those who take an interest in the progress of geography will doubtless think with us that such an exhibition adds one more to the many attractions of Paris; now that the Loan Collection is closed, nothing at all approaching it exists in London.

TEMPERATURES AND OCEAN CURRENTS IN THE SOUTH PACIFIC

IN the *Annalen der Hydrographie und maritimen Meteorologie* (Jahrg. iv., 1876, Heft 6, p. 219), Herr von Schleinitz, a member of the recent expedition in the German corvette *Gazelle*, states his views on ocean temperatures and currents; these are somewhat different from those expressed by Sir C. Wyville Thomson (Proc. Roy. Soc., vol. xxiv.), which are based on the data obtained during the *Challenger* expedition. The *Gazelle*, after leaving Auckland (New Zealand), pursued a course almost due north as far as the Fiji Islands; thence she proceeded to the Samoan Islands, situated at a short distance north-east of Fiji. After a brief excursion to the Tonga group and back, the *Gazelle* (from long. 172° 18'·5 W., and lat. 14° 28'·1 S.) sailed some 2,500 nautical miles in a south-south-east direction (to long. 141° 11'·4 W., and lat. 45° 33'·6 S.), after which she took a due easterly, and later on, a south-easterly course, to Magellan's Straits (long. 80° 30'·3 W., lat. 51° 41'·6 S.). The observations of temperature on the long cruise between the Samoan Islands and the Magellan's Straits are of special interest, as the course taken by the *Gazelle* lies to the south of that pursued by the *Challenger*.

On the first part of the course described, which has a direction nearly coinciding with the meridian, eight series of observations of temperature were made. The bottom profile of this part shows a peculiar absence of elevations, which is all the more remarkable when compared with any similar profile of the same length in the Atlantic.

The conclusion arrived at by Herr von Schleinitz, and based on the results of his observations is, that in the Pacific the arctic deep-sea current crosses the equator in a southerly direction and meets the antarctic current only between lat. 30° and 36° S. This is just the reverse of what takes place in the Atlantic, as it seems highly probable from the observations of both the *Challenger* and the *Gazelle* expeditions, that in the Atlantic the antarctic deep-sea current passes the equator, running northward of the same to a considerable distance.

Herr von Schleinitz concludes from these latter observations, that if the antarctic deep current enters the North Atlantic, even as a current of limited breadth, it must nevertheless carry enormous quantities of water from the South Atlantic to the North Atlantic, as it is certain that the current has a depth of more than 1,000 fathoms on the average. He then asks the question, What becomes of this mass of water? There is no strong surface current in existence which carries it back to the South Atlantic; even the current caused by the south-east trade winds runs more towards the Gulf Stream than towards the Brazilian coast current. There seems only one hypothesis possible, viz., that a great part of the water flows through the Arctic Sea and Behring's Strait into the North Pacific, and that may be the cause of the preponderance of the arctic current of this ocean over its antarctic one.

The natural conclusion drawn from this is that the South Pacific, in order to complete the whole circle, gives a great part of its waters to the South Atlantic, and as a proof of this it might be pointed out that the ice limit does not approach the equator so much anywhere as it does in the South Atlantic.

The following facts may also be mentioned as in favour of the hypothesis of a certain regular circulation taking place in the manner described. A comparison of the air-isotherms as well as the sea-isotherms both of the Atlantic and Pacific Oceans shows that (1) the South Atlantic is colder than the North Atlantic; (2) the North Atlantic is warmer than the North Pacific; (3) the South Pacific is warmer than the South Atlantic.

The higher temperature of the North Atlantic Ocean has hitherto been generally explained by the influence of the Gulf Stream. But a similar current exists in the North Pacific, and yet this is colder. There is no doubt that the Gulf Stream has a warming effect on some European coasts, but it is very probable that considering its comparatively small breadth of about 100 nautical miles, and shallow depth of only 100 fathoms, the stream is far too insignificant to be able to exercise a perceptible influence upon the climate of the whole North Atlantic and of the coasts surrounding this ocean.

On the other hand it does not seem to have been sufficiently appreciated hitherto, that a very large part of the North Atlantic is filled by water, which has crossed the equator, even if at a considerable depth. However trifling the rise in the temperature of this water, as caused by the passage over the equator, may be, when compared to the general temperature of the South Atlantic, it is nevertheless a fact that there is an important amount of heat, which the South Atlantic loses and the North Atlantic gains, on account of the very large extension of the current. Nor can it be objected with regard to this, that the mean temperature of that mass of water is probably below the mean temperature of air in the North Atlantic, because there is no question of absolute heat, but only of difference of temperatures between the North and South Atlantic.

