adumbrated at the summit of the diagram, or a compound leaf with pinnate leaflets like the commonest papilionaceous type, as shown in the lower portion. These examples will at once make clear the principle that with very slight changes in the real structural composition of a leaf we may have very great differences in the resulting outline. How the various underlying types of venation themselves are acquired or modified we must consider at a later stage; for the present we must take them for granted as relatively fixed generic or tribal characteristics.

It may be necessary to warn the reader in passing that comparatively little importance must be attached to the particular circumstances of each individual leaf. It is the average circumstances of the species which give rise to the specific type. True, each particular blade cannot grow at all except in so far as material is supplied to it during its growth from the older and more settled members of the complex plant-commonwealth; but even when such material is supplied to it, it will only grow to the extent and into the shape which natural selection has shown to be the best on the average for all its predecessors. For example, no plethora of available material would make the sycamore or the oak produce leaves like those represented in Figs. 1 and 5; it would only make them produce a greater number of normal leaves like those represented in Figs. 2 and 7, since these embody the final result of all the past experience of the race—the residuum of countless generations of unsparing selection.

A single illustration of the way in which these general principles work can best be found, as a first example, in the foliage of the water-crowfoot (*Ranunculus aquatilis*, Fig. 9). This well-known plant, growing as it does in streams or pools, has two forms of leaf on the self-same branch, strikingly different from one another. The lower or submerged leaves, which wave freely to and fro in the water, are minutely subdivided into long, almost hair-like, filaments; the upper or floating leaves, which loll upon the surface of the stream, are full and rounded, though more or less indented at the edge into from three to six obovate lobes. Familiar as is this curious little English plant, the causes which give it its two types of leaves admirably illustrate the laws which we must employ as the general key to all the shapes of foliage throughout the vegetal kingdom.

First, as to the submerged leaves. These organs, growing in the water under the surface, have not nearly so free access to carbonic acid as those which grow in the open air. For the proportion of carbonic acid held in solution by water is very small; and for this small amount there is a great competition among the various aquatic plants. As a rule, the cryptogamic flora of fresh waters consists of long streaming algæ or characeæ, which assume filamentous shapes, and wave about in the water so as to catch every passing particle of the precious gas. When flowering-plants, like the water-crowfoot, take to inhabiting similar spots, their submerged leaves also tend to assume somewhat the same forms, and to move freely with every current in the pond or stream, so as to catch whatever fragments of carbon may happen to pass their way. In this case, there is no dearth of sunshine, no interference of other plants with the incidence of the light; the waving thread-like form depends solely upon the comparative want of carbon in the surrounding medium. The leaves have acquired the shape which enables them best to lay hold on whatever carbon there may be in their neighbourhood; any other arrangement would involve a waste of chlorophyll—a misplacing of it in an unadvantageous position. Full round leaves would be useless under water, because there would not be work enough for them to do there.

On the other hand, when the leaves reach the surface, they have room to spread out unmolested into an area singularly free from competing foliage. Here, then, they plim out at once into a larger rounded type, as they can obtain abundant carbonic acid from the air around, and can catch the unimpeded sunlight on the surface of their pond. The two cases, as Lamarck long since remarked, are somewhat analogous to those of gills and lungs; for though in the one case it is oxygen that is required, and in the other case carbonic acid, yet inasmuch as both are gases dissolved in water, the parallelism on the whole is very close.

It is to be noted, however, that in both cases the central ranunculaceous type of leaf is faithfully preserved in the ground-plan or framework. This central type of leaf is found in a rounded form in the lesser celandine (*R. ficaria*), and in the radical leaves of the goldilocks (*R. auricomus*). It is more divided and cut, or (to put the same thing conversely) less filled out between the ribs in the common meadow buttercup (*R. acris*). But in the water-crowfoot, the floating leaves remain very close to the rounded form of lesser celandine, though a little more lobed at the edge; while in the submerged leaves, we get hardly anything more than an attenuated skeleton of the venation, still essentially keeping up the typical form, though in a somewhat exaggerated and minutely subdivided manner. When one compares these submerged leaves with the equally filiform and minutely dissected submerged foliage of the water-violet (*Hottonia palustris*) and the water-milfoil (*Myriophyllum spicatum*), one sees at once that the same effect has been obtained in the various cases by like modification of wholly unlike ancestral forms. While assuming extremely similar outer appearances, all these plants retain essentially diverse underlying ground-plans.

