The cortex of course contains most ash, and the quantity of total ash increases with age and with height: these facts have been shown for other trees also.

In the wood proper, the quantity of ash *as a whole* increases from the periphery to the centre, but as we shall see that the distribution of the various constituents is very different in different parts, this generalization will have to be cut up into a series of less general statements. In the same period of growth the total ash increases with the height.

It is somewhat striking that the inner zones of the inner alburnum yield most ash, and thus the central part of the highest transverse section of the stem will contain most ash.

As regards the changes due to age, the ash per cent. decreases till the tree is about 60 years old, and then it increases rapidly for twenty years or so, gradually diminishing again with increasing age. These periods show such close relation to certain facts in the culture of the trees, that they are evidently explained somewhat as follows. During the first 60 years in the plantation, the young beeches crowd one another more and more, and the competing roots restrict one another, and the percentage amount of salts absorbed diminishes year by year: at or about the age of 60 years the trees are thinned by systematic felling, and so more space is given to those which remain, as well as more soil and ingredients from the decomposition of the roots, &c., of the felled trees. The consequence is the increase of ash to a first maximum. At the period about 80 to 90 years the beech has attained the seed-bearing age, and the probability that the diminution of ash henceforth is due to the drain to supply the seeds is too great to be overlooked.

It is interesting to note that shaded beeches, at all periods and in all parts, show a higher percentage of total ash than fully exposed trees, and the same is true of the silver fir (another tree which bears much shading): the trees store up mineral substances, which must be an advantage to them under the circumstances of growth.

If, instead of regarding the total ash, we now look at the constituents, it results that the enormous excess of ash in the cortex consists chiefly of calcium carbonate, from the calcium oxalate (which may form 70 to 90 per cent. of the whole). Much potash, magnesia, and phosphoric acid also occur.

In the wood, the quantity of potassium salts increases from the periphery to the centre; whereas the reverse is the case with the phosphoric acid, sulphur, and magnesia, a fact the more remarkable because the potash usually accompanies the phosphoric acid in other parts of plants —*e.g.* in leaves, &c. It is no accident, however, and the fact comes out that the beech forms large reserve stores of potash (this being the chief cause of the large increase of total ash in the interior of the stem), whereas the phosphoric acid and sulphur travel outwards with the proteids, being repeatedly used in metabolism in the cambium, &c.

We must pass over a number of other peculiarities of the distribution of the ash-constituents, to notice the effect of the age of the tree on the chief salts. The distribution of the potash, lime, and magnesia is little influenced by age, but an extraordinary effect comes out in the case of the phosphoric acid. The young tree starts with a relatively large quantity of this constituent, but the amount sinks year by year till the fiftieth or sixtieth year, and then rises again to about the ninetieth year, to fall afterwards: in fact, the behaviour is similar to what occurs with the total ash, and is doubtless to be referred to the same causes.

Another curious result comes out in studying shaded trees: whereas they take up as much potash and lime as exposed trees, their magnesia and phosphoric acid fall far below those of exposed trees. But the most astonishing discovery is that shaded trees *take up four times as much sulphur* as exposed ones. The analyst himself notes how astounding this is, but he insists that a second series of analyses gave confirmatory results.

Another queer fact is that the kind of soil exerts little influence on the analyses; though a similar conclusion has been come to with other plants.

The study of the absolute quantities of individual ash-constituents in 1000 parts of the dry substance brings out some interesting and important generalizations, which are expressed in the form of curves, and fully bear out in detail what has already been stated.

The quantity of ash and of each ash-constitutent in 1 cubic metre of beech-wood at various ages, as compared with the wood of other trees, is next investigated. The results show that the beech takes more potash than most trees except the *Robinia*—for instance, at 40 years it contains more than four times as much as the spruce fir.

As regards phosphoric acid, the beech and oak need more than other trees, beech-wood at 40 years old having seven times as much as spruce at the same age. With lime the facts are similar: beech needs much more than conifers.