The excess of water in the North Atlantic, which is not carried back into the South Atlantic by the surface-currents, and which passes through the Arctic Ocean (where it loses the heat it possessed) into the North Pacific, causes a decrease of temperature in the latter, and, proceeding southward, *i.e.*, again crossing the equator and thus absorbing heat, produces an increase of temperature in the South Pacific. Finally, the South Pacific gives back to the South Atlantic a part of that water at a very low temperature, which originally flowed from the latter into the North Atlantic perceptibly heated, on account of its passage through the tropics.

This circulation, however, is not to be understood as if the lowest strata of all the oceans took part in it; on the contrary, there are doubtless only single currents in the lower strata which follow it, while others may flow in an opposite direction. Further observations will throw light on these hypotheses; those made up to the present are yet insufficient and at times even contradictory. At the same time it must not be overlooked that a constant exchange of water between the lower and upper strata, *i.e.*, currents flowing in a vertical direction, are proved to exist beyond doubt, particularly in certain zones.

In conclusion Herr von Schleinitz considers the oceanic system of currents to be evidently a very complicated and at present obscure one, upon which the observations made on board the *Challenger* and the *Gazelle* throw but a very faint light.

The second part of the course pursued by the *Gazelle*, as described above, did not differ sufficiently in latitude, and therefore could not furnish any data which would be useful or decisive on the subject in question. However, the observations which were made give results in complete accordance with the hypothesis referred to above.

ON THE MEANS OF PROTECTION IN FLOWERS AGAINST UNWELCOME VISITORS

THE phenomena relating to this subject, which have important bearings on the doctrine of selection, have recently been discussed by M. Kerner in an interesting monograph communicated to the *Festschrift* published on occasion of the twenty-fifth anniversary of the Zoo-

© 1877 Nature Publishing Group

logico-Botanical Society in Vienna. The following is a brief outline of this paper:—

M. Kerner, first of all, thinks it unwarrantable to divide the characters found in plants into *physiological*, which bring their possessors a certain advantage, and *morphological*, which are of no advantage. While, no doubt, profitless and even disadvantageous formations occur in plants, it is yet certain that such individuals are soon extinguished and suppressed by others which bear advantageous characters. Most of the so-called morphological characters have rather a certain biological significance, and it is only from the lack of observations regarding them that the material for their comprehension is so defective.

Hitherto study has mostly been directed to the relations between the forms of flowers and those of the animals visiting them. M. Kerner gives an account of those manifold forms hitherto regarded as only of morphological significance, but the use of which is to guard flowers against uninvited guests and against all injurious influence, and attacks to which they may be exposed; these forms therefore are of essential biological value.

How numerous are these enemies and uninvited guests will appear from the following brief sketch:—First, there are the large grazing animals, such as the ruminants, solipedia, &c. Then there are snails, especially the voracious Helicidæ, which, indeed, are seldom found in the flowers, not because they despise them, but because they are kept from them by a group of stiff bristles and prickles underneath the flowers. The same holds for soft insects, especially many larvæ of caterpillars. The wingless aphides are, specially among soft insects, to be noted as unwelcome guests of flowers. They are found extremely seldom in flowers, being warded off by suitable means, but if they are carried into the flower they immediately force their proboscis into the sappy tissue. The insects with a firm chitinous skeleton, again, easily pass over the bristles and prickles; only their posterior feelers are sensitive to contact with sharp points. Among animals of this class those are injurious to flowers which, in consequence of their too small size do not, in passing through to the nectar at the bottom of the flower, brush against either the anthers or the stigma. They take away the nectar without effecting fertilisation. But even when the chitinous insects are of the proper size they are unwelcome to flowers if they are wingless, for in that case they are a comparatively long time in reaching the flower of another individual of the same species, and the pollen with which they are laden is exposed to so many hazards, that fertilisation by these insects is extremely improbable.

Now the means of protection against access of these numerous animals are very various, as we shall presently see.

We may first notice the protection afforded by the leaves, which produce the building materials of the flowers and are necessary to their growth. They afford protection through certain alkaloids and other compounds contained in the cell-gap, and also through a hard leather-like consistence and thorny processes by which a portion of the leaves are protected from injury by grazing animals.

The means of protection in the flowers consist, first of all, in the production of matters which are repugnant to some animals; such are alcohols, resins, and etheric oils, to which a number of the unwelcome guests have such a dislike that they will rather endure the sharpest hunger than eat these plants.

