or series of cones of one species) must be accompanied by a label giving the name of the species, the estate and county where produced, and the year grown. The Prize collection to become the property of the Society.

IX. For the best and approved collection of prepared sections of different kinds of Wood grown in the county in which the competitor resides. (*A Medal.*)

Each section must have a label attached, bearing the name of the wood and the estate and county where grown. The Prize collection to become the property of the Society.

X. For the best and approved series of Geological Specimens illustrating the different rocks and formations on which Forest Trees and Shrubs grow in the county in which the competitor resides. The specimens to be accompanied by a Report. (*A Medal.*)

The successful collection to be the property of the Society. Buteshire, having already been reported on, is excluded.

XI. For the best and approved Report on the distances apart at which Forest Trees, of different species, should be planted in different soils, altitudes, and situations. (*A Medal.*)

XII. For an approved Report on the Plantations of which the competitor is Forester. (*Three Medals.*) One to be awarded for the best Report from each of the countries—England, Scotland, and Ireland—and competition to be confined to each country respectively. Reporters must state the extent of plantations under their charge, the kind of timber grown, soil, situation, management, age, etc. *This is a standing subject.*

XIII. For an approved Report on the management of Forests in Germany, France, or other places on the Continent. (*A Medal.*)

Special reference to be made to any appliances or modes of culture and treatment not generally adopted in this country, but followed in such arboricultural schools as those of Nancy and Hanover, and elsewhere abroad. Foreigners are specially invited to compete.

XIV. For an approved Report on the different Ages at which the various sorts of Timber Trees usually grown in Scotland may be most profitably felled in different soils and situations. (*A Medal.*)

XV. For an approved Report on the Diseases most incidental to Forest Trees, including those that effect the roots as well as the bark, branches, and foliage. (*A Medal.*)

XVI. For an approved Report on the results obtained by experience of Seedlings of Coniferæ, being the produce of trees grown in Britain, as compared with plants obtained from foreign-ripened seed. (*A Medal.*)

XVII. For the best and approved Rustic Chair, designed and executed by the Competitor. (*A Medal.*)

XVIII. To any Member of the Society who shall send to the Secretary from abroad, cones or seeds of Forest Trees of new or rare species or varieties, capable of germination, and of thriving in this country. (*A Medal.*)

To be awarded when fifty of any sort, or fifty plants in all, have been successfully raised. These plants to be the property of the Society, and to be balloted for amongst Members intimating their desire to have them. The packages to be delivered free of cost to the Society at any British port.

XIX. For an approved Essay or Report on any subject connected with Arboriculture. (*A Medal.*)

XX. For any marked advantageous improvement on any of the Implements used in Forestry. (Models or Implements to be accompanied by a Report.) (*A Medal.*)

For conditions of Competition see Proceedings of the Twenty-second Annual General Meeting.

4.—ABSTRACT OF THE LAWS OF THE SCOTTISH ARBORICULTURAL SOCIETY, AS AMENDED TO NOVEMBER 1875.

I. The object of the Society shall be the promotion of the science of Arboriculture in all its branches, by periodical meetings of the Members for the reading of Papers; by offering Prizes for Essays and Reports on the Practical operations of Forestry, and publication of the same; and by such other means as may be found advisable.

II. The Society shall consist of the following classes of *Ordinary* Members: 1. Proprietors, Factors, Nurserymen, and others, paying an annual subscription of Half-a-Guinea; 2. Head-Foresters, and others, paying an annual subscription of Five Shillings; 3. Assistant Foresters, and others, paying an annual subscription of Three Shillings.

III. Any Member may become a *Life* Member by compounding for his annual subscriptions by a single payment—those of the First Class paying Five Guineas; and those of the Second and Third Classes, Three Guineas.

IV. The Society shall elect a limited number of *Honorary* Members—gentlemen who have acquired eminence in the Science of Arboriculture, or who are otherwise deemed worthy.

V. All annual subscriptions shall be payable in advance, at the Annual General Meeting in November.

VI. In addition to the annual subscriptions above stipulated, the Society shall receive, from those friendly to its objects, Donations of larger or smaller amount.

VII. A Candidate for admission into the Society must be recommended by at least one Member, and shall, on payment of his annual subscription, be immediately admitted a Member of the Society, subject to the revision of the first General Meeting thereafter. Any Member of the Society introducing a New Member shall be held responsible for the first year's subscription of such party.

VIII. The affairs of the Society shall be conducted by a President, five Vice-Presidents, Secretary, Treasurer, Auditor, and fifteen Councillors—these office-bearers to be elected from the *Life* and *Ordinary* Members annually at the General Meeting in November; the three Councillors at the top of the list to go out annually, but one to be eligible for re-election.

IX. A General Meeting of the Members shall be held on the first Wednesday of November annually, for the election of New Members, the appointment of Office-Bearers, awarding of Prizes, the reading of Papers, Discussion on selected subjects, etc.

JOHN SADLER,
Secretary.

5.—OFFICE-BEARERS for 1875-76.

PRESIDENT.

JOHN HUTTON BALFOUR, M.D., M.A., F.R.SS.L. and E., Professor of Medicine and Botany in the University of Edinburgh.

VICE-PRESIDENTS.

ROBERT HUTCHISON, F.R.S.E., of Carlowrie, Kirkliston.
JOHN GRANT THOMSON, Wood Manager, Grantown.
WILLIAM M'CORQUODALE, Forester and General Surveyor, Perth.
ROBERT DUNDAS of Arniston, Gorebridge.
HUGH CLEGHORN, M.D., F.R.S.E., of Stravithie, St Andrews.

COUNCIL.

JOHN M'GREGOR, Forester, Ladywell, Dunkeld.
ALEXANDER RICHARDSON, Land-Steward, Arniston, Gorebridge.
JAMES MOFFAT, Forester, Newbattle Abbey, Dalkeith.
JOHN ALLAN, Forester, Dalmeny Park, Edinburgh.
JAMES MICHIE, Forester, Wemyss Castle, Kirkcaldy.
THOMAS METHVEN, Nursery and Seedsman, Edinburgh.
CHARLES S. FRANCE, Overseer, Penicuik House, Penicuik.
D. SCOTT, Wood Manager, Darnaway Castle, Forres.
JOHN ANDERSON, Nursery and Seedsman, Perth.
P. S. ROBERTSON, Nursery and Seedsman, Edinburgh.
ROBERT BAXTER, Forester, Dalkeith Park, Dalkeith.
WILLIAM STEWART, Land-Steward, Dalhousie Castle, Lasswade.
JOHN M'LAREN, Forester, Hopetoun House, S. Queensferry.
WILLIAM GILCHRIST, Forester, Cluny Castle, Aberdeen.
MALCOLM DUNN, The Palace Gardens, Dalkeith.

JUDGES.

WILLIAM GORRIE (Convener), Rait Lodge, Trinity, Edinburgh.
ANDREW PEEBLES, Highclere Castle, Newbury, Berks.
PETER M'LAREN, Wood Manager, Altyre Estates, Forres.

COMMITTEE ON TRANSACTIONS.

The Secretary (J. SADLER), *Editor.*
Dr CLEGHORN, of Stravithie, St Andrews.
ROBERT HUTCHISON, of Carlowrie, Kirkliston.
WILLIAM GORRIE, Rait Lodge, Edinburgh.

SECRETARY.

JOHN SADLER, F.R.Ph.S., Lecturer on Botany in the Royal High School, and Assistant to the Professor of Medicine and Botany in the University of Edinburgh.

TREASURER.

GEORGE CRICHTON, of Messrs G. & M. Crichton, 18 Princes Street, Edinburgh.

AUDITOR.

JOHN ORD MACKENZIE, W.S., of Dolphinton.

APPENDIX (B.)

Scottish Arboricultural Society.

6.—ABSTRACT OF THE ANNUAL ACCOUNT for the Year 1875-76.

CHARGE.

Amount of arrears received,	£16	14	0			
Subscriptions for the year 1875-76 received,	138	1	0			
				154	15	0
Advertisements, sale of Transactions, etc., received,				10	8	6
Life Memberships and Donations received,				57	17	6
Received from Bank,				131	6	2
Balance due to Treasurer,				7	1	5½
				£361	8	7½

DISCHARGE.

Amount paid into Bank,	£160	11	10
Amount of Prizes paid in money,	17	5	0
Amount of salaries,	25	0	0
Amount of allocations to Sinking Fund,	63	1	0
Balance from last account,	3	3	7½
Amount paid for printing, advertisements, postages, etc.,	92	7	2
	£361	8	7½

EDINBURGH, 31*st Octobcr* 1876.—I have examined the account of Mr George Crichton, as Treasurer of the Scottish Arboricultural Society, for year to 1st November 1876, and find the same to be correctly stated and sufficiently vouched.

The funds of the Society at this date consist of—			
1. Sinking Fund deposited in National Bank of Scotland, ...	191	5	5
2. Balance at credit of Treasurer's account with ditto,	55	0	7
	£246	6	0
Less balance due to Treasurer, per account of Charge and Discharge, ...	7	1	5½
Total funds,	£239	4	6½

JOHN ORD MACKENZIE, *Auditor.*

7.—LIST OF MEMBERS.

Corrected to February 1877.

PATRON—HER MOST GRACIOUS MAJESTY THE QUEEN.

The Names of Members whose present Address is not known to the Secretary are printed in italics.

LAW V. Members in arrear shall not receive their Transactions while their Subscriptions remain unpaid; and any Member whose Annual Contribution to the Society has remained unpaid for three years shall cease to be a Member of the Society; and no such Member shall be eligible for re-election till he shall have paid up his arrears; and an annual list of those parties struck off the roll of Members from this cause shall be submitted and read by the Treasurer to the Annual General Meeting in November in each year.

HONORARY MEMBERS.

BALFOUR, John Hutton, M.D., A.M., F.R.SS.L. and E., Professor of Medicine and Botany in the University of Edinburgh (also a *Life* Member by composition).

BRANDIS, Dietrich, Ph.D., Inspector-General of Forests to the Government of India.

BULLEN, Robert, Curator of the Botanic Garden, Glasgow.

HUTCHISON, Robert, F.R.S.E., of Carlowrie, 29 Chester Street, Edinburgh.

LAWSON, George, LL.D., Ph.D., Professor of Natural History and Chemistry, Dalhousie College, Halifax, Nova Scotia.

M'CORQUODALE, William, Forester and Wood Surveyor, Jeanie Bank, Perth (also an *Ordinary Member*).

M'NAB, James, F.B.S.E., Curator of the Royal Botanic Garden, Edinburgh.

LIFE MEMBERS.

ACLAND, Sir Thomas Dyke, Bart., M.P., of Killerton, Exeter.
ADAM, The Right Hon. W. P., M.P., of Blairadam, Kinross-shire—*President.*
BARBOUR, George F., of Bonskeid, Pitlochrie, Perthshire.
BARRIE, James, Forester, Stevenstone, Torrington, Devon.
BELL, William, of Gribdae, Kirkcudbright.
BERTRAM, William, Ellengowan Villa, Newington, Edinburgh.
BOSANQUET, Rev. G. H., Broom-y-Close Court, Llanwarne, Ross, Herefordshire.
BRUCE, Hon. T. C., 24 Hill Street, Berkeley Square, London, W.
CHAMBRES, Philip Henry, of Llsmevichion, Rhyl, Denbighshire.
CLEGHORN, Hugh, M.D., F.R.S.E., of Stravithie, St Andrews, Fife.
COWAN, Charles W., younger of Logan House, Valleyfield, Penicuik.
CRAIG, William, M.D., C.M., F.R.S.E., 7 Lothian Road, Edinburgh.
CRAWFORD, William Stirling, of Milton, Glasgow.
DALGLEISH, Laurence, of Dalbeath, 8 Athole Crescent, Edinburgh.
DEWAR, Colonel A., of Vogrie, Ford, Dalkeith.
DUNCAN, Alexander, of Knossington Grange, Oakham, Leicestershire.
DUNCAN, James, of Benmore, Kilmun, Greenock.
DUNDAS, Robert, of Arniston, Gorebridge.
EDWARDS, William Peacock, W.S., 21 Hill Street, Edinburgh.
FISH, D. T., Hardwick, Bury St Edmunds.
FITZWILLIAM, The Right Hon. the Earl, K.G., Wentworth, Rotherham, Yorkshire.
FORBES, Arthur E., Wentworth, Rotherham.
GORDON, John, of Cluny Castle, Aberdeenshire.
GOUGH, William, Wood Manager, Wykeham, York.
GRANT, John, Overseer, Daldowie, Tollcross.
GRANTHAM, George, Barcombe Place, Lewes, Sussex.
GRIMMOND, Alexander D., of Glenericht, Blairgowrie.
HERBERT, H. A., of Muckross, Killarney.
HOPE, H. W., of Luffness, Drem.
HORNE, John, F.L.S., Director of the Royal Botanic Gardens, Mauritius.
HORSBURGH, John, Photographist and Portrait Painter, 131 Princes Street, Edinburgh.
HUBBARD, Egerton, M.P., of Addington Manor, Winslow, Bucks.
HUNTER, William F., of Hafton, Advocate, 1 Ainslie Place, Edinburgh.
HUTH, Louis, of Possingworth, Hawkhurst, Sussex.
HUTTON, James, Sub-Factor, Roy Bridge, Kingussie.
INNES, James, of Wroxton, Banbury.
KINNEAR, William Balfour, Foo-Chow, China.
LEICESTER, Right Hon. the Earl of, Holkham Hall, Wells, Norfolk.
LESLIE, Charles P., of Castle-Leslie, Glasslough, Ireland.
LOVELACE, The Right Hon. the Earl of, East Horsley Towers, Woking Station, Surrey.
LUTTRELL, George F., of Dunster Castle, Dunster, Taunton, Somersetshire.
MACDONALD, Ronald, Factor, Cluny Castle, Aberdeenshire.
M'DOUGALL, Captain J. W., jun., of Orchill, by Blackford.