From the whole of the preceding, it is possible to put together some ideas on the quantity of ash-constituents per acre needed for beech forests, and some interesting tables and curves are given in this connection; the return of minerals to the soil in the leaf-fall, &c., is also considered. Perhaps the most important conclusion come to here is that the increment in dry weight of the tree is nearly proportional to the up-take of potash, whereas the up-take of lime is the same—gradually increasing to old age—whether the wood is good or bad, and whatever the nature of the soil. The nitrogenous substance in beech-wood behaves very like the phosphoric acid, in that it diminishes from the tenth to the sixtieth year, and then ascends to a second maximum as the tree reaches 80 years old; and again, the cause is to be found in the influence of the thinning, and in the demands on the reserves when the tree begins to bear seed.

As in all trees, there is of course most nitrogen in the twigs and buds, and in the finer roots. Beech and oak need more nitrogen than other trees, and (so far as the wood goes) the conifers need much less. The total quantity of nitrogen taken up by the beech at 6 years old, in fully stocked plantations, is calculated to be 39·43 kilogrammes per hectare, and this rises to 389·63 at 60 years, and 896·50 at 130 years.

Calculations as to the quantity of nitrogen needed annually per hectare to produce the known yield of wood are then given, and again we meet with the rapid loss after about 90 years, due to seed-production. To these are added estimates of the nitrogen removed in the thinnings, and of that restored in the fallen leaves. All things considered, the quantity of nitrogen concerned annually varies with the age, but at the critical period of 50 to 100 years it amounts to something like 60 kilogrammes per hectare *per annum*.

It is unnecessary to point out further the extreme importance of such investigations as these: it is only in proportion as a nation is armed with statistics based on careful researches like these that it can form any conclusions worth having as to the future value of its forests and the technical merits of those administering them. As to their "practical" bearings, the results speak for themselves: if this is not allowed to be practical science, we may indeed ignore the cry.

H. Marshall Ward.

SPECTROSCOPIC RESEARCHES AT THE NORWEGIAN POLAR STATION.

PART II. of the Report on the results obtained at the Norwegian Polar Station at Bossekop in Alten (in connection with the International Polar Investigation, 1882–83) was recently issued at Christiania; and we have already said something as to the contents (NATURE, December 13, 1888, p. 155). The following is a translation of a statement, by Herr Cand. C. Krafft, in this Report:—

"For spectroscopic researches the Expedition took with them a Wrede spectroscope. Unfortunately the obligatory observations did not render it possible to devote adequate attention to spectroscopic researches. The writer may also specially note that the use of powerful magnifiers made measurements with the above-mentioned apparatus extremely fatiguing, and often quite impossible. It seemed to me all the more permissible to omit these measurements because the situation of the usual aurora-line is often very distinctly defined. Other lines besides these were only sometimes observed. Weak, indeterminable bands I observed on November 12, 4h. 18m. If I remember rightly, I saw similar indeterminable bands on another occasion, but I cannot find any notice of it in the observations. The red line was sometimes remarked, but it showed itself very conspicously, and flashed up only some moments (November 2, 9h. 15m.; November 17, 4h.). The general rule is that only the aurora-line was to be seen even in strong auroræ; as, for example, on November 2, 8h. 55m., during a crown-formation, and on November 5, 8h.–9h. on a bow with the intensity 2–3.

"In order to find the value of the scale-division of the spectroscope expressed in wave-lengths, I made, on October 30, 1882, the following determination of the most important Fraunhofer lines:—

B ...	25·04 ($\lambda = 6867$)	*a* ...	23·27 ($\lambda = 6276$)
C ...	24·16 ($\lambda = 6562$)	D (Mean)	21·78 ($\lambda = 5892$)
E ...	18·51 ($\lambda = 5269$)		
b (Mean)	17·84 ($\lambda = 5174$)		

"With the help of these determinations I constructed a curve, and obtained from it the following wave-lengths of the auroral lines:—

November 2, 8h. 55m. aurora-line (mean) 20·37 ... $\lambda = 5595$
November 11, 10h. 15m. aurora-line 20·26 ... ... $\lambda = 5586$
[D (NaCl flame) 21·71.]

"November 17, 4h. 20m.; Herr Schroeter found the following values:—

Aurora-line 20·37, 31, 34, 34 } Mean 20·34 ... $\lambda = 5587$
Red line 23·00 ... $\lambda = 6205$.

"On account of the rapid flashing-up and disappearance of the red line only this one measurement could be obtained.