A second kind of protection consists in prevention of approach to the flowers by isolation of these with water, as is the case in the Bromeliaceæ. Generally the foliage leaves have funnel-like forms in which the atmospheric precipitates, rain and dew collect and so form an insurmountable barrier to the passage of creeping, wingless insects, while the access of the flying insects which affect fertilisation is not prevented. The water-plants are also defended against unwelcome guests which might otherwise creep to them; and it is very remarkable that in water plants with projecting flowers, other means of protection against creeping animals are wanting; they are only developed when the isolating layer of water, from some cause or other, disappears. Very instructive in this relation is the behaviour of *Polygonum amphibium*. To the flowers of the plants growing in water, creeping insects cannot come, the flowers being surrounded with water. When, however, the water has run off and the plant is on dry ground, there develop on the leaves and stalks gland-hairs, which secrete a sticky matter, rendering the flower-bearing axis all smeary, so that access is equally forbidden to the creeping insects. If, now, a plant of Polygonum bearing these gland-hairs be put in the water again, the trichome-tufts with their sticky material disappear, and the surface appears once more smooth and even.

Such a formation of sticky matters is developed in very many plants as a sure protection against unwelcome visitants. These sticky matters appear on the most different parts of plants, under the flower, and ward off especially creeping, but also unwelcome flying animals from the flowers. The variety of the glandular forms yielding sticky matter is very great, and their occurrence is very widespread.

While these sticky matters are effective against creeping animals which have a pretty firm chitinous coat, and especially against ants, they are ineffective against the soft creeping animals, *e.g.*, the snails, which secrete slime on the sticky parts of the plants, enabling them to pass over these. Against such enemies the plants are armed with the most various thorns, prickles, and sharp teeth, which mostly have their points directed downwards, but may have the most diverse positions and forms. Quite peculiarly interesting are those prickles and needles, which serve the purpose not so much of keeping off unwelcome visitants as of showing to the insects which visit the flowers the right way for effecting fertilisation; whereas if the same insects visited the plants and removed the nectar by another way, fertilisation would not be accomplished.

The means of protection thus far described are all on the path which the unwelcome guest must traverse if he would reach the flower. There are other means of defence, however, within the flower itself. These, indeed, cannot be regarded as absolute, for they may be overcome by unwelcome visitors. They consist of hair-like formations, which are united in large numbers, into grating-like groups, rendering access impossible to one animal, while to another, which is furnished with a longer, thin proboscis, or can drive with greater force against the grating, they yield the desired food. These soft hair formations, which have the most various modifications towards the end in question, also often serve to point the way by which welcome visitors may reach the nectar.

Where all the formations that have been mentioned are wanting, protection is still afforded by bends, enlargements, and collocations of particular parts of plants, which are so diverse that it is difficult to indicate them cursorily. In general they may be divided into two groups, one of which comprises those formations by which the nectar is completely covered, whereas in the other the entrance is merely narrowed so that an opening remains by which the animals may introduce their sucking organs. The most different parts of the flower share in these formations, producing a very great variety of forms.

A last means of protection of flowers is represented in those numerous cases in which the flowers open only in the evening, and thereby are guarded against the visit of insects which swarm during the day. Further, there is the diversion of injurious insects, due to the fact of the nectaries being sometimes situated in other parts of the

© 1877 Nature Publishing Group

plants, and mostly in the foliage leaves, so that creeping insects satisfy here their need of food, and do not trouble themselves about reaching the flowers higher up, and thus these remain protected from their visits.

"From the foregoing obervations," says M. Kerner, "it will sufficiently appear that the relations of plant-form to that of animals living at the expense of plants are far more manifold than has hitherto been supposed, and that especially numerous formations in foliage-leaves and stem are so far of biological significance that by them protection is afforded to the flowers against the prejudicial visits of certain animals. Where the attacking animals are absent this defence is also, naturally, useless, and therefore all these formations are properly to be regarded as means of protection only for those plant-stocks which occur in their original region—in the region where the species to which they belong has arisen. In another place they are perhaps not means of defence; indeed they may even be of disadvantage, or their formation there is at least something superfluous, not in the economy of the plant, and as a matter of course, these disadvantageous, because not economically organised plants, when they come under conditions which are not in harmony with their form, are driven out of the field by competitors that are more advantageously organised.

"If, for example, a plant species comes, in course of its migrations, into a region in which it is exposed to other attacks, or if the external relations in the place where the species arose (and with which it was formerly in agreement) are altered, it may become more and more rare, and gradually quite die out. Among these changes of external relations, however, are to be understood not merely changes of climate; a not less important part is played by the changes which occur in the animal world in a particular region. Apart altogether from changes in the extent of distribution of animals, the animals vary as well as the plants, and individual varieties, which occur with new characters that are advantageous relatively to given external conditions, may become the starting point of new species. What is of advantage, however, to the animals which attack the plants, constitutes, as a rule, a disadvantage for the attacked plant, and it is therefore not only possible, but in course of time it has actually often happened that in consequence of the multiplication of an advantageously organised animal form in a certain region, some plants in this same region having their flowering function destroyed, and their formation of seeds hindered, have disappeared gradually from the scene.