MACKENZIE, Colin J., of Portmore, Eddleston, Peebles.
M'GREGOR, John, Ladywell, Dunkeld, Perthshire.
M'Tier, Alexander Walker.
MAXWELL, Wellwood H., of Munches, Dalbeattie.
METHVEN, Thomas, Nursery and Seedsman, Edinburgh.
MINTO, The Right Hon. the Earl of, Minto House, Hawick.
MOORE, Thomas, F.L.S., Curator, Botanic Garden, Chelsea.
PORTSMOUTH, The Right Hon. the Earl of, Eggesford, North Devon.
RAMSDEN, Sir John, Bart., 6 Upper Brook Street, London, W.
RIDLEY, G., 2 Charles Street, Berkeley Square, London, W.
RITCHIE, William, of Middleton House, Gorebridge, Edinburgh.
ROSEBERY, The Right Hon. the Earl of, Dalmeny Park, Edinburgh.
ROSSLYN, The Right Hon. the Earl of, Dysart House, Fife.
SADLER, John, F.R.P.S., Experimental Cottage, Edinburgh—*Secretary.*
STAIR, The Right Hon. the Earl of, Lochinch, Castle Kennedy, Wigtownshire.
TALBERT, Peter, Forester, Glenericht, Blairgowrie.
THOMSON, John Grant, Wood Manager, Grantown, Strathspey.
TROTTER, Colonel, R.A., The Bush, Edinburgh.
URQUHART, B. C., of Meldrum, Aberdeenshire.
WAVENEY, Lord, Flixton Hall, Bungay, Suffolk.
WELSH, James, Nursery and Seedsman, 1 Waterloo Place, Edinburgh.
WEMYSS, Randolph Gordon Erskine, of Wemyss and Torry, Fife.
WILD, A. E., Assistant Conservator of Forests, Punjaub, India (6 George Street, Sheffield).
WILSON, John, F.R.S.E., Professor of Agriculture, University, Edinburgh.

ORDINARY MEMBERS.

AIRLIE, The Right Hon. the Earl of, Cortachy Castle, Forfarshire.
ALEXANDER, James, Nursery and Seedsman, Edinburgh.
ALEXANDER, James, jun., 1 Waterloo Place, Edinburgh.
ALEXANDER, William (Ragmai Tea Estate, Upper Assam, India), 1 Waterloo Place, Edinburgh.
ALLAN, Andrew, Rankeillor, Cupar-Fife.
ALLAN, John, Forester, Dalmeny Park, Edinburgh.
ANDERSON, Alexander, Forester, St Fort, Newport, Dundee.
ANDERSON, Alexander, Forester, Hensol, Castle-Douglas.
ANDERSON, Alexander, Manager, Kilcooley Abbey, Thurlis, Co. Tipperary.
ANDERSON, Alexander, Gardener, Oxenford Castle, Dalkeith.
ANDERSON, James, Meadowbank, Uddingston.
ANDERSON, John, Nursery and Seedsman, Perth.
ANDREW, Alexander, Nurseryman, West Shaw Street Nursery, Kilmarnock.
ANGUS, George, The Gardens, Kincardine Lodge, Torphins, Aberdeen.
Annand, Charles, Forester, Cromar Estates, Tarland, Aberdeenshire.
ANNANDALE, Robert Burns, The Gardens, Fonthill, Tisbury, Wilts.
ARCHER, James, Overseer, Haldin House, Exeter.
ARCHER, John, Assistant Forester, Lindores House, Newburgh.
ARCHIBALD, Thomas, Forester, 41 Channel Street, Galashiels.

ASHDOWN, Samuel Harding, Land Agent, Uppington, Wellington, Salop.
AUSTIN & M'AUSLAN, Messrs, Nursery and Seedsmen, Glasgow.

BAIGRIE, Andrew, Forester, Echo Bank, Edinburgh.
BAINBRIDGE, C. M., of Dissington Hall, Newcastle-on-Tyne.
BALDEN, James, Forester, Lennoxlove, Haddington.
BALDEN, Peter G., Forester, Vaenol Park, Bangor, North Wales.
BALDEN, William, Appleby Castle, Appleby.
BALLANTYNE & SON, Messrs John, Nursery and Seedsmen, Dalkeith.
BALLINGALL, Robert, Factor, Eallabus, Islay, by Greenock.
BARRIE, David, Forester, Comlongan Castle, Annan.
BARTER, Frederick, Burraie Braes Tea Estate, Cachar, India.
BARTON, James, Assistant Forester, Lynedoch, Perth.
BATY, David, Forester, Lowther Castle, Penrith.
BAUCHOPE, Thomas, Land Surveyor, East Brucefield, West Calder.
BAXTER, Robert, Forester, Dalkeith Park, Dalkeith.
BAXTER, William, The Gardens, Riccarton, Currie.
BAYNE, Lewis, Forester, Kinmel Park, Abergele, North Wales.
BEGG, John, jun., Factor, Durris, Aberdeenshire.
BELL, James, Strathfieldsaye, Winchfield, Hants.
BELL, James, Forester, Newcastleton, Carlisle.
BENNETT, T. Oatley, jun., Land Agent, Bruton, Somerset.
BERRY, George, Longleat, Horningsham, Warminster, Wiltshire.
BERRY, Peter, Assistant Forester, Highclere Castle, Newbury, Berks.
BIGGE, Matthew, Marsham Hatch, Ashford, Kent.
BIRCH, John, The Gardens, Windlestone Hall, Ferry Hill, Durham.
BIRNIE, John, Normanby Park, Brigg, Lincolnshire.
BISSETT, Alexander, Overseer, Rednock, Stirling.
BISSETT, David, Land-Steward and Forester, Alva House, Stirling.
BISSETT, William S., Land-Steward and Forester, Moncrieffe House, Bridge of Earn, Perthshire.
BLACK, Robert, The Lawson Seed and Nursery Company, George IV. Bridge, Edinburgh.
BOA, Andrew, Estate Office, Marton Hall, Middlesboro'-on-Tees.
BOA, Andrew, jun., Land-Agent, Wykeham, York.
BOA, James S. M., Agent, Fettercairn, Fettercairn.
BOOTH, John, of Flottbeck Nurseries, Hamburg.
BORTHWICK, William, Forester, Dunnichen, Forfar.
BOTTOMER, Frederick, The Gardens, Mackree Castle, Ballisodare, Sligo.
BOYD, Alexander, Assistant Forester, Castle Grant, Grantown.
BOYD, J. B., of Cherrytrees, Yetholm, Kelso.
BRODIE, James, Land-Steward, Glasslough, Armagh, Ireland.
BROUGH, James, Assistant Forester, Mr Reid's Nursery, Aberdeen.
BROWN, Andrew, Assistant Forester, Portmore, Eddleston.
BROWN, J., Bretby, Burton-on-Trent.
BROWN, James, LL.D., Nurseryman and Wood-Surveyor, Easingwold, Yorkshire.
BROWN, James, Carnwath.
BROWN, John E., Easingwold, Yorkshire.

Brown, William, Land Valuator and Estate Agent (N. America).
BROWN, William, Nursery and Seedsman, Stamford, Lincolnshire.
BROWN, Wishart, Carlowrie, Kirkliston.
BRUCE, T. R., of Slogarie, Lauriestown, Castle-Douglas.
BRYAN, F. G. D., Factor, Drumpellier, Coatbridge.
BRYDON, John, Forester, Somerford, Wolverhampton.
BUCHAN, Alexander, A.M., F.R.S.E., Secretary of the Scottish Meteorological Society, Edinburgh.
BUCHAN, George, Forester, Bakewell, Derbyshire.
BUCHANAN, Robert R., Forester, Dunse Castle, Dunse.
BURGESS, William, Assistant Forester, Drumpellier, Coatbridge.

CAIRD, Jr., Alexander M'Neil, Factor, Benmore and Kilmun Estates, by Greenock.
CALLOGHIN, John, Assistant Forester, Houston, Paisley.
CAMERON, Alexander, Forester, Countlich Lodge, Ballinluig, Perthshire.
CAMERON, Angus, Assistant Forester, Altyre, Forres.
CAMERON, Donald, Assistant Forester, Duthill, Carr Bridge.
CAMERON, John, Assistant Forester, Fowlis Wester, Crieff, Perthshire.
CAMERON, Robert, Forester, Pale, Corwer, North Wales.
CAMPBELL, Alexander, Forester, Gray House, Liff, Dundee.
CAMPBELL, James, of Tillichewan Castle, Dumbartonshire.
CAMPBELL, John, Forester, Aboyne Castle, Aberdeenshire.
CAIRNDUFF, Andrew, Forester, Abbeyleix, Queen's County, Ireland.
CARLISLE, John, of 49 Hanover Street, Edinburgh.
CARMICHAEL, John, The Gardens, Glen Tulchan, The Cairnies, Perth.
CHAPLAIN, George, Assistant Forester, Glamis Castle, Glamis, Forfarshire.
CHAPMAN, James, Assistant Forester, Grinkle Park, Saltburn-by-the-Sea, Yorkshire.
CHAPPLOW, John, Glencoin Cottage, Patterdale, Penrith.
Christie, A. D., Foreman, Heaton Park Gardens, Manchester.
CHRISTIE, David, Forester, Abington House, Lanarkshire.
CHRISTISON, Sir Robert, Bart., M.D., D.C.L., 40 Moray Place, Edinburgh.
CHURNSIDE, Francis, Forester, Ladykirk, Berwickshire.
CHURNSIDE, Robert, Forester, Edlingham, Alnwick.
CLARK, David, Forester, Elie House, Elie, Fife.
Clark, George, Liberton, Edinburgh.
CLARK, J., Forester to the Earl of Kintore, Keith Hall, Aberdeenshire.
CLARK, James, Forester, Balvaird Cottage, Strathmiglo, Fife.
CLARK, John, jun., Forester, Esslemont, Ellon, Aberdeenshire.
CLARK, Thomas, Beechwood Gardens, Bortly, Hants.
CLARK, William, Assistant Forester, Hawkhead, Paisley.
CLEETON, Edward, Curator, Albert Park, Middlesboro'.
CLEGHORN, William, Forester, Ayton Castle, Ayton.
CLERK, Sir George D., Bart., Penicuik House, Penicuik.
COBBAN, John, Wood Agent, Wentworth Woods, Rotherham.
COCKBURN, William, Forester, Willowbank, Penicuik.
COCKER, James, jun., Nursery and Seedsman, Aberdeen.
COLQUHOUN, Major James, Ben Cruach House, Dumbartonshire.

COOKE, Lieutenant-Colonel B. Davies, of Colomendy, Mold, Flintshire.
COOKES, Rev. W. H., Astley Rectory, near Stourport.
COOPER, George, Messrs Hurst & Son, Leadenhall Street, London.
COOPER, James, 24 St Andrew Square, Edinburgh.
CORBET, James, Forester, Underley Hall, Kirkby, Lonsdale, Westmoreland.
COWAN, James, Forester, Bridgend, Islay.
COWE, John, Metropolitan Cemetery, Edinburgh.
COWIE, John, Assistant Forester, Mount Stewart, Rothesay.
COWPER, R. W., Assistant Agent, 81 High Street, Sittingbourne.
CRABBE, David, Assistant Forester, Glamis Castle, Glamis.
CRABBE, James, Forester, Glamis Castle, Glamis, Forfarshire.
CRAIG, James, Bailiff, Weston, Shifnal, Salop.
CRAIG, Nathan, Cherry Cottage, Anowe Park, Birkenhead.
CRAIG, Richard, Forester and Gardener, Carlowrie, Kirkliston,
CRANSTON, Alexander, Assistant Forester, Linthaugh, Jedburgh.
CRANSTON, G. C. Trotter, of Harvieston, Gorebridge.
CRAWFORD, Muir, of 6 Annandale Street, Edinburgh.
CRICHTON, George, 18 Princes Street, Edinburgh—*Treasurer.*
CROMB, James, Forester, Gowan Bank, Armadale.
CROSBIE, John, Forester and Ground Officer, Ballindalloch Castle, Ballindalloch, Banffshire.
CROSS, David G., Forester, Kylisk, Nenagh, Ireland.
CUMMING, Alexander, Forester, Huntly Lodge, Huntly.
CUMMING, Donald, Assistant Forester, Newbattle, Dalkeith.
CUNNINGHAM, D., The Gardens, Darnaway Castle, Forres.
CUNNINGHAM, John, Forester, Ardross, Alness, Ross-shire.
CURRIE, James, of Halkerstone, Gorebridge.
CURRIE, John, Gardener, Salisbury Green, Dalkeith Road, Edinburgh.

DALGLEISH, John J., of Ardnamurchan, 8 Athole Crescent, Edinburgh.
DALRYMPLE, Charles, Forester, Mitchelstown Castle, Mallow, County Cork.
DANIELS, Peter, Forester, Slindon Hall, Arundel, Sussex.
DARIEN, James, Assistant Gardener, Erskine, by Glasgow.
DARLING, John, Forester, St Martins, Perthshire.
DAVIDSON, George, Land-Steward, Carriden, Linlithgow.
DAVIDSON, James, Coonoor, Neilgherries, S. India.
DAVIDSON, John, Forester, Aldbar, Brechin.
DAVIDSON, John, Land and Wood Bailiff, Greenwich Hospital Estates, Haydan, Bridge-on-Tyne.
DAVIDSON, Richard, Scottish Colour Works, Leith.
DAVIDSON, W., Leager House, Chuseburn Grange, Newcastle-on-Tyne.
DAVIES, John, Forester, Garnstone Castle, Weobley, Herefordshire.
DAWSON, James, Forester, Kilmun, Argyleshire.
DEAN, Richard, Ealing, London.
DEMPSEY, Charles, Assistant Forester, Powerscourt, Enniskerry.
DICK, Joseph, Assistant Forester, Galloway House, Garlieston, Wigtownshire.
DICKSON, George, Stronvar, Lochearnhead.
DICKSON & SONS, Messrs James, Nursery and Seedsmen, Chester.