"The spectroscope was used chiefly to decide occasionally, in doubtful cases, whether and how far the aurora was present—a matter which, as is well known, it is very often impossible to decide in any other way. Fine cirrostratus clouds may so closely resemble the aurora as to be taken for it, especially if they are lighted by the moon or by twilight. In the latter case one may recognize the aurora-line apart from the continuous spectrum (January 15, 12h.; March 29, 14h.). Meanwhile I do not think I can decide whether the aurora line is to be regarded as absolute criterion for the aurora; I have had an opportunity of observing pulsating masses of light (December 18, 9h.), and also otherwise inexplicable phenomena of light, as well with the usual aurora colour (January 13, 10h.) as with red (November 17, 6h. 15m.), without being able to discover the aurora-line. On a red mass of light it might appear very weakly, even if the light-mass shone powerfully (November 17, 16h.). Beside, the aurora-line was very often to be recognized everywhere. This sometimes made me think that the whole firmament was covered with aurora material, although the explanation may be that the line everywhere visible springs from an aurora, only slightly extended, reflected from fine clouds, &c., floating in the air. This reflected light showed the aurora-line even on objects on the earth (snow on a field, a wall), and even when the sky was pretty well covered (November 11, 10h.; November 12, 5h.; November 14, 8h.; December 15, 15h. 25m.; December 16, 9h.)."

NOTES.

THE Croonian Lecture of the Royal Society, which, as we have already announced, is to be delivered this year by M. Roux, the "Chef de Service" of the Pasteur Laboratory, has now been fixed for Thursday, May 23, at 4.30 p.m., in the Royal Society's apartments at Burlington House.

A GOOD many arrangements for the Newcastle meeting of the British Association, over which Prof. Flower will preside, have now been made. Among the Vice-Presidents are the Duke of Northumberland, the Earl of Durham, the Bishop of Newcastle, Lord Armstrong, the Mayors of Newcastle and of Gateshead, and Mr. John Morley. The following are the Presidents of the various Sections:—A—Mathematical and Physical Science, Captain W. de W. Abney, F.R.S. B—Chemical Science, Sir I. Lowthian Bell, F.R.S. C—Geology, Prof. James Geikie, F.R.S. D—Biology, Prof. J. S. Burdon Sanderson, F.R.S. E—Geography, Colonel Sir Francis de Winton. F—Economic Science and Statistics, Prof. F. Y. Edgeworth. G—Mechanical Science, Mr. William Anderson. H—Anthropology, Prof. Sir W. Turner, F.R.S. The first general meeting will be held on Wednesday, September 11, at 8 p.m. On Thursday evening, September 12, there will be a *soirée;* on Friday evening, September 13, a discourse on "The Hardening and Tempering of Steel," by Prof. Roberts-Austen, F.R.S.; on Monday evening, September 16, another discourse; and on Tuesday evening, September 17, a *soirée.* Excursions to places of interest in the neighbourhood of Newcastle-on-Tyne are being arranged for Saturday, September 14, and Thursday, September 19.

AT a recent meeting of the Executive Council of the British Section of the Paris Exhibition, the cordial thanks of the Council were given to Sir Frederick Leighton, P.R.A., and the Fine Arts Committee, for their exertions to insure that the Fine Arts Department at the Exhibition should be a credit to the British Section and the country. The result of the exertions of the Committee will be that British art will be represented in Paris by works of many of our foremost artists. Why is not like energy being displayed by English men of science? There ought to be a Science as well as a Fine Arts Committee, and the necessary arrangements might easily be made, as there are several members of the French Institute in England.

THE Directors of the Ben Nevis Observatory have applied to the Association of the Glasgow International Exhibition of 1888 for a grant from the surplus fund of the Exhibition. In the memorial setting forth the claims of the Observatory on the support of the public and of public bodies, reference is made to the immediate and important advantages that will result from the work of the High and Low Level Observatories of Ben Nevis towards the further development of the meteorology of the Clyde, in which Glasgow has taken so prominent a part, and by the results of which the shipping and commercial interests will to a certainty be largely benefited; and it is urged that, in carrying out these national objects, the Directors must look to the liberality of the public and of public bodies, for the assistance required to supplement the aid offered by the Government towards the completion and maintenance of this double Observatory.

THE Botanical Society of France has issued a circular signed by its President, M. de Vilmorin, and Secretaries, inviting foreign