Furthermore, there are various minor forms or varieties of the water-crowfoot in which minor peculiarities of like import may be observed. The form known as *R. fluitans* lives chiefly in rapidly-running streams, where none of its leaves can reach the surface; hence all its foliage is submerged, and deeply cut into very long, thin, parallel segments, which wave up and down in the rapids, and are admirably adapted to catch the floating particles of carbonic acid carried down by the water in its course. The variety known as *R. circinatus* grows mainly in deep still pools, where also its leaves cannot reach the top; and it has likewise submerged foliage with finely-cut segments, but the separate pieces are "shorter and more spreading," because this form is best adapted to catch the stray dispersed particles of carbonic acid in the quiet waters. The common type (*vulgaris* of Bentham) has both forms of leaves, floating and submerged, and grows mostly in shallow pools or slow streams. The type known as ivy-leaved crowfoot (*R. hederaceus*) creeps on mud or ooze, and has only the full three-lobed leaves. Finally, it may be noted that even the particular position of individual leaves here counts for something; since nothing is commoner than to find one of the finely-cut submerged leaves with a few upper segments floating on the surface; and these upper segments begin to fill out at once into broader green tips, thus giving the end of the leaf an odd, swollen, and bloated appearance.

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(To be continued.)

HERRING AND SALMON FISHERIES

AT a meeting of the Executive Committee of the Edinburgh International Fisheries Exhibition of 1882, which proved so successful, held on Wednesday, February 28, it was resolved, on the motion of Mr. John Murray, seconded by Sheriff Irvine, that the funds at the disposal of the Executive Committee be granted to the Council of the Scottish Meteorological Society to carry out the proposed investigations with reference to the herring, salmon, and other fisheries which are described in the Circular submitted by the Council with their letter of application to the Committee of May 23, with power to arrange for a zoological station, and with a recommendation that an application be made to Government for assistance. The sum granted is upwards of 1500*l.*

The results already obtained by the Scottish Meteorological Society in connection with the herring fishery show a close relation between the fluctuations of the catches and changes of temperature, wind, sunshine, cloud, thunder, and other weather phenomena. Thus the observations show, for the six years ending with 1878, that a low temperature is attended with large catches, and a high temperature with small catches. Good catches are also had when the temperature fluctuates about the average, and high temperatures, if short continued, scarcely diminish the catches. So far as the discussion of the observations has gone, it appears that the maximum catches are made when the temperature of the sea is about 55°·5, but this point requires further investigation. Thunderstorms, if widespread, are followed for some days with small catches over the region covered by them.

The Council has hitherto been unable, from want of funds, to complete the discussion of the observations already made; to inspect the fishing districts and confer with the fishermen, and thereby secure observations of the fulness and exactness which are required; and to carry on certain investigations in physics and in natural history which are essential to this inquiry. Of the physical investigations may be mentioned the heating power of the sun's rays at different depths of the sea, which appears to have important bearings, directly and indirectly, on the depth at which the herrings are caught. The inquiries in natural history are mainly those which concern the food of the herring and also the food of the animals on which the herrings prey, together with the influence of weather and season on the distribution of these animals in the sea. In carrying out the latter inquiries, the fishermen would be invited to assist, by entering, in schedules prepared for the purpose, observations as to the colour and appearances of the sea-water, due to the presence of minute organisms. As regards the discussion, it will be necessary to make weather maps of Scotland for each day of the fishing seasons—say upwards of 500—in which special prominence is given to charting the temperature, wind, cloud, thunder, and the other elements of weather which affect the fishings,—together with the catch of each day entered on the positions of the maps where they were severally made round the coast. From these maps some of the causes which tend to localise the shoals will become apparent.