DICKSON & SONS, Messrs James, Nursery and Seedsmen, 32 Hanover Street, Edinburgh.
DICKSON, Thomas, Nursery and Seedsman, Chester.
DODDS, George, Overseer, Hawkhead, Paisley.
DON, John, Assistant Forester, Ardgowan, Greenock.
DONALDSON, William, Forester, Panmure, Carnoustie.
DOUGLAS, F., M.D., Woodside, Kelso.
DOW, Thomas, Forester, Idvies, Forfar.
DOWNIE & LAIRD, Messrs, Nursery and Seedsmen, 17*a* Frederick Street, Edinburgh.
DOYLE, James, Land-Steward, Heywood, Ballinakill, Queen's County.
DRUMMOND BROTHERS, Messrs, Nursery and Seedsmen, Edinburgh.
DRUMMOND & SONS, Messrs William, Nurserymen, Stirling.
DUFF, James, Factor, Blackwood, Lesmahagow.
DUFF, James, Freeland, Bridge of Earn, Perthshire.
DUFF, James, Wood Manager, Bayham Abbey, Tunbridge Wells.
DUGAN, Charles, Assistant Forester, Cally House, Gatehouse.
DUNCAN, Charles, of Woodend, Rothesay.
DUNCAN, James, Land-Steward, Glack, Old Meldrum.
DUNCAN, John, Forester, Blanepant, Llandyssil.
DUNCAN, Thomas, Assistant Forester, Meldrum House, Old Meldrum.
DUNCAN, William, Forester, Ardgowan, Greenock.
DUNLOP, Alexander, Factor, Luffness, Drem.
DUNN, David, The Gardens, Heaton Park, Manchester.
DUNN, Malcolm, The Palace Gardens, Dalkeith.
DURWARD, Robert, Manager, Blelack, Aberdeenshire.
DYKES, Thomas, Factor, Maybole, Ayrshire.

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ELLIOT, Robert, Forester, Blairquhan, Maybole, Ayrshire.
EWING, David, Assistant Forester, Urie House, Stonehaven.

FERGUSON, A., Gossfield Hall, Hallstead, Essex.
FERGUSON, James, Forester, Barjarg Tower, Dumfries.
FERGUSON, John, Forest Department, Madras.
FERGUSON, Joseph, Assistant Forester, Lambton Park, Fence Houses.
FERNIE, Andrew, Assistant Forester, Logiealmond, Perth.
FERNIE, Robert, Forester, Balcarres, Colinsburgh, Fife.
FETTES, Francis, Forester and Gardener, Forneth, Blairgowrie, Perthshire.
FINGLAND, J., Forester, Drumlanrig, Thornhill, Dumfriesshire.
FINLAY, James, Forester, Quinish, Tobermory, Isle of Mull.
FINN, P. W., Forester, Borris House, Borris, County Carlow.
FISHER, William, Forester, Wentworth Castle, Barnsley, Yorkshire.
FISKIN, Alexander, Assistant Forester, Rossdhu, Dumbartonshire.
Fletcher, Joseph, Superintendent of the Meadows, Edinburgh.
FORBES, Andrew, Forester, Stracathro, Brechin.
FORBES, William, Assistant Forester, Castlecary, Denny.

FORGAN, James, Gardener and Overseer, Bonskeid, Pitlochrie.
FOULIS, Robert, M.D., Cairnie Lodge, Cupar-Fife.
FOULIS, Robert, Forester, Fordel, Inverkeithing, Fife.
FOWLER, Archibald, The Gardens, Castle Kennedy, Stranraer.
FRANCE, Charles, Nursery and Seedsman, Lanark.
FRANCE, C. S., Overseer, Penicuik House, Penicuik.
FRANCE, George, Overseer, Glenelg, Lochalsh.
FRANCE, James, Nursery and Seedsman, Lanark.
FRASER, Archibald, Forester, Skipness Castle, Tarbert, Greenock.
FRASER, Donald, Assistant Forester, Duthill, Carr Bridge.
FRASER, Hugh, Leith Walk Nurseries, Edinburgh.
FRASER, James, Forester, Cabairdy, Huntly.
FRASER, James, Forester, Drumpellier, Coatbridge.
FRASER, P. Neill, of Rockville, Edinburgh.
FRASER, Simon, Forester, Haddo House, Aberdeenshire.
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FROST, Philip, Gardener, Dropmore, Maidenhead.

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GARDNER, George, of Carrington Barns, Lasswade.
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GARNER, John, Assistant Gardener, Cantley Hall, Doncaster, Yorkshire.
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Grant, James, Forester, Cliffe Hall, Piercebridge, Yorkshire.
Grant, John C., Manager, Eilan Shona Salen, Fort William.
Green, Alexander, Lanark Nurseries, Lanark.
Green, William, Assistant Forester, Charleston, Malmesbury, Wilts.
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M'DONALD, Charles, Helton, Skipton, Yorkshire.
M'FADYEN, Duncan, Forester, Dunmore, Stirling.
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M'GREGOR, Alexander, Assistant Forester, Darnaway, Forres.
M'GREGOR, Robert, Forester, Booth Hall, Knutsford, Cheshire.
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M'HATTIE, John, Seedsman, Northgate, Chester.
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MARSHALL, James, Forester, Preston, Dunse.
MARSHALL, James, Assistant Forester, Scone, Perth.
MARSHALL, Robert, Forester, Horton Manor, near Epsom.
MARSHALL, Robert, Assistant Forester, Ardgowan, Greenock.
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Mitchell, James, Forester, Knossington Grange, Oakham, Leicestershire.
Mitchell, John, Assistant Forester, Logiealmond, Perth.
Moffat, Adam, Forester, Hindlip Hall, Worcester.
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SMITH, A., Factor, Douglas Castle, Lanarkshire.
SMITH, G. B., Wire Fence Manufacturer, 56 West Regent Street, Glasgow.
SMITH, James, The Gardens, Mentmore, Leighton-Buzzard, Buckinghamshire.
SMITH, John, Hansworth Nurseries, Sheffield.
SMITH, John Crombie, Assistant Forester, Drummond Castle, Crieff.
SMITH, Thomas, Nursery and Seedsman, Stranraer.
SMITH, W. Baxter, Messrs Little & Ballantyne, Nursery and Seedsmen, Carlisle.
SMITH & SIMMONS, Messrs, Nursery and Seedsmen, Howard Street, Glasgow.
SMITH & SON, Messrs William, Nursery and Seedsmen, Aberdeen.
SMYTH, John B., Forester, Duff House, Banff.
SOLLY, Professor Edward, F.R.S., Park House, Sutton, Surrey.
STAPYLTON, Major, Myton Hall, Borobridge, Yorkshire.
STARK, John, Assistant Forester, Woodhall, Airdrie.
STEELE, David, Forester, Skene House, Aberdeen.
STEPHEN, John, jun., Assistant Forester, Cluny Castle, Aberdeen.
STEVENSON, Alexander, Forester, Oldstead, Oswaldkirk.
STEVENSON, David, Forester, Kelly, Wemyss Bay, Greenock.
STEVENSON, James, Forester, Cobham Park, Surrey.
STEWART, Alexander, Messrs Hill, Thomson, & Co., 45 Frederick Street, Edinburgh.
STEWART, Alexander, Agent, Bodnaut Estate, Conway, N. Wales.
STEWART, Andrew, of Lunkart, by Keith.
STEWART, D., Manager, Dalnavart, Aviemore.
STEWART, John, Forester, Tummel Ferry, Ballinluig, Perthshire.
STEWART, John, Forester, Woodneuk Cottage, Denny.
STEWART, John M., Assistant Forester, Yester, Haddington.
STEWART, Robert, Assistant Forester, Ardgowan, Greenock.
STEWART, William, Land-Steward, Dalhousie Castle, Lasswade.
STEWART, William, Nurseryman, Dundee.
STEWART, William, Assistant Forester, Underley Hall, Kirkby, Lonsdale.
STIRLING, John, Forester, Garth House, Aberfeldy.
STRANG, Alexander, Forester, Rendlesham Hall, Woodbridge, Suffolk.
STRANG, William, Assistant Forester, New Scone, Perth.
STUART, Charles, Assistant Forester, Abernethy, Strathspey.
STUART, John, Forester, Castle Grant, Grantown, Strathspey.
STUART, Lewis A. G., Forester, Galloway House, Garliestown, Wigtownshire.
STUART, William, Assistant Forester, Castle Grant, Grantown.
STUART & MEIN, Messrs, Nurserymen, Kelso.
STURROCK, David, Assistant Forester, Panmure, Carnoustie.
SUTTIE, James, Evington, Ashford, Kent.
SWAN, R. G., Auctioneer, Dunse.
SWINTON, A. Campbell, LL.D., F.R.S.E., of Kimmerghame, Dunse.
SYME, David, 1 George IV. Bridge, Edinburgh.
SYMON, John, Forester, Cawdor Castle, Nairn.
SYMON, Peter, Forester, Forres.

TAIT, David, Forester, Owston Park, Doncaster, Yorkshire.
TAIT, Walter, Seedsman, 45 Chapel Street, Dublin.

TAYLOR, Andrew, 6 South Clerk Street, Edinburgh.
TAYLOR, David, Barskimming, Mauchline.
TAYLOR, George, Forester, Monymusk, Aberdeenshire.
TAYLOR, George, Nursery and Seedsman, Inverurie.
THOMSON, David, of Messrs Ireland & Thomson, Nursery and Seedsmen, Waterloo Place, Edinburgh.
THOMSON, James, Assistant Forester, Penicuik House, Penicuik.
THOMSON, Lockhart, S.S.C., 20 Coates Crescent, Edinburgh.
THOMSON, Thomas, Forester, Gelston Castle, Castle-Douglas.
THORNTON, Thomas, Heatherside, Frimley, Surrey.
TOMLINSON, Wilson, Forester and Timber Valuator, Athlone, Ireland.
TIVENDALE, William, Wood Manager, Burn House, Galston, Ayrshire.
TURNBULL, James, Nurseryman, Hawick.
TURNBULL, William, Assistant Forester, Bowmont Forest, Kelso.
TURNER, James, Forester, Bonnington, Lanark.
TURNER, James, The Gardens, Brittas, Clonaslie, Queen's County, Ireland.
TWEEDIE, John, Forester, Dunglass, Cockburnspath, Berwickshire.

VEITCH, John, Nurseryman, Falkirk.
VEITCH, William, Hedger, Arniston, Gorebridge.

WADDINGTON, David, Crosshouse, Airdrie.
WADDS, Philip, Gardener, Moore Abbey, County Kildare.
WALKER, George, Forester, Balgonie, Markinch, Fife.
WALKER, William, Assistant Forester, Penicuik House, Penicuik.
WALL, G. Y., jun., Exchequer Office, Durham.
WARD, James, Overseer, Keith.
WATERER, Anthony, Nurseryman, Knaphill, Woking, Surrey.
WATERS, Denis, Forester, Kelburn Castle, Largs.
WATERSON, A., Wood Manager, Glenark Castle, Arklow, County Wicklow.
WATSON, John, Gardener, Stravithie, St Andrews.
WATSON, William, Forester, Milton Abbey, Blandford, Dorsetshire.
WATSON, W. J., Nursery and Seedsman, Newcastle-on-Tyne.
WATT, James, Messrs Little & Ballantyne, Nurserymen, Carlisle.
WATT, William, Forester, Nisbet House, Dunse.
WEBSTER, Angus D., Assistant Forester, Penicuik House, Penicuik.
WEBSTER, David, Golden Acre Cottage, Edinburgh.
WEBSTER, J., The Gardens, Gordon Castle, Fochabers.
WEBSTER, John Blaikie, Verner's Bridge, Moy, Ireland.
WELSH, Duncan, Gardener, Mount Merrion, Dublin.
WELSH, William M., Nursery and Seedsman, Edinburgh.
WEST, Major William Cornwallis, Ruthin Castle, Denbighshire.
WHITE, George, Seedsman, Paisley.
WHITEFORD, Robert, Assistant Hedger, Bute Estate, Rothesay.
WILKIE, Thomas, Forester, New Scone, Perth.
WILLIAMS, B. S., Paradise Nursery, Upper Holloway, London, N.
WILLIAMS, Robert, of Bodelwyddn, St Asaph, North Wales.
WILSON, John, Land-Steward and Forester, Borthwickbrae, Hawick.
WILSON, John, Forester, Greystoke Castle, Penrith.

Wilson, John, Forester, Auchendolly, Dalbeattie.
Wilson, John, Assistant Forester, Arniston, Gorebridge.
Wilson, John, Forester, Sudbourn Hall, Wickham Market, Suffolk.
Wilson, Peter, Forester, Carnwath House, Carnwath.
Wilson, Robert, Farmer, Bathcarty, Clackmannan.
Wilson, Stephen, 132 Union Street, Aberdeen.
Wilson, Thomas, Royal Botanic Garden, Edinburgh.
Wishart, Edward, of Hermitage House, Laverock Bank Terrace, Trinity, Edinburgh.
Wood, John, Gardener, Hutton Castle, Aberdeenshire.
Wylie, James, Assistant Forester, Douglaston, Milngavie, Glasgow.
Wyllie, George, Estate Overseer, Ballogie, Aboyne.

Young, James, of Durris, by Aberdeen.
Young, John, Messrs Imrie & Son's Nurseries, Ayr.
Young, William, Assistant Forester, Lennoxlove, Haddington.

8.—SUBJECTS OFFERED FOR COMPETITION DURING 1876-77.

Law X. The converted values of the Society's Premiums shall be: Gold Medal, Five Pounds; No. 1 Silver Medal, Three Pounds, or No. 2 Silver Medal and Two Pounds; No. 2 Silver Medal, Two Pounds; Bronze Medal, Ten Shillings.

I. For a full and complete account, from published descriptions (with authorities distinctly quoted), personal observation and experiment, of the history and present state of the cultivation in Great Britain and Ireland of *Cedrus Deodara* (*C. Libani*, and *C. atlantica*, all now classed at Kew as one species). (Special Medal, value Three Guineas, offered by Dr Cleghorn.)

II. For an approved Report on the most extensive, complete, and judiciously arranged Arboretum. (*A Medal.*)
The author must describe the positions as to soil, exposure, elevation, etc., of the respective species of varieties of trees reported on, and state their ages, treatment, cost, and mode of planting adopted.

III. For an approved Essay on the present state and future prospects of Arboriculture in the county in which the competitor resides. This is a standing subject. (*A Medal.*)

IV. For an approved Report on the Old and Remarkable Trees on the estate on which the competitor resides; correct measurements of the circumference of the trunks, at 1 foot and 5 feet from the ground, must be given; also height of tree, spread of branches, etc. Photographs are desirable. (*A Medal.*)

V. For an approved Report on the Summer operations most beneficial to plantations and woodlands.
The Report to embrace such subjects as pruning, thinning, transplanting, draining, etc., with special reference to the effects produced by them while the trees are in full growth and leaf, compared with similar operations performed while nature is dormant. (*A Medal.*)

VI. For an approved Report on Plantation Enclosures of any New Construction, and their management, cost, and durability for various situations.
The Reporter will detail the various modes of protecting plantations, their comparative costs and expense of maintenance, whether live fences, palings, or walls. (*A Medal.*)

VII. For the best and approved collection of Cones, ripened in Britain during 1875, 1876, and 1877. (*A Medal.*)

Each cone (or series of cones of one species) must be accompanied by a label giving the name of the species, the estate and county where produced, and the year grown. The Prize collection to become the property of the Society.