"While, on the one hand, the dying out of certain species with altered external relations, is at once explained by changes in the attacks of animals, the same relations, on the other hand, afford an explanation of the phenomenon, that under similar external conditions, plant species, which, with reference to other characters, are classed under the most different genera and families, do yet in certain formations agree with each other. Only the advantageous forms can maintain themselves, and only those individual varieties which appear with characters that are advantageous with reference to the conditions presented by the locality and position become the starting-points of new species. Since, however, the creation of new species in this way may occur in the most different plant-families, it is explicable that we find, *e.g.*, in one floral region, very many species of the most different stocks guarded with prickles, in another floral region such species furnished pre-eminently with flowers very rich in nectar, and that often even the character of the whole vegetation is determined by the preponderance of plants with like formations. Owing to the fact that the variety of the means of protection, as well as of the means of attraction is very great, and that through formations of the most different kind the same result can be reached, this conformity is again, of course, greatly limited. Indeed, precisely by this circumstance that, against the same prejudicial attacks, very different formations may serve as equally good means of defence, is the phenomenon explained that frequently several species of a family occur beside one another, without entering into competition in this relation, because the species, each after its own fashion, possess equal advantages."

THE ACTION OF THE WINDS IN DETERMINING THE FORM OF THE EARTH[1]

IN view of the most recent discoveries in the region of physics, especially with regard to the nature and properties of forces, it became necessary *eo ipso* for dynamical geology to give up as unsatisfactory the division of geological forces into "igneous" and "aqueous," and to substitute a division of them into "primary" and "secondary"; of which the former explain all the motions which we observe on and in the earth, according to their origin and nature; while the others—one might call them "agencies" to distinguish them from the first—would teach us what and how great changes in the figure of the earth's surface are produced by the bodies so moved, through reciprocal action on each other. Sensible of this inevitable reform in dynamic geology, the author of an essay entitled "The Action of the Winds on the Configuration of the Earth," sought to call attention to the gaps hitherto existing in physical geography, and especially to show what a mighty and yet hitherto very little observed agent the wind is, considered as one of these secondary geological forces. In the following paper the author offers to the readers of NATURE a *résumé* of his memoir.

It is at once evident and conformable to nature that the winds are to be regarded, in the first instance, as a proof of the unequal insolation at different points of the earth's surface, but, in their direction and variation, they are immediately influenced now by the position of the sun, now by the earth's rotation and the distribution of the solid and the liquid; that the winds are, on the one hand, a product of these geophysical actions, and, on the other, become a special factor, of which not only the meteorologist, but also, in front rank, the geologist, is called on to take account. Since, that is to say, it is purely the winds which determine the condition of moisture of the atmosphere, and have to perform the *rôle* of distribution of rain over the entire surface of the earth, but at the same time, in their constant circulation from the equator to the poles and from the poles to the equator, represent an imposing motive force, it is obvious that to be able to prove and establish more fully their geological *rôle*, one must consider them in this twofold relation; on the one hand as a climatic-meteoric, on the other as a mechanical agent. Accordingly the essay referred to treats, in its first part, of the climatic-meteoric, in the second, of the mechanical action of the winds; while the third part comprehends those actions of the winds which they perform indirectly either in meteorological or in mechanical relation.

More particularly the *First Part* is concerned with the characteristics of the two principal wind systems, the polar and equatorial currents, and with their reaction on those continents and mountain-chains, by which, in their typical course—as is manifest on oceans and neighbouring coasts, especially west coasts, of continents—they are variously disturbed. The equatorial currents here appear as properly the distributors of precipitation, and therefore as the principal factors by which the transporting power of flowing water, or generally the levelling action of water on the earth's surface, is produced. The polar currents, on the other hand, discover a tendency to act contrary to the work of the equatorial currents, that is, to restore the precipitated water in vapour form to the atmosphere, and generally to further evaporation. In view, however, of the fact that not all the water, which by action of the winds is precipitated on the solid land, returns to the ocean or the atmosphere, these two air-currents together appear to be similarly empowered to empty entirely, some time, the immense water-basin of the earth from which they continually procure anew their freight of water, and meanwhile to continuously lower the sea-level, through by a very small quantity, and therefore to take a prominent part in the so-called secular elevation of continents.

These two air-currents, indeed, are not everywhere and always true to the character just given. On the contrary, when they have to accomplish a great work, and especially when a polar current has to rise over a lofty mountain, or an equatorial current

[1] Abstract, by Dr. Francis Czerny, of a memoir of his in the 48th supplementary number of Petermann's *Mittheilungen.*

© 1877 Nature Publishing Group