The desiderata at present requiring to be supplied in carrying on the investigation of sea and river fishing are these:—1. Fuller and more exact observations of the temperature of the sea at the surface, and at different depths, by the fishermen at the fishing grounds. 2. The resumption of continuous maximum and minimum temperature observations at Peterhead, and the establishment of similar observations at other points round the coast. 3. The observation of maximum and minimum temperatures in other of the more important salmon rivers. 4. Daily temperature of the sea, by boat at some distance from land, at about six selected places. 5. The discussion of past observations, particularly of the herring fishings as described above. 6. Assistance of specialists in carrying on investigations into the food of the herrings, and into the heating power of the sun's rays at different depths.

We are glad to think that with the surplus funds of the Edinburgh Fisheries Exhibition, so wisely disposed of, the Scottish Meteorological Society will be able to prosecute their researches on these points with some hope of a satisfactory result.

NOTES

THE mathematical papers and memoirs of the late Prof. Henry Smith are, we believe, to be collected, and published in two volumes quarto by the Press of his own University. Miss Smith will contribute a biographical introduction; and the general editorship of the work, which will include a considerable quantity of hitherto unpublished material, will be intrusted to Mr. J. W. L. Glaisher.

IN NATURE for February 1 we gave a brief account of the remarkable results obtained by Prof. Lemström with his network of wires arranged up the face of the mountain at his station at Sodankylä, in North Finland. By this means he succeeded in procuring an appearance exactly similar to that of the aurora borealis. In connection with these experiments Mr. G. A. Rowell, assistant in the Natural History Department at Oxford, has issued a circular calling attention to the suggestion made by him forty years ago in reference to similar experiments. "My views on the cause of auroræ," Mr. Rowell states, "are that they result from electricity carried over with vapour by the superior trade-winds, from tropical to polar regions, and its occasional accumulation in the latter to such a degree as to flash back to lower latitudes, through the atmosphere at a reduced density, but still within the regions at which vapour is flotable although in a frozen condition. The directive properties of the magnetic needle I attribute to the return current of electricity from polar to tropical regions. The following is the concluding paragraph of the report on my paper on this subject:—'The author supports his opinion by general reference to the observations on the aurora, &c., in the appendix to Capt. Franklin's "Journey to the Polar Seas," and concludes with proposing the experiments of raising electrical conductors to the height of the clouds in the *frigid regions during the frosts in winter*, which in his opinion would cause the aurora to be exhibited and lead to important discoveries in the science of magnetism.'"—(*Report* of the British Association, 1840, *Transactions* of the Sections, p. 49.)

DURING the past winter, the weather in Shetland and the north has been more stormy than for a number of years. In evidence of the severity of the weather, the inhabitants of the Island of Foula, which lies about eighteen miles to the west of Shetland were only able last week for the first time this year to cross to the mainland in their boats. The large supplies of food laid in, as is usually done, were in many cases exhausted, and several families were only saved from starvation by help received from neighbours who were better supplied.

ARRANGEMENTS have been completed for an exhibition, on an important scale, of hygienic dress, sanitary appliances, and household decoration, under Royal and distinguished patronage, and under the direction of the National Health Society, at Humphreys' Hall, Knightsbridge. The exhibition will be opened on June 2 next. The exhibits will be divided into seven classes, and besides hygienic, rational, and artistic dress, will include food-products, appliances for the sick-room, home nursing and home education, industrial dwelling and cottage hygiene, the sanitation of the house and hygienic decoration, heating, lighting, and cooking apparatus, fuel, &c. The Superintendent is Mr. E. J. Powell, 44, Berners Street, W.

THE National Smoke Abatement Institution is making arrangements for opening a permanent exhibition in a central part of London in an extensive range of buildings, for the display of apparatus, fuels, and systems of heating, combining economy with the prevention of smoke, and the best methods of ventilating and lighting. The exhibition will be free to the public, and will include examples of all the most recent inventions and improved apparatus. A lecture hall for the reading of papers, and instruction classes will be provided; also testing rooms under the