VIII. For the best and approved collection of Seeds of Forest Trees and Shrubs ripened in Britain. (*A Medal.*)

Each example of seeds to have a label, giving the name of the species, and where produced. The Prize collection to become the property of the Society.

IX. For the best and approved collection of prepared sections of different kinds of Wood grown in the county in which the competitor resides. (*A Medal.*)

Each section must have a label attached, bearing the name of the wood, the estate and county where grown. The Prize collection to become the property of the Society.

X. For the best and approved series of Geological Specimens illustrating the different rocks and formations on which Forest Trees and Shrubs grow in the county in which the competitor resides. The specimens to be accompanied by a Report. (*A Medal.*)

The successful collection to be the property of the Society. Buteshire, having already been reported on, is excluded.

XI. For an approved Report on the Plantations of which the competitor is Forester. (*Three Medals.*) One to be awarded for the best Report from each of the countries—England, Scotland, and Ireland—and competition to be confined to each country respectively. Reporters must state the extent of plantations under their charge, the kind of timber grown, soil, situation, management, age, etc. This is a standing subject.

XII. For an approved Report on the Forests of the United States of America. (*A Medal.*)

XIII. For an approved Report on the Forests of India. (*A Medal.*)

XIV. For an approved Report on the Forests of any of the British Colonies. (*A Medal.*)

XV. For an approved Report on the Management of Forests on the Continent of Europe. (*A Medal.*)

Special reference to be made to any appliances or modes of culture and treatment not generally adopted in this country, but followed in such Arboricultural schools as those of Nancy and Hanover, and elsewhere. Foreigners are specially invited to compete.

XVI. For an approved Report on the Diseases most incidental to Forest Trees, including those that affect the roots as well as the bark, branches, and foliage. (*A Medal.*)

XVII. For an approved Essay on the Natural History of *Adelgis laricis*, the Larch Bug. (*A Medal.*)

The Essay must include the injury done by the insect to larch, and suggest remedies.

XVIII. For an approved Report on the results obtained by experience of Seedlings of Coniferæ, being the produce of trees grown in Britain, as compared with plants obtained from foreign-ripened seed. (*A Medal.*)

XIX. For an approved Essay on the Best Methods for Seasoning Different Kinds of Timber. (*A Medal.*)

XX. For an approved Essay on the Best Methods of Rearing Timber Trees in Deer Forests for Shelter. (*A Medal.*)

XXI. For the best and approved Model of a Rustic Arbour or Summer-House, designed and executed by the Competitor. Model not to exceed three feet in height. (*A Medal.*)

XXII. To any Member of the Society who shall send to the Secretary from abroad, cones or seeds of Forest Trees of new or rare species or varieties, capable of germination, and of thriving in this country. (*A Medal.*)

To be awarded when fifty of any sort, or fifty plants in all, have been successfully raised. These plants to be the property of the Society, and to be balloted for amongst Members intimating their desire to have them. The packages to be delivered free of cost to the Society at any British port.

XXIII. For an approved Essay or Report on any subject connected with Arboriculture. (*A Medal.*)

XXIV. For any marked advantageous improvement on any of the Implements used in Forestry. (Models or Implements to be accompanied by a Report.) (*A Medal.*)

For Conditions of Competition see Proceedings of the Twenty-third Annual General Meeting.

9.—OFFICE-BEARERS for 1876-77.

PRESIDENT.

The Right Hon. W. P. ADAM, of Blairadam, M.P.

VICE-PRESIDENTS.

ROBERT HUTCHISON, F.R.S.E., of Carlowrie, Kirkliston.
JOHN GRANT THOMSON, Wood Manager, Grantown.
WILLIAM M'CORQUODALE, Forester and Wood Surveyor, Perth.
HUGH CLEGHORN, M.D., F.R.S.E., of Stravithy, St Andrews.
JOHN HUTTON BALFOUR, M.D., M.A., F.R.SS.L. and E., Regius Professor of Botany in the University of Edinburgh.

COUNCIL.

JOHN ALLEN, Forester, Dalmeny Park, Edinburgh.
JAMES MICHIE, Forester, Wemyss Castle, Kirkcaldy.
THOMAS METHVEN, Nursery and Seedsman, Edinburgh.
CHARLES S. FRANCE, Overseer, Penicuik House, Penicuik.
D. SCOTT, Wood Manager, Darnaway Castle, Forres.
JOHN ANDERSON, Nurseryman, Perth.
P. S. ROBERTSON, Nursery and Seedsman, Edinburgh.
ROBERT BAXTER, Forester, Dalkeith Park, Dalkeith.
WILLIAM STEWART, Land-Steward, Dalhousie Castle, Lasswade.
JOHN M'LAREN, Forester, Hopetoun House, S. Queensferry.
WILLIAM GILCHRIST, Forester, Cluny Castle, Aberdeen.
MALCOLM DUNN, The Palace Gardens, Dalkeith.
WILLIAM GORRIE, of Rait Lodge, Edinburgh.
JAMES ROBERTSON, Forester, Panmure, Carnoustie.
ALEXANDER RICHARDSON, Land-Steward, Arniston, Gorebridge.

JUDGES.

JOHN M'GREGOR (Convener), Forester, Ladywell, Dunkeld.
C. Y. MICHIE, Forester, Cullen House, Cullen.
ANDREW GILCHRIST, Forester, Urie House, Stonehaven.

COMMITTEE ON TRANSACTIONS.

The Secretary (J. SADLER), *Editor.*
Dr CLEGHORN, of Stravithy, St Andrews.
ROBERT HUTCHISON, of Carlowrie, Kirkliston.
WILLIAM GORRIE, of Rait Lodge, Edinburgh.

SECRETARY.

JOHN SADLER, F.R.Ph.S., Lecturer on Botany and Natural History in the Royal High School, and Assistant to the Regius Professor of Botany in the University of Edinburgh.

TREASURER.

GEORGE CRICHTON, of Messrs G. & M. Crichton, 18 Princes Street, Edinburgh.

AUDITOR.

JOHN ORD MACKENZIE, W.S., of Dolphinton, 9 Hill Street, Edinburgh.

APPENDIX (C.)

Scottish Arboricultural Society.

10.—ABSTRACT OF THE ANNUAL ACCOUNT for the Year 1876-77.

CHARGE.

Amount received in arrears,	£18	15	0
,, ,, in Subscriptions, 1876-77,	133	7	0
,, ,, for Transactions,	0	8	6
,, ,, for Advertisements,	6	0	0
,, ,, for Life Membership,	69	6	0
,, ,, in Donations,	0	10	6
Balance of Operations on Bank Account,	7	15	5
Balance to next Account,	0	6	5½
	£336	8	10½

DISCHARGE.

Amount of Prizes paid in money,	£16	0	0
,, of Salaries,	25	0	0
,, of Accounts paid,	83	0	2
,, of Allocation to Sinking Fund,	76	5	0
,, of Incidental Expenses and Balance of last Account,	36	3	8½
	£336	8	10½

EDINBURGH, 1*st November* 1877.—I have examined the account of Mr George Crichton, as Treasurer of the Scottish Arboricultural Society, for year to 1st November 1877, and find the same to be correctly stated and sufficiently vouched.

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The funds of the Society at this date consist of—

1. Sinking Fund deposited in National Bank of Scotland, ...	£271 11 6
2. Balance at credit of Treasurer's account with ditto, .	48 5 10
	£319 17 4
Less balance due to Treasurer, per account of Charge and Discharge, ...	0 6 5½
Total funds,	£319 10 10½

John Ord Mackenzie, *Auditor.*

11.—LIST OF MEMBERS.

Corrected to March 1878.

Patron—HER MOST GRACIOUS MAJESTY THE QUEEN.

The Names of Members whose present Address is not known to the Secretary are printed in italics.

Law V. Members in arrear shall not receive their *Transactions* while their Subscriptions remain unpaid; and any Member whose Annual Contribution to the Society has remained unpaid for three years shall cease to be a Member of the Society; and no such Member shall be eligible for re-election till he shall have paid up his arrears; and an annual list of those parties struck off the roll of Members from this cause shall be submitted and read by the Treasurer to the Annual General Meeting in November in each year.

HONORARY MEMBERS.

Balfour, John Hutton, M.D., A.M., F.R.SS.L. & E., Professor of Medicine and Botany in the University of Edinburgh (also a *Life* Member by composition).

Brandis, Dietrich, Ph.D., Inspector-General of Forests to the Government of India.

Bullen, Robert, Curator of the Botanic Garden, Glasgow.

Hutchison, Robert, F.R.S.E., of Carlowrie, 29 Chester Street, Edinburgh.

Lawson, George, LL.D., Ph.D., Professor of Natural History and Chemistry, Dalhousie College, Halifax, Nova Scotia.

M'Corquodale, William, Forester and Wood Surveyor, Jeanie Bank, Perth (also a *Life* Member by composition).

M'Nab, James, F.B.S.E., Curator of the Royal Botanic Garden, Edinburgh.

LIFE MEMBERS.

ACLAND, Sir Thomas Dyke, Bart., M.P., of Killerton, Exeter.
ADAM, The Right Hon. W. P., M.P., of Blairadam, Kinross-shire—*President.*
BARBOUR, George F., of Bonskeid, Pitlochrie, Perthshire.
BARRIE, James, Forester, Stevenstone, Torrington, Devon.
BELL, William, of Gribdae, Kirkcudbright.
BERTRAM, William, Ellengowan Villa, Newington, Edinburgh.
BOLCKOW, C. F. H., of Brackenhoe, Middlesbro'-on-Tees.
BOSANQUET, Rev. G. H., Broom-y-Close Court, Llanwarne, Ross, Herefordshire.
BRUCE, Hon. T. C., 24 Hill Street, Berkeley Square, London, W.
CHAMBRES, Philip Henry, of Llsmevichion, Rhyl, Denbighshire.
CLEGHORN, Hugh, M.D., F.R.S.E., of Stravithie, St Andrews, Fife.
CLERK, Sir George D., Bart., Penicuik House, Penicuik.
COWAN, Charles W., younger of Logan House, Valleyfield, Penicuik.
CRAIG, William, M.D., C.M., F.R.S.E., 7 Lothian Road, Edinburgh.
CRAWFORD, William Stirling, of Milton, Glasgow.
DALGLEISH, Laurence, of Dalbeath, 8 Athole Crescent, Edinburgh.
DEWAR, Colonel A., of Vogrie, Ford, Dalkeith.
DUNCAN, Alexander, of Knossington Grange, Oakham, Leicestershire.
DUNCAN, James, of Benmore, Kilmun, Greenock.
DUNDAS, Robert, of Arniston, Gorebridge.
EASTWOOD, James, The Gardens, Bryn-y-Newadd, Bangor, North Wales.
EDWARDS, William Peacock, W.S., 21 Hill Street, Edinburgh.
FISH, D. T., Hardwick, Bury St Edmunds.
FITZWILLIAM, The Right Hon. the Earl, K.G., Wentworth, Rotherham, Yorkshire.
FORBES, Arthur E., Wentworth, Rotherham.
FRANCE, Charles S., Overseer, Penicuik House, Penicuik.
GOUGH, William, Wood Manager, Wykeham, York.
GRANT, John, Overseer, Daldowie, Tollcross.
GRANTHAM, George, Barcombe Place, Lewes, Sussex.
GRIMMOND, Alexander D., of Glenericht, Blairgowrie.
HERBERT, H. A., of Muckross, Killarney.
HOPE, H. W., of Luffness, Drem.
HORNE, John, F.L.S., Director of the Royal Botanic Gardens, Mauritius.
HORSBURGH, John, Photographist and Portrait Painter, 131 Princes Street, Edinburgh.
HUBBARD, Egerton, M.P., of Addington Manor, Winslow, Bucks.
HUNTER, William F., of Hafton, Advocate, 1 Ainslie Place, Edinburgh.
HUTH, Louis, of Possingworth, Hawkhurst, Sussex.
HUTTON, James, Sub-Factor, Roy Bridge, Kingussie.
INNES, James, of Wroxton, Banbury.
JEFFREY, John, of Balsusney, Kirkcaldy, Fife.
LEICESTER, Right Hon. the Earl of, Holkham Hall, Wells, Norfolk.
LESLIE, Charles P., of Castle-Leslie, Glasslough, Ireland.

LOVELACE, The Right Hon. the Earl of, East Horsley Towers, Woking Station, Surrey.
LUTTRELL, George F., of Dunster Castle, Dunster, Taunton, Somersetshire.
MACDONALD, Ronald, Factor, Cluny Castle, Aberdeenshire.
M'DOUGALL, Captain J. W., jun., of Orchill, by Blackford.
MACKENZIE, Colin J., of Portmore, Eddleston, Peebles.
M'GREGOR, John, Ladywell, Dunkeld, Perthshire.
M'Tier, Alexander Walker.
MAXWELL, Wellwood H., of Munches, Dalbeattie.
METHVEN, Thomas, Nursery and Seedsman, Edinburgh.
MINTO, The Right Hon. the Earl of, Minto House, Hawick.
MOORE, Thomas, F.L.S., Curator, Botanic Garden, Chelsea.
PORTSMOUTH, The Right Hon. the Earl of, Eggesford, North Devon.
PUNCHARD, Frederick, Underley Estate Office, Kirkby Lonsdale, Westmoreland.
RAMSDEN, Sir John, Bart., 6 Upper Brook Street, London, W.
RIDLEY, G., 2 Charles Street, Berkeley Square, London, W.
RITCHIE, William, of Middleton, Gorebridge, Edinburgh.
ROSEBERY, The Right Hon. the Earl of, Dalmeny Park, Edinburgh.
ROSSLYN, The Right Hon. the Earl of, Dysart House, Fife.
RUTHERFORD, James, Agent, Kirkleatham, Redcar, Yorkshire.
RUTHERFORD, Thomas, Hotfield, Ashford, Kent.
SADLER, John, F.R.P.S., Experimental Cottage, Edinburgh—*Secretary.*
SMITH, Thomas Valentine, of Ardtornish, Morvern, Argyleshire (111 Grosvenor Road, London, S.W.).
STAIR, The Right Hon. the Earl of, Lochinch, Castle Kennedy, Wigtownshire.
TALBERT, Peter, Forester, Glenericht, Blairgowrie.
THOMSON, John Grant, Wood Manager, Grantown, Strathspey.
TROTTER, Colonel, R.A., The Bush, Edinburgh.
URQUHART, B. C., of Meldrum, Aberdeenshire.
WAVENEY, Lord, Flixton Hall, Bungay, Suffolk.
WELSH, James, Nursery and Seedsman, 1 Waterloo Place, Edinburgh.
WEMYSS, Randolph Gordon Erskine, of Wemyss and Torry, Fife.
WILD, A. E., Assistant Conservator of Forests, Punjaub, India (6 George Street, Sheffield).
WILSON, John, F.R.S.E., Professor of Agriculture, University, Edinburgh.

ORDINARY MEMBERS.

AIRLIE, The Right Hon. the Earl of, Cortachy Castle, Forfarshire.
ALEXANDER, James, Nursery and Seedsman, Edinburgh.
ALEXANDER, James, jun., 1 Waterloo Place, Edinburgh.
ALLAN, Andrew, Rankeillor, Cupar-Fife.
ALLAN, John, Forester, Dalmeny Park, Edinburgh.
ANDERSON, Alexander, Forester, St Fort, Newport, Dundee.
ANDERSON, Alexander, Forester, Hensol, Castle-Douglas.
ANDERSON, Alexander, Manager, Kilcooley Abbey, Thurlis, Co. Tipperary.
ANDERSON, Alexander, Gardener, Oxenford Castle, Dalkeith.

ANDERSON, James, Meadowbank, Uddingston.
ANDERSON, John, Nursery and Seedsman, Perth.
ANDREW, Alexander, Nurseryman, West Shaw Street Nursery, Kilmarnock.
ANGUS, George, The Gardens, Kincardine Lodge, Torphins, Aberdeen.
ANNANDALE, Robert Burns, The Gardens, Fonthill, Tisbury, Wilts.
ARCHER, James, Overseer, Haldon Park, Exeter.
ARCHIBALD, Thomas, Forester, Monkwray, Whitehaven, Cumberland.
ASHDOWN, Samuel Harding, Land Agent, Uppington, Wellington, Salop.
AUSTIN & M'AUSLAN, Messrs, Nursery and Seedsmen, Glasgow.

BAIN, W. P. C., Lochrin Ironworks, Edinburgh.
BAINBRIDGE, C. M., of Dissington Hall, Newcastle-on-Tyne.
BALDEN, James, Forester, Lennoxlove, Haddington.
BALDEN, Peter G., Forester, Vaenol Park, Bangor, North Wales.
BALDEN, William, Appleby Castle, Appleby.
BALFOUR, Isaac Baley, Sc.D., M.B., F.L.S., 27 Inverleith Row, Edinburgh.
BALLANTYNE & SON, Messrs John, Nursery and Seedsmen, Dalkeith.
BARCLAY, David, Forester, Sorn Castle, Mauchline, Ayr.
BARNES, Alfred W., Nurseryman, Seedsman, and Florist, Skipton.
BARRIE, David, Forester, Comlongan Castle, Annan.
BARRY, John W., of Park Hill, Heworth Hall, York.
BARTER, Frederick, Burraie Braes Tea Estate, Cachar, India.
BARTON, James, Assistant Forester, Lynedoch, Perth.
BAUCHOPE, Thomas, Land Surveyor, East Brucefield, West Calder.
BAXTER, Robert, Forester, Dalkeith Park, Dalkeith.
BAXTER, William, The Gardens, Riccarton, Currie.
BAYNE, Lewis, Forester, Kinmell Park, Abergele, North Wales.
BEGG, John, jun., Factor, Durris, Aberdeenshire.
BELL, James, Strathfieldsaye, Winchfield, Hants.
BELL, James, Forester, Newcastleton, Carlisle.
BENNETT, T. Oatley, jun., Land Agent, Bruton, Somerset.
BERRY, George, Longleat, Horningsham, Warminster, Wiltshire.
BERRY, Peter, Assistant Forester, Highclere Castle, Newbury, Berks.
BIGGE, Matthew, Marsham Hatch, Ashford, Kent.
BIRCH, John, The Gardens, Windlestone Hall, Ferry Hill, Durham.
BIRNIE, John, Normanby Park, Brigg, Lincolnshire.
BISSET, Alexander, Overseer, Rednock, Stirling.
BISSET, David, Land-Steward and Forester, Alva House, Stirling.
BISSET, William S., Land-Steward and Forester, Moncrieffe House, Bridge of Earn, Perthshire.
BLACK, Robert, The Yorkshire Nursery and Seed Establishment, Malton.
BOA, Andrew, jun., Estate Office, Marton Hall, Middlesboro'-on-Tees.
BOA, Andrew, Land-Steward, Dalton House, Newcastle-on-Tyne.
BOA, James S. M., Agent, Fettercairn, Fettercairn.
BOOTH, John, of Flottbeck Nurseries, Hamburg.
BORTHWICK, William, Forester, Dunnichen, Forfar.
BOTTOMER, Frederick, The Gardens, Mackree Castle, Ballisodare, Sligo.
BOYD, Alexander, Assistant Forester, Castle Grant, Grantown.

BOYD, J. B., of Cherrytrees, Yetholm, Kelso.

BRODIE, James, Land-Steward, Glasslough, Armagh, Ireland.

BROWN, Andrew, Assistant Forester, Portmore, Eddleston.

BROWN, J., Bretby, Burton-on-Trent.

BROWN, James, LL.D., Nurseryman and Wood Surveyor, Easingwold.

BROWN, James, Carnwath.

BROWN, John E., Craigmid, Stirling.

BROWN, William, Professor of Agriculture, Ontario School of Agriculture, Guelph, Ontario, Canada.

BROWN, William, Nurseryman and Seedsman, Stamford, Lincolnshire.

BROWN, Wishart, Carlowrie, Kirkliston.

BRUCE, T. R., of Slogarie, New Galloway.

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BRYDON, John, Forester, Four Othes, Wolverhampton.

BUCHAN, Alexander, A.M., F.R.S.E., Secretary of the Scottish Meteorological Society, Edinburgh.

BUCHAN, George, Forester, Bakewell, Derbyshire.

BUCHAN, William, Forester, Grangemuir, Pittenweem, Fife.

BUCHANAN, Robert R., Forester, Dunse Castle, Dunse.

BURGES, William, Assistant Forester, Drumpellier, Coatbridge.

CAIRD, Jr., Alexander M'Neil, Factor, Benmore and Kilmun Estates, by Greenock.

CALLOGHIN, John, Assistant Forester, Houston, Paisley.

CAMERON, Alexander, Forester, Countlich Lodge, Ballinluig, Perthshire.

CAMERON, Donald, Assistant Forester, Duthill, Carr Bridge.

CAMERON, Robert, Forester, Pale, Corwer, North Wales.

CAMPBELL, Alexander, Forester, Grey House, Liff, Dundee.

CAMPBELL, James, of Tillichewan Castle, Dumbartonshire.

CAMPBELL, John, Forester, Aboyne Castle, Aberdeenshire.

CAIRNDUFF, Andrew, Forester, Abbeyleix, Queen's County, Ireland.

CARMICHAEL, John, The Gardens, Glen Tulchan, The Cairnies, Perth.

CHAPLAIN, George, Assistant Forester, Glamis Castle, Glamis, Forfarshire.

CHAPMAN, Frederick, Overseer, Wansford, Peterborough.

CHAPMAN, James, Assistant Forester, Grinkle Park, Saltburn-by-the-Sea.

CHAPPLOW, John, Glencoin Cottage, Patterdale, Penrith.

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CHURNSIDE, Robert, Forester, Edlingham, Alnwick.

CLARK, David, Forester, Elie House, Elie, Fife.

CLARK, J., Forester to the Earl of Kintore, Keith Hall, Aberdeenshire.

CLARK, James, Forester, Balvaird Cottage, Strathmiglo, Fife.

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CLARK, William, Forester, Hawkhead, Paisley.

CLEETON, Edward, Curator, Albert Park, Middlesboro'.

CLEGHORN, William, Forester, Ayton Castle, Ayton.

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COCKBURN, William, Forester, Willowbank, Penicuik.
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COLQUHOUN, William, of Rossdhu House, Luss, Dumbartonshire.
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CRABBE, James, Forester, Glamis Castle, Glamis, Forfarshire.
CRAIG, James, Bailiff, Weston, Shifnal, Salop.
CRANSTON, Alexander, Assistant Forester, Linthaugh, Jedburgh.
CRANSTON, G. C. Trotter, of Harvieston, Gorebridge.
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CROSS, David G., Forester, Kylisk, Nenagh, Ireland.
CUMMING, Alexander, Forester, Huntly Lodge, Huntly.
CUMMING, Donald, Forester, Galloway Estate, Springwell Cottage, Kirkinner, Wigtownshire.
CUNNINGHAM, D., The Gardens, Darnaway Castle, Forres.
CUNNINGHAM, John, Forester, Ardross, Alness, Ross-shire.
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DARLING, John, Forester, St Martins, Perthshire.
DAVIDSON, George, Land-Steward, Carriden, Linlithgow.
DAVIDSON, James, Coonoor, Neilgherries, S. India.
DAVIDSON, John, Forester, Albar, Brechin.
DAVIDSON, John, Land and Wood Bailiff, Greenwich Hospital Estates, Haydan, Bridge-on-Tyne.
DAVIDSON, Richard, Scottish Colour Works, Leith.
DAVIES, John, Forester, Granstone Castle, Weobley, Herefordshire.
DAWSON, James, Forester, Kilmun, Argyllshire.
DEAN, Richard, Ealing, London.
DEWAR, Daniel, Forester, Beaufort Castle, Beauly.

DEWAR, John, Assistant Forester, Lynedoch, Perth.
DICK, Joseph, Assistant Forester, Grimsthorpe Castle, Bourne, Lincolnshire.
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DOIG, Charles, Overseer, Glen Tulchan, Methven, Perth.
DON, John, Assistant Forester, Ardgowan, Greenock.
DONALDSON, William, Forester, Panmure, Carnoustie.
DOUGLAS, F., M.D., Woodside, Kelso.
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DUFF, James, Freeland, Bridge of Earn, Perthshire.
DUFF, James, Wood Manager, Bayham Abbey, Tunbridge Wells, Kent.
DUGAN, Charles, Assistant Forester, Cally House, Gatehouse.
DUNCAN, Charles, of Woodend, Rothesay.
DUNCAN, James, Land-Steward, Glack, Old Meldrum.
DUNCAN, John, Forester, Blaenpant, Boneath, R.S.O., South Wales.
DUNCAN, William, Forester, Ardgowan, Greenock.
DUNLOP, Alexander, Factor, Luffness, Drem.
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DUNN, Malcolm, The Palace Gardens, Dalkeith.
DURWARD, Robert, Manager, Blelack, Aberdeenshire.
DYKES, Thomas, Factor, Maybole, Ayrshire.

EDEN, The Hon. R. Henley, Estate Agent, The Coigne, Minchinghampton.
EDWARDS, John, Forester, Abercairney, Crieff.
ERSKINE, William, of Oaklands, Trinity.
EWING, David, Assistant Forester, Urie House, Stonehaven.

FERGUSON, A., Gossfield Hall, Hallstead, Essex.
FERGUSON, James, Forester, Shelton Abbey, Arklow, County Wicklow.
FERGUSON, John, Forest Department, Madras.
FERGUSON, Joseph, Forester, Ford Manor, Lingfield, Surrey.
FERNIE, Andrew, Assistant Forester, Logiealmond, Perth.
FERNIE, Robert, Forester, Balcarres, Colinsburgh, Fife.
FETTES, Francis, Forester and Gardener, Forneth, Blairgowrie, Perthshire.
FINGLAND, J., Forester, Drumlanrig, Thornhill, Dumfriesshire.
Finlay, James, Forester, Quinish, Tobermory, Isle of Mull.
FINN, P. W., Forester, Borris House, Borris, County Carlow.

FISHER, William, Forester, Wentworth Castle, Barnsley, Yorkshire.
FISKIN, Alexander, Assistant Forester, Rossdhu, Dumbartonshire.
FORBES, Andrew, Forester, Stracathro, Brechin.
FORBES, William, Assistant Forester, Castlecary, Denny.
FORGAN, James, Gardener and Overseer, Bonskeid, Pitlochrie.
FOULIS, Robert, M.D., Cairnie Lodge, Cupar-Fife.
FOWLER, Archibald, The Gardens, Castle Kennedy, Stranraer.
FRANCE, Charles, Nursery and Seedsman, Lanark.
FRANCE, George, Overseer, Glenelg, Lochalsh.
FRANCE, James, Nursery and Seedsman, Lanark.
Fraser, Archibald, Forester, Skipness Castle, Tarbert, Greenock.
FRASER, Donald, Assistant Forester, Duthill, Carr Bridge.
FRASER, Hugh, Leith Walk Nurseries, Edinburgh.
FRASER, James, Forester, Cabairdy, Huntly.
FRASER, James, Forester, Craigbarnet, Lennoxtown, Campsie.
FRASER, P. Neill, of Rockville, Edinburgh.
FRASER, Simon, Forester, Haddo House, Aberdeenshire.
FROST, Philip, Gardener, Dropmore, Maidenhead.

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GARDINER, James, Forester, Hawkstone Park, Salop.
GARDINER, R., Agent, Birchgrove, Crosswood, Aberystwith.
GARDNER, George, of Carrington Barns, Lasswade.
GARNER, John, Assistant Gardener, Cantley Hall, Doncaster, Yorkshire.
GEIKIE, P. M., Factor, Cortachy, Kirriemuir.
GERRISH, Edward, Wood Overseer, Maiden Bradley, Bath.
GILBERT, James, Forester, Ardverikie, Kingussie.
GILCHRIST, Andrew, Forester, Urie House, Stonehaven.
GILCHRIST, William, Forester, Cluny Castle, Aberdeen.
GILLANDERS, Alexander, Assistant Forester, Durris, Aberdeen.
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GOW, James, Forester, Camperdown, Dundee.
GOW, John, jun., Agent, Grinkle Park, Saltburn-by-the Sea.
GOW, Peter, Assistant Forester, Lynedoch, Perth.
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GRANT, Henry, Assistant Forester, Drumpellier, Coatbridge.
GRANT, James, Forester, Dalvey, Forres.
GRANT, James, Forester, Cliffe Hall, Pierse Bridge, Yorkshire.
GRANT, John C., Manager, Eilan Shona Salen, Fort William.
GREEN, Alexander, Lanark Nurseries, Lanark.
GREEN, William, Assistant Forester, Charleston, Malmesbury, Wilts.
GREER, Robert, Assistant Forester, Ardgowan, Greenock.
GREIG, Gavin, Forester, Parkhill, Aberdeen.
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HARLEY, Andrew, Penybout, Radnorshire.
HARROLD, George, Gardener, Mount Henrie, Queen's County, Ireland.
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HART, Thomas, Assistant Forester, Yester, Haddington.
HARTLAND, Richard, The Lough Nurseries, Cork.
HAVELOCK, Thomas, Forester, Raby Park, Staindrop, County Durham.
HAVELOCK, William, Forester, Dilston, Corbridge, Newcastle-on-Tyne.
HAYMAN, John, jun., Overseer, Dumfries House, Old Cumnock.
HEALE, William, Manager, Messrs Dickson & Turnbull's Nurseries, Perth.
HELMAN, George, Upton Nurseries, Chester.
HENDERSON, Alexander, Kilmaron, Cupar-Fife.
HENDERSON, Archibald, Forester, Clonad Cottage, Tullamore, King's County.
HENDERSON, George, Assistant Forester, Linthaugh, Jedburgh.
Henderson, John, Forester, Cardoness, Gate House, Kirkcudbrightshire.
HENDERSON, John, Overseer, Vogrie, Ford, Dalkeith.
HENDERSON, Robert, Assistant Forester, Dalmeny Park, Edinburgh.
HENDRIE, William W., of Thomas Imrie & Sons, Nursery and Seedsmen, Ayr.
HENDRY, David, The Knowefield Nurseries, Carlisle.
HEPBURN, William, Assistant Forester, Altyre, Forres.
HERINGTON, Edward, Highclere Nursery, Newbury, Berks.
HERMISTON, James, Forester, Kirkton and Boghall, Bathgate.
HETHERTON, Walter, Forester, Heanton, Satchville, Bedworth, N. Devon.
HILSON, John, Assistant Forester, Floors Castle, Kelso.
HODD, William, Gardener, Stubben Edge, Chesterfield, Derbyshire.
HOGARTH, James, Forester, Duthill, Strathspey.
HOGG, Thomas, Forester, Hampton Court, Leominster, Hereford.
HOOD, James, Assistant Forester, Langlee, Jedburgh.
HOME, George, Assistant Forester, Bellstane, Drumlanrig, Thornhill.
HOMES, Edward, Forester, Eddington, Chirnside.

HORSBURGH, James, Forester, Yester, Haddington.
HOWDEN, Andrew, Gardener and Forester, Tandragee Castle, Co. Armagh.
HOWIE, Charles, Eden Cottage, Largo, Fife.
HULL, Frank, Assistant Forester, Lilleshall, Newport, Shropshire.
HUNTER, Patrick, Forester, Grey Abbey, County Down.
HUSSEY, Samuel M., Estate Office, Tralee.
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JEFFREY, James, Forester, Craighall, Blairgowrie.
JOHNSTON, George, The Gardens, Glamis Castle, Glamis.
JOHNSTON, William, Fencer, Lee, Lanark.
JOHNSTON, William, Assistant Forester, Arniston, Gorebridge.
JOHNSTONE, Alexander, Assistant Forester, Arniston, Gorebridge.
JOHNSTONE, Alexander, Forester, Lee Castle, Lanark.

KAY, James, Forester and Hedger, Bute Estate, Rothesay.
KEDZIE, Walter, Forester, Arundel Castle, Arundel, Sussex.
KEIR, David, Forester, Blair Athole, Perthshire.
KELMAN, J., Forester, Glenkindie.
KEMP, John, Assistant Forester, Midmar, Aberdeenshire.
KENMARE, The Right Hon. the Earl of, Killarney House, Killarney.
KENNEDY, Duncan, Assistant Forester, Underley, Kirkby Lonsdale.
KENNEDY, G. G. Allan, Forester, Moy, Forres.
KENNEDY, John, Forester and Ground Officer, Glen Urquhart, Drumnadrochit.
KENNEDY, William, Overseer, Carradale, Greenock.
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KINGHORN, Adam, Forester, Rochsoles, Airdrie.
KINGHORN, James, Assistant Forester, Dunse Castle, Dunse.
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LENOX, William, Forester, Keir, Dunblane.
LENNOX, William, jun., Assistant Forester, Kelly, Wemyss Bay.
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LINGEN, Rev. C. N., Penlanole, Rhayader, Radnorshire.
LITTLE, Alexander, Forester, Relugas, Dunphail, Morayshire.
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M'CORQUODALE, Donald, Forester, Dunrobin Castle, Golspie.
M'CORQUODALE, D. A., Assistant Factor, Panmure, Forfarshire.
M'CREATH, Hugh, Assistant Forester, Culzean, Maybole, Ayrshire.
M'CUTCHEON, Robert, Assistant Forester, Cawdor Castle, Nairn.
M'DONALD, Alexander, Forester, Balnagowan, Ross-shire.
M'DONALD, Charles, Helton, Skipton, Yorkshire.
M'DONALD, James, Assistant Forester, Hopetoun House, South Queensferry.
M'FAYDEN, Duncan, Forester, Dunmore, Stirling.
M'FADZEAN, Samuel, Saw Miller, Culzean Castle, Maybole, Ayr.
M'GRATH, Patrick, Assistant Forester, Galtie Castle, Mitchelstown, County Tipperary.
M'GREGOR, Alexander, Assistant Forester, Scone, Perth.
M'GREGOR, Donald, Assistant Forester, Abercarney, Crieff.
M'GREGOR, Robert, Forester, Booth Hall, Knutsford, Cheshire.
M'HARDY, Charles, Forester, Durris Estate, Aberdeen.
M'HATTIE, John, Seedsman, Northgate, Chester.
M'KAY, James, Forester, Whittinghame, Prestonkirk.
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M'Laren, John, Ballencrieff, Drem.
M'Laren, John, Forester, Hopetoun House, South Queensferry.
M'Laren, John, Forester, Darnhall, Eddlestone, Peebles.
M'Laren, Peter, Forester, Lilleshall, Newport, Salop.
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M'Lean, Andrew, Assistant Forester, Rutherford, Kelso.
M'Lean, John, Forester, Ashengrove, Swainston, Newport, Isle of Wight.
M'Lean, John, Assistant Forester, Altyre, Forres.
M'Lean, Malcolm, The Gardens, Tinton Park, Maidstone, Kent.
M'Lean, William, Forester, Eglinton Castle, Irvine.
M'Lellan, Duncan, Superintendent of Parks, Glasgow.
M'Leod, Alexander, Forester, Upton Nurseries, Chester.
M'Leod, Angus, Superintendent of City Gardens, Edinburgh.
M'Leod, J., Nurseryman, Crieff, Perthshire.
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Marshall, James, Assistant Forester, Galloway House, Garlieston, Wigtounshire.
Marshall, Robert, Forester, Kirklington Hall, Southwell, Notts.
Marshall, Robert, Assistant Forester, Ardgowan, Greenock.
Martin, George, Forester, Dunecht House, Aberdeen.
Martin, James, Assistant Forester, Scone, Perth.
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Methven, John, Nursery and Seedsman, Edinburgh.
Michie, Christopher Young, Forester, Cullen House, Cullen, Banffshire.
Michie, James, Forester, Wemyss Castle, Kirkcaldy.
Middlemass, Archibald, Forester, Meikleour, Perthshire.
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Miller, John, Forester, Ochtertyre, Stirling.

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MILNE, James, Land-Steward, Kemnay, Aberdeen.
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MITCHELL, Forbes, of Thainstone, Kintore.
MITCHELL, Garlies, Nurseryman, Stranraer.
MITCHELL, James, Aldie, Kinross.
MITCHELL, James, Forester, Donibristle, Aberdour, Fife.
MITCHELL, John, Assistant Forester, Logiealmond, Perth.
MOFFAT, Adam, Forester, Hindlip Hall, Worcester.
Moffat, Henry, Forester, Monkray, Whitehaven, Cumberland.
MOFFAT, James, Forester, Newbattle Abbey, Dalkeith.
MOFFAT, John, Forester, Kimmerghame, Dunse.
MORE, Robert, Forester, Hafton, Kirn, Argyllshire.
MORGAN, Andrew, Assistant Forester, Penicuik House, Penicuik.
MORGAN, George, Wood Merchant, Turrit Bank, Crieff.
MORGAN, Hugh, Wood Merchant, Crieff.
MORRISON, Alexander, Nurseryman, Elgin.
MORRISON, James, Assistant Gardener, Dalkeith Palace, Dalkeith.
MORRISON, John, Coney Park Nursery, Stirling.
MUIR, William, of Inistrynich, Inverary, Argyleshire.
MUIRHEAD, John, Forester, Bicton, Budleigh, Salterton, Devonshire.
MUNRO, Hugh, Forester, Holkham Hall, Wells, Norfolk.
MUNRO, James, Forester, Avoch, by Inverness.
MUNRO, James, Assistant Forester, Darnaway Castle, Forres.
MUNRO, John, Assistant Forester, Cluny Castle, Aberdeen.
MUNRO, Robertson, Abercorn Nursery, Jock's Lodge, Edinburgh.
MYLES, James, Overseer, Harburn, West Calder.

NEWBIGGING, Alexander T., Nurseryman, Dumfries.
NICOL, W. R., Forester, Loudoun Castle, Galston.
NICOL, William, Forester, Pitcaple, Aberdeenshire.
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PALK, Sir Laurence, Bart., M.P., of Haldon Park, Exeter.
PALMER & SON, Messrs John, Nurserymen, Annan.
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PATERSON, Andrew, Surveyor, Exton, Oakham, Rutland.
PATERSON, Charles, Factor, Castle Menzies, Aberfeldy, Perthshire.

PATTON, Donald, Assistant Forester, Scone, Perth.
PEARSON, John B., Messrs Main & Co., 25 George IV. Bridge, Edinburgh.
PEEBLES, Andrew, Estate Office, Albury, Guildford.
PENDER, John, M.P., 18 Arlington Street, London, S.W.
PENDREIGH, John, Assistant Forester, Port Bannatyne, Rothesay.
PHILIP, John, Wood Merchant, Bonnyrigg, Lasswade.
PIERSON, Joshua, Forester, Old Shields, Airdrie.
PIRIE, John, Forester, Blackhall, Aberdeenshire.
PLATT, Major, Gorddinag, Langairfechan, near Bangor.
PONSONBY, Charles John, Deputy Conservator of Forests, Indian Forest Department, Baraitch, Oudh (12 Royal Circus, Edinburgh).
POWNER, George, Forester, Willey Hall, Broseley, Shropshire,
POWNER, Thomas, 6 Queen Street, Carmarthen, South Wales.
PREECE, J., Forester, Garnstone Castle, Weobley, Hereford.
PRESSLEY, D., Gardener, Knockmaroon, Chapelizod, Dublin.
PURVES, Alexander Paterson, W.S., 102 George Street, Edinburgh.
PURVES, Thomas, Assistant Forester, Durris, Aberdeen.

RAE, James, Overseer, Ormidale Estate, Colintrave, Argyllshire.
RAE, William Alexander, Estates Office, Durris, Aberdeen.
RAIT, James, Forester, Castle Forbes, Whitehouse, Aberdeen.
RANKINE, Thomas, Nurseryman, Hamilton.
RATTRAY, Thomas, Forester, Westonbilt House, Tetbury, Gloucestershire.
RAVENSCROFT, Edward, *Farmer* Office, 13 Salisbury Square, Fleet St., London.
RAWLENCE & SQUAREY, Messrs, Salisbury.
RAY, Andrew, Assistant Forester, Athronhall, Milnathort.
REA, Archibald Henry, Assistant Forester, Urie House, Stonehaven.
REID, George, Nursery and Seedsman, Aberdeen.
REID, James, Assistant Forester, Dalkeith Park, Dalkeith.
REID, Samuel, Bowmont Forest, Kelso.
RENTON, James, Forester and Land-Steward, Cleghorn, Lanark.
RICHARDSON, Adam, Assistant Land-Steward, Arniston, Gorebridge.
RICHARDSON, Alexander, Land-Steward, Arniston, Gorebridge.
RIDER, William H., *Journal of Forestry* Office, 14 Bartholomew Close, London, E.C.
RIGHY, William, Messrs King & Co., 45 Pall Mall, London.
RITCHIE, Alexander, Assistant Forester, Logiealmond, Perth.
RITCHIE, Walter, Forester, Doldowlod, Rhayader, Radnorshire.
ROBERTSON, Alexander, Forester, Arndilly, Craigellachie.
ROBERTSON, D., Albert Hotel, Hanover Street, Edinburgh.
ROBERTSON, David, Estate Manager, Curraghmore, Portlaw, Waterford.
ROBERTSON, David, Nurseryman, Helensburgh.
ROBERTSON, George, Overseer, Plean, Bannockburn.
ROBERTSON, George, jun., Assistant Forester, Thirlstane Castle, Lauder.
ROBERTSON, James, Forester, Panmure, Carnoustie.
ROBERTSON, John, Skielton Abbey, Arklow.
ROBERTSON, John, Forester, Minto House, Hawick.
ROBERTSON, Robert, Forester, Markree Castle, Collooney, County Sligo.

Robertson, Peter, Gordon Castle, Fochabers, Morayshire.
Robertson, P. S., Nursery and Seedsman, 33 St Andrew Square, Edinburgh.
Robertson, William W., Forester, Blinkbonny, Earlston.
Robinson, William, Editor of the *Garden*, 37 Southampton Street, Covent Garden, London, W.C.
Robson, Alexander, Duchfour Woods, Lochend, Inverness.
Robson, David, Forester, Ashmore and Persie, Bridge of Cally, Blairgowrie.
Robson, John, Forester, Everleigh, Pewsey, Wilts.
Robson, Ralph, Nursery and Seedsman, Hexham.
Ross, Archibald, Overseer, Skipton Castle, Skipton-in-Craven, Yorkshire.
Ross, D., Forester, Letham, by Nairn.
Ross, Robert, Assistant Forester, Darnaway, Forres.
Rule, John, Forester, Monymusk, Aberdeenshire.
Russell, John, Craigie, Ayr.
Russell, Robert, Forester, Mostyn, Holywell, North Wales.
Rust, Joseph, The Gardens, Eridge Castle, Tunbridge Wells, Kent.
Rutherford, Andrew, Forester, Bowmont Forest, Kelso.
Rutherford, James, Forester, Linthaugh, Jedburgh.
Rutherford, John, Assistant Forester, Linthaugh, Jedburgh.
Rutherford, Robert O., Manager, Leinster Estates, Athy, Ireland.

Samson, John, Forester, Abernethy, Strathspey.
Sandbach, Henry R., Hafodunos, Abergele.
Sang, Edmund, of E. Sang & Sons, Nursery and Seedsmen, Kirkcaldy.
Scarth, T. W., Land-Agent, Keverstone, Staindrop, Darlington.
Scott, Adam, Forester, Southwick Park, Fareham, Hants.
Scott, Andrew, Assistant Forester, Penicuik House, Penicuik.
Scott, D., Wood Manager, Darnaway Castle, Forres.
Scott, David, Forester, Ballinacourte, Tipperary.
Scott, John W., Roslevan, Ennis, County Clare, Ireland.
Scott, Walter, Forester, Oxnam, Jedburgh.
Scrimgeour, James, Assistant Forester, Hopetoun House, South Queensferry.
Seaton, Allan, Assistant Forester, Curraghmore, Portlaw, Waterford.
Sedgwick, A. O., of 38 High Street, Watford, Herts.
Service, George, Assistant Forester, Dunse Castle, Dunse.
Service, James, Assistant Forester, Dunse Castle, Dunse.
Service, Robert, Assistant Forester, Dunse Castle, Dunse.
Shand, James, Gardener, Meldrum House, Aberdeenshire.
Shanks, John, Forester, Kildrummy Castle, by Mossat.
Sharp, Charles, Assistant Forester, Abercarney, Crieff.
Shaw, William, The Gardens, Banff House, Alyth.
Shiels, Robert, Assistant Forester, Hopetoun House, South Queensferry.
Sim, William, Nurseryman, Forres.
Sime, John, Timber Merchant, Rafford, Forres.
Simpson, J., Land-Steward, Alloa Park, Alloa.
Simpson, Peter, Assistant Forester, Daughty Mill, Kirkcaldy.
Simpson, Thomas, Forester, Glenferness, Nairnshire.
Sinton, David, Assistant Forester, Charlton, Malmesbury, Wilts.

SINTON, James, Forester, Stourhead, Bath.
SINTON, John, Estate Bailiff, Hirsh Hall, Tamworth, Staffordshire.
SKELDON, John, Assistant Forester, Dunse Castle, Dunse.
SKIRVING, Archibald, Forester, Duncombe Park, Helmsley, York.
SKIRVING, William, Nursery and Seedsman, Liverpool.
SKIRVING, William, Assistant Forester, Duncombe Park, Helmsley, York.
SLATER, Andrew, Forester, Loftus, Saltburn-by-the-Sea, Yorkshire.
SLATER, Andrew, jun., Overseer, Wyreside Cottages, Lancaster.
SMITH, A., Factor, Douglas Castle, Lanarkshire.
SMITH, G. B., Wire Fence Manufacturer, 61 West Regent Street, Glasgow.
SMITH, James, The Gardens, Mentmore, Leighton-Buzzard, Buckinghamshire.
SMITH, John, Hansworth Nurseries, Sheffield.
SMITH, John Crombie, Assistant Forester, Portmore, Eddlestone, Peebles.
SMITH, Thomas, Nursery and Seedsman, Stranraer.
SMITH, Thomas Valentine, of Ardtornish, Morvern, Argyllshire (111 Grosvenor Road, London, S.W.).
SMITH, W. Baxter, Messrs Little & Ballantyne, Nursery and Seedsmen, Carlisle.
SMITH & SIMMONS, Messrs, Nursery and Seedsmen, Howard Street, Glasgow.
SMITH & SON, Messrs William, Nursery and Seedsmen, Aberdeen.
SMYTH, John B., Forester, Duff House, Banff.
SOLLY, Professor Edward, F.R.S., Park House, Sutton, Surrey.
STAPYLTON, Major, Myton Hall, Borobridge, Yorkshire.
STARK, John, Assistant Forester, Woodhall, Airdrie.
STEELE, David, Forester, Skene House, Aberdeen.
STEPHEN, John, jun., Assistant Forester, Cluny Castle, Aberdeen.
STEVENSON, Alexander, Forester, Oldstead, Oswaldkirk.
STEVENSON, David, Forester, Kelly, Wemyss Bay, Greenock.
STEVENSON, James, Forester, Cobham Park, Surrey.
STEWART, Alexander, Agent, Bodnaut Estate, Conway, N. Wales.
STEWART, Andrew, of Lunkart, by Keith.
STEWART, D., Manager, Dalnavart, Aviemore.
STEWART, John, Forester, Tummel Ferry, Ballinluig, Perthshire.
STEWART, John, Forester, Woodneuk Cottage, Denny.
STEWART, John M., Assistant Forester, Yester, Haddington.
STEWART, Robert, Assistant Forester, Ardgowan, Greenock.
STEWART, William, Land-Steward, Dalhousie Castle, Lasswade.
STEWART, William, Nurseryman, Dundee.
STEWART, William, Assistant Forester, Underley Hall, Kirkby, Lonsdale.
STIRLING, John, Forester and Land-Steward, Cally Mains, Gatehouse of Fleet.
STRANG, Alexander, Forester, Rendlesham Hall, Woodbridge, Suffolk.
STRANG, William, Assistant Forester, New Scone, Perth.
STUART, Charles, Forester, Glenmoriston, Inverness.
STUART, John, Forester, Castle Grant, Grantown, Strathspey.
STUART, Lewis A. G., Forester, Galloway House, Garliestown, Wigtownshire.
STUART, William, Assistant Forester, Castle Grant, Grantown.
STUART & MEIN, Messrs, Nurserymen, Kelso.
STURROCK, David, Assistant Forester, Panmure, Carnoustie.

SUTTIE, James, Evington, Ashford, Kent.
SWAN, R. G., Auctioneer, Dunse.
SWINTON, A. Campbell, LL.D., F.R.S.E., of Kimmerghame, Dunse.
SYME, David, 1 George IV. Bridge, Edinburgh.
SYMON, John, Forester, Cawdor Castle, Nairn.
SYMON, Peter, Forester, Forres.

TAIT, David, Forester, Owston Park, Doncaster, Yorkshire.
TAIT, Walter, Seedsman, 45 Chapel Street, Dublin.
TAYLOR, Andrew, 6 South Clerk Street, Edinburgh.
TAYLOR, David, Barskimming, Mauchline.
TAYLOR, George, Estate Overseer, Hassop Hall, Bakewell, Derbyshire.
TAYLOR, George, Nursery and Seedsman, Inverurie.
TERRIS, James, jun., Factor, Dullomuir, Blairadam, Kinross.
THOMSON, David, of Messrs Ireland & Thomson, Nursery and Seedsmen, Waterloo Place, Edinburgh.
THOMSON, James, Assistant Forester, Penicuik House, Penicuik.
THOMSON, Lockhart, S.S.C., 20 Coates Crescent, Edinburgh.
THOMSON, Thomas, Forester, Gelston Castle, Castle-Douglas.
THORNTON, Thomas, Heatherside, Frimley, Surrey.
TIVENDALE, William, Wood Manager, Burn House, Galston, Ayrshire.
TURNBULL, William, Assistant Forester, Marton Hall, Middlesbro'.
TURNER, James, Forester, Bonnington, Lanark.
TURNER, James, The Gardens, Brittas, Clonaslie, Queen's County, Ireland.
TWEEDIE, John, Forester, Dunglass, Cockburnspath, Berwickshire.

VEITCH, John, Nurseryman, Falkirk.
VEITCH, William, Hedger, Arniston, Gorebridge.

WADDS, Philip, Gardener, Moore Abbey, County Kildare.
WALKER, George, Forester, Balgonie, Markinch, Fife.
WALKER, William, Assistant Forester, Penicuik House, Penicuik.
WALL, G. Y., jun., Exchequer Office, Durham.
WARD, James, Overseer, Keith.
WATERER, Anthony, Nurseryman, Knaphill, Woking, Surrey.
WATERS, Denis, Forester, Kelburn Castle, Largs.
WATSON, John, Gardener, Stravithie, St Andrews.
WATSON, W. J., Nursery and Seedsman, Newcastle-on-Tyne.
WATT, James, Messrs Little & Ballantyne, Nurserymen, Carlisle.
WATT, William, Forester, Nisbet House, Dunse.
WEBSTER, Angus D., Assistant Forester, Penrhyn Castle, Bangor, N. Wales.
WEBSTER, J., The Gardens, Gordon Castle, Fochabers.
WEBSTER, John Blaikie, Verner's Bridge, Moy, Ireland.
WELSH, William M., Nursery and Seedsman, Edinburgh.
WEST, Major William Cornwallis, Ruthin Castle, Denbighshire.
WHITE, George, Seedsman, Paisley.
WHITEFORD, Robert, Assistant Hedger, Bute Estate, Rothesay.
WILKIE, Thomas, Forester, Ardkinglas, Inverary.

WILLIAMS, B. S., Paradise Nursery, Upper Holloway, London, N.
WILLIAMS, Lewis, Agent, Brecknock Priory, Brecon, South Wales.
WILSON, John, Land-Steward and Forester, Borthwickbrae, Hawick.
WILSON, John, Forester, Greystoke Castle, Penrith.
WILSON, John, Forester, Auchendolly, Dalbeattie.
WILSON, John, Assistant Forester, Arniston, Gorebridge.
WILSON, John, Forester, Sudbourn Hall, Wickham Market, Suffolk.
WILSON, Stephen, 132 Union Street, Aberdeen.
WILSON, Thomas, Assam, India.
WISHART, Edward, of Hermitage House, Laverock Bank Terrace, Trinity, Edinburgh.
WOOD, John, Gardener, Hutton Castle, Aberdeenshire.
Wylie, James, Assistant Forester, Douglaston, Milngavie, Glasgow.
WYLIE, George, Estate Overseer, Ballogie, Aboyne.

YOUNG, James, of Durris, by Aberdeen.
YOUNG, John, Messrs Imrie & Son's Nurseries, Ayr.
YOUNG, William, Assistant Forester, Lennoxlove, Haddington.

12.—SUBJECTS OFFERED FOR COMPETITION DURING 1877-78.

By-Law X. The converted values of the Society's Premiums shall be: Gold Medal, Five Pounds; No. 1 Silver Medal, Three Pounds, or No. 2 Silver Medal and Two Pounds; No. 2 Silver Medal, Two Pounds; Bronze Medal, Ten Shillings.

I. For the best and approved Report describing fully the tools at present used by Foresters in Britain. (Prize of Three Guineas offered by the Proprietors of the *Journal of Forestry*).

II. For the best and approved Essay on the Peeling and Harvesting of the different kinds of Native Bark used in Tanning. Competition confined to Assistant Foresters. (*A Medal.*)

III. For an approved Report on the most extensive, complete, and judiciously arranged Arboretum. (*A Medal.*)
The author must describe the positions as to soil, exposure, elevation, etc., of the respective species of varieties of trees reported on, and state their ages, treatment, cost, and mode of planting adopted.

IV. For an approved Essay on the present state and future prospects of Arboriculture in the county in which the competitor resides. This is a standing subject. (*A Medal.*)

V. For an approved Report on the Old and Remarkable Trees on the estate on which the competitor resides; correct measurements of the circumference of the trunks, at 1 foot and 5 feet from the ground must be given; also height of tree, spread of branches, etc. Photographs are desirable. (*A Medal.*)

VI. For an approved Report on the Summer Operations most beneficial to plantations and woodlands.
The report to embrace such subjects as pruning, thinning, transplanting, draining, etc., with special reference to the effects produced by them while the trees are in full growth and leaf, compared with similar operations performed while nature is dormant. (*A Medal.*)

VII. For an approved Report on Plantation Enclosures of any New Construction, and their management, cost, and durability for various situations.
The reporter will detail the various modes of protecting planta-

tions, their comparative costs and expense of maintenance, whether live fences, palings, or walls. (*A Medal.*)

VIII. For the best and approved collection of Cones ripened in Britain during 1875, 1876, and 1877-78. (*A Medal.*)

Each cone (or series of cones of one species) must be accompanied by a label giving the name of the species, the estate and county where produced, and the year grown. The Prize collection to become the property of the Society.

IX. For the best and approved collection of Seeds of Forest Trees and Shrubs ripened in Britain. (*A Medal.*)

Each example of seeds to have a label, giving the name of the species, and where produced. The Prize collection to become the property of the Society.

X. For the best and approved collection of prepared sections of different kinds of wood grown in the county in which the competitor resides. (*A Medal.*)

Each section must have a label attached, bearing the name of the wood, the estate and county where grown. The Prize collection to become the property of the Society.

XI. For the best and approved series of Geological Specimens illustrating the different rocks and formations on which Forest Trees and Shrubs grow in the county in which the competitor resides. The specimens to be accompanied by a Report. (*A Medal.*)

The successful collection to be the property of the Society. Buteshire, having been already reported on, is excluded.

XII. For an approved Report on the Plantations of which the competitor is Forester. (*Three Medals.*) One to be awarded for the best Report from each of the countries—England, Scotland, and Ireland—and competition to be confined to each country respectively. Reporters must state the extent of plantations under their charge, the kind of timber grown, soil, situation, management, age, etc. This is a standing subject.

XIII. For an approved Report on the Forests of the United States of America. (*A Medal.*)

XIV. For an approved Report on the Forests of India. (*A Medal.*)

XV. For an approved Report on the Forests of any of the British Colonies. (*A Medal.*)

XVI. For an approved Report on the Management of Forests on the Continent of Europe. (*A Medal.*)

Special reference to be made to any appliances or modes of culture and treatment not generally adopted in this country, but followed in such Arboricultural schools as those of Nancy and Hanover and elsewhere. Foreigners are specially invited to compete.

XVII. For an approved Report on the Diseases most incidental to Forest Trees, including those that affect the roots as well as the bark, branches, and foliage. (*A Medal.*)

XVIII. For an approved Essay on the Natural History of *Adelgis laricis*, the Larch Bug. (*A Medal.*)

The Essay must include the injury done by the insect to larch, and suggest remedies.

XIX. For an approved Report on the results obtained by experience of Seedlings of Coniferæ, being the produce of trees grown in Britain, as compared with plants obtained from foreign-ripened seed. (*A Medal.*)

XX. For an approved Essay on the Best Methods for Seasoning Different Kinds of Timber. (*A Medal.*)

XXI. For an approved Essay on the Best Methods of Rearing Timber Trees in Deer Forests for Shelter. (*A Medal.*)

XXII. For the best and approved Model of a Rustic Arbour or Summer-House, designed and executed by the Competitor. Model not to exceed three feet in height. (*A Medal.*)

XXIII. To any Member of the Society who shall send to the Secretary from abroad, cones or seeds of Forest Trees of new or rare species of varieties, capable of germination, and of thriving in this country. (*A Medal.*)

To be awarded when fifty of any sort, or fifty plants in all, have been successfully raised. These plants to be the property of the Society, and to be balloted for amongst Members intimating their desire to have them. The packages to be delivered free of cost to the Society at any British port.

XXIV. For an approved Essay or Report on any subject connected with Arboriculture. (*A Medal.*)

XXV. For any marked advantageous improvement on any of the Implements used in Forestry. (Models or Implements to be accompanied by a Report.) (*A Medal.*)

For Conditions of Competition see Proceedings of Annual General Meeting of 6*th November* 1877.

13.—OFFICE-BEARERS for 1877-78.

PRESIDENT.

The Right Hon. W. P. ADAM, of Blairadam, M.P.

VICE-PRESIDENTS.

WILLIAM M'CORQUODALE, Forester and General Surveyor, Perth.
HUGH CLEGHORN, M.D., F.R.S.E., of Stravithie, St Andrews.
Professor JOHN HUTTON BALFOUR, M.D., M.A., F.R.SS.L. & E., Regius Keeper of the Royal Botanic Garden, Edinburgh.
THOMAS METHVEN, Nurseryman and Seedsman, Edinburgh.
ROBERT HUTCHISON, F.R.S.E., of Carlowrie, Kirkliston.

COUNCIL.

JOHN ANDERSON, Nurseryman, Perth.
P. S. ROBERTSON, Nursery and Seedsman, Edinburgh.
ROBERT BAXTER, Forester, Dalkeith Park, Dalkeith.
WILLIAM STEWART, Land Steward, Dalhousie Castle, Lasswade.
JOHN M'LAREN, Forester, Hopetoun House, S. Queensferry.
WILLIAM GILCHRIST, Forester, Cluny Castle, Aberdeen.
MALCOLM DUNN, The Palace Gardens, Dalkeith.
WILLIAM GORRIE, of Rait Lodge, Edinburgh.
JAMES ROBERTSON, Forester, Panmure House, Carnoustie.
ALEXANDER RICHARDSON, Land Steward, Arniston, Gorebridge.
JOHN M'GREGOR, Forester, Ladywell, Dunkeld.
C. Y. MICHIE, Forester, Cullen House, Cullen.
JOHN GRANT THOMSON, Wood Manager, Grantown.
CHARLES S. FRANCE, Overseer, Penicuik House, Penicuik.
D. SCOTT, Wood Manager, Darnaway Castle, Forres.

SECRETARY.

JOHN SADLER, F.R.P.S., Lecturer on Botany and Natural History in the Royal High School, and Assistant to the Professor of Botany in the University of Edinburgh.

TREASURER.

GEORGE CRICHTON, of Messrs G. & M. Crichton, 18 Princes Street, Edinburgh.

AUDITOR.

JOHN ORD MACKENZIE, W.S., of Dolphinton.

JUDGES.

Dr CLEGHORN (Convener), of Stravithie, St Andrews.
JAMES ROBERTSON, Forester, Panmure House, Carnoustie.
WILLIAM GORRIE, of Rait Lodge, Trinity, Edinburgh.

COMMITTEE ON TRANSACTIONS.

The Secretary (J. Sadler), *Editor.*
Dr Cleghorn, of Stravithie, St Andrews.
Robert Hutchison, of Carlowrie, Kirkliston.
William Gorrie, of Rait Lodge, Edinburgh.

PHOTOGRAPHIC ARTISTS.

Magnus Jackson, Marshall Place, Perth.
John Horsburgh, 131 Princes Street, Edinburgh.

LOCAL SECRETARIES.

Scotland.

James Kay, Wood Manager, Bute Estate, Rothesay.
Donald M'Corquodale, Forester, Dunrobin Castle, Golspie.
William M'Lean, Forester, Eglinton Castle, Irvine.
C. Y. Michie, Forester, Cullen House, Banffshire.
James Robertson, Forester, Panmure House, Carnoustie.
William W. Robertson, Forester, Blinkbonny, Earlston.

England.

James Archer, Overseer, Haldon Park, Exeter.
James Bell, Strathfieldsaye, Winchfield, Hants.
James Rutherford, Agent, Kirkleatham, Redcar, Yorkshire.
Andrew Slater, jun., Overseer, Wyreside Cottages, Lancaster.
James Duff, Wood Manager, Bayham Abbey, Tunbridge Wells, Kent.

Ireland.

Robert O. Rutherford, Manager, Leinster Estates, Athy.
David Scott, Forester, Ballincourte, Tipperary.
John Blaikie Webster, Verner's Bridge, Moy.

14.—LAWS OF THE SOCIETY.

1. FUNDAMENTAL LAWS.

I. The name of the Society shall be "The Scottish Arboricultural Society."

II. The objects of the Society are,—the advancement of scientific and practical Arboriculture in all its branches, and the dissemination of a knowledge of such branches of Natural History as are connected with it. These objects are proposed to be attained :—

1. By holding meetings for discussion, and for the interchange of arboricultural and botanical information; for the reading of papers, original or translated, abstracts, or reviews of works bearing upon the objects of the Society, or regarding arboricultural knowledge—practical, physiological, geographical, and palæontological—and the application of such knowledge to constructive economy, manufactures, and the arts.

2. By publishing annually *Proceedings* and *Transactions*, including a list of Members, and Abstracts of Accounts and Funds of the Society.

3. By the formation in Edinburgh of a Museum of Specimens of British and Foreign Woods, and other articles of forest produce, or connected with Forestry, such as implements, models, etc., or specimens of geological formations specially suited to the growth of different trees and shrubs, and of a Library for general consultation and reference.

4. By encouraging the cultivation of such trees and shrubs of recent introduction, or of newer varieties, as may be found suitable to the climate of Britain, with the view of facilitating the study of their habits, uses, topographical distribution, and furthering the principle of exchange amongst the Members.

5. By directing, authorising, and assisting arboricultural excursions and investigations connected with Forestry or kindred sciences, to be undertaken in any part of Britain, or countries abroad.

6. By appointing Local Secretaries in suitable provincial localities, from amongst the Members of the Society, to co-operate with the General Secretary and Officials in Edinburgh in the interests of the Society, and from whom, in their respective districts, all information regarding the Society's objects and proceedings may be obtained.

III. The Society shall consist of two classes, viz.: *Honorary* and *Ordinary* Members. The ordinary membership shall comprise—(1.) Proprietors, Factors, Nurserymen, and others, contributing an Annual Subscription of Half-a-Guinea; (2.) Head Foresters, and others, paying an Annual Subscription of Five Shillings; (3.) Assistant Foresters, and others, paying an annual subscription of Three Shillings.

IV. All Annual Subscriptions shall be payable in advance, at the Annual General Meeting in November.

V. Members in arrear shall not receive their *Transactions* while their subscriptions remain unpaid; and any Member whose Annual Contribution to the Society has remained unpaid for three years shall cease to be a Member of the Society; and no such Member shall be eligible for re-election till he shall have paid up his arrears; and an annual list of those parties struck off the roll of Members from this cause shall be submitted and read by the

Treasurer to the Annual General Meeting in November in each year.

VI. Any *Ordinary* Member may become a *Life* Member by compounding for his Annual Subscription by a single payment; those of the First Class by paying Five Guineas, and those of the Second and Third Classes, Three Guineas.

VII. All Subscriptions and Life Compositions shall be paid direct to the Treasurer.

VIII. The Society may elect ten British and twenty Foreign *Honorary* Members, gentlemen who have acquired eminence in the science of Arboriculture at home or abroad, or who are otherwise deemed worthy, on the recommendation of the Council, and sanction of the General Meeting of the Society; but an *Honorary* Member who has not been elected from the list of Life or Ordinary Members of the Society, shall not be eligible for election as an Office-Bearer in the Society or to vote at any of its meetings.

IX. The Society may receive, from time to time, from those friendly to its objects, donations to its Funds, Museum, or Library, or Premiums to be given for the furtherance of any of its objects.

X. The Funds of the Society shall, with the concurrence of the Council for the time being, be invested in such security or securities as they shall approve, and shall be held in the names of three Trustees, for behoof of the Society, and the first Trustees so designated shall be Robert Hutchison, of Carlowrie; John Ord Mackenzie, of Dolphinton, W.S.; and John Hutton Balfour, M.D., Professor of Botany in the University of Edinburgh, as Trustees for the Society.

XI. A Candidate for admission into the Society must be proposed by at least one Member, and shall, on payment of his Annual Subscription, be immediately admitted a Member of the Society, subject to the revision of the first General Meeting thereafter. Any Member of the Society proposing a new Member shall be held to be responsible for the amount of the first year's subscription of such party.

XII. The affairs of the Society shall be conducted by a President, five Vice-Presidents, Secretary, Treasurer, Auditor, and fifteen Councillors—these Office-Bearers to be elected annually at the General Meeting in November—the two Vice-Presidents at the top of the list to retire by rotation annually, but one shall be eligible for re-election; the five Councillors at the top of the list shall retire by rotation annually, but two shall be eligible for re-election.

XIII. A General Meeting of the Society shall be held on the first

Tuesday of November in each year for the election of new Members, the appointment of Office-Bearers, awarding of prizes, the reading of papers, discussion on selected subjects, and for the disposal of any other business which can be competently brought before the Meeting.

XIV. An Extraordinary Meeting of the Society may be called at any time, upon ten days' notice, by authority of the Council, on the requisition of Twelve Members of the Society, who shall state precisely the objects for which they wish such Extraordinary Meeting to be summoned, and the business to be brought up shall be intimated to each Member in the billet calling the Meeting, and it shall not be competent to introduce or discuss any other subject or business at such meeting.

XV. Any proposal or motion for the alteration or amendment of the existing Fundamental Laws, or the enactment of new ones, shall be intimated in writing to the Annual General Meeting in November, but shall lie over for discussion till the following Annual Meeting, and be then determined by a majority of at least two-thirds of the votes of Life and Ordinary Members present, provided at least thirty Members are present and vote. Such motion shall be printed in the Billet calling the Meeting at which it is to be discussed.

2. BY-LAWS.

I. At any Meeting of the Society the Chair shall be taken by the President for the time being, in whose absence the Senior Vice-President present, failing whom the senior Member in the list of the Council shall preside.

II. The Chairman shall have a deliberative and a casting vote.

III. The voting, upon all occasions, except as specially provided for in Law XV. and By-Law XI., shall be in the option of the Chairman, either by a show of hands, or, in case of doubt, *numeratim*, *i.e.*, the Chairman shall ascertain the majority of the votes of Life and Ordinary Members present at the Meeting.

IV. In electing Office-Bearers, the Council shall suggest and recommend to the General Meeting the names of Members eligible to fill the vacancies. Such names to be intimated to each Member in the Billet calling the Meeting; and it shall be in the option of any Member present, to propose to substitute any other name or names, in lieu of any of those recommended; and in the event of this being done, and a seconder to the new proposal being found, the vote shall be taken, as between the name or names substituted, and those proposed.

V. Three Judges shall be elected at the Annual General Meeting, who shall adjudicate upon the Essays and Reports, and other matters offered in competition, and who shall be eligible for re-election. There shall also be elected a Publishing Committee, consisting of at least four Members, and of whom the Secretary shall be a Member *ex officio*, and shall superintend the arrangement and passing through the press of the Society's *Transactions.* There may be also elected annually a suitable person to act as Photographic Artist to the Society.

VI. The Judges of essays and subjects proposed for competition are, during their term of office, debarred from competition.

VII. Intimation of all papers intended to be brought before the Meetings of the Society must be given to the Secretary, and submitted to the Council, at least ten days previous to the Meeting at which they are to be read.

VIII. Any Member may transmit to the Secretary papers and communications, which, if approved of by the Council, may be read by the author, or, in his absence, by the President or Secretary, at any Ordinary Meeting of the Society.

IX. Any Member who may be awarded a Medal or Premium by the Society shall have it in his option to receive the value in money or plate; and in the event of his selecting any other article than a Medal, it shall be competent for him to adopt and use upon it the inscription which would have been engraved on the Medal.

X. The converted values of the Society's Premiums shall be: Gold Medal, Five Pounds; No. 1 Silver Medal, Three Pounds, or No. 2 Silver Medal and Two Pounds; No. 2 Silver Medal, Two Pounds; Bronze Medal, Ten Shillings.

XI. Local Secretaries in suitable districts may be from time to time appointed by the Council, but such nominations must be confirmed at the first General Meeting of the Society held thereafter. These appointments shall not confer on the parties receiving them any right to vote in the administration of the Society by its Council, but they shall act in the interests of the Society in the respective districts assigned to them, in securing new Members, and in furnishing information regarding the Society to the Members in their districts; and, for that purpose, they shall correspond with the General Secretary in Edinburgh, or with the Treasurer, in regard to parties in arrears, whose address has been changed or cannot be traced. The Local Secretaries shall not be called on to collect the Subscriptions of Members either in arrear or otherwise.

XII. It shall be in the power of any General Meeting of the

Society to fix or alter the time and place of Meeting for the next year, if, upon the votes of two-thirds of the Members present, this shall be deemed advisable; or to arrange for holding a Summer Meeting of the Society, in such place, and at such time, as may be deemed expedient.

XIII. Every Member of the Society shall have the privilege of bringing with him to the Annual General Meeting of the Society two friends, as Visitors, who shall, however, take no part in the business of the Meeting.

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