BOTANY UP TO DATE.

A readable article by R. Francé on "The Form-Feeling of Plants" appears in Ueber Land und Meer. It begins by speaking of the revolution in natural history effected in Germany (in common with the other countries in which that theory has been accepted) by Darwinism, and what it has led to. The adaptation of the instruction in natural history in the German intermediate schools to the progress of the science in the last ten years, no longer making the naming and recognition of plants and animals, and their ranging into systems, the main point, but "the introduction of the pupils into the manifold phenomena of Life," will now, the writer declares, "for the first time implant the genuine love and understanding of Nature enduringly in the rising generation."

For the first time, in the last decade the plant was recognized in its true nature. And in uninterrupted sequence since then, two young yet aspiring sciences, plant-physiology and plant-ecology, have made the surprised learned world acquainted with what is new and almost incredible; using the abundance of intricate and most skillfully adapted phenomena of life which show that the plants, apparently so quiet, through sensation and a kind of "experience" share in life's joy and sorrow equally with all other creatures. There was discovered in quick succession in the higher plants a number of (partly even intricate) organs of sensation which prove that the plant is very noticeably sensitive to pressure, to the attraction of gravitation (scarcely perceptible to us), to touchings, to the proximity of nutritious substances.

One of the most recent physiological discoveries has, however, not yet gone beyond the specialists, and yet it gives such a deep insight into the strangeness and (according to our other ideas) foreignness with which the life of plants expresses itself, that it must be of greatest interest to the widest circles. This is the form-perception (morphæsthesia) of plants. This strange name the Berlin botanist, Prof. Roll, inflicted recently upon the fact discovered by him, that the position of their organs exerts a stimulus upon plants. In experiments with sprouts and young specimens of the most varied food-plants, he noticed that on their vertical or bow-shaped principal root, the little side roots are always so arranged that they stand only on the convex side of the curvature. This strange behavior can be no accident, for it is found throughout their distribution among all examined plants—ferns as well as trees and shrubs. The layman would probably find in this behavior only an interesting fact; the botanist was forced to say to himself that a phenomenon of such universal scope could only be the expression of a special obedience to law. Roll investigated it also in experimental ways, and forced roots into certain artificial curvatures, with such success that the new-forming little side roots formed themselves again only on the outward-curved side of the principal root.

It thus appeared that the organs of plants are bound to a quite fixed mutual position; and this, all at once, sheds light upon many relations hitherto enigmatical. It had long been noticed that all plants have an appearance highly characteristic of them and exactly determined, i. e., brought about by the fact that, in all variability of size, of leaf-forms, of exuberance in the development, yet the mutual place of the branches, leaves, and blossoms is fixed with perfect regularity—somewhat as different buildings are obliged to correspond with each other, when they are built in the same style. This was called 'the habit of plants. It is unconsciously familiar to everyone schooled in nature, for this habit it is by which from a distance the woodsman can distinguish, e.g., the fir tree from the pine tree so like it.' By the most varied considerations (the discussion of which here would lead too far), attention now came to be given to the question of the single factor by which this habit is governed; and it was found that it is caused, first and foremost, by the arrangement of the side limbs, branches, twigs, leaves, which for every plant produce a mathematically constant type. Within this type, then, the individual variation creates the differences between the single plant-individuals, which otherwise would have to resemble each other as one egg another. This individual variation, however, depends upon the nourishment conditions and the fitness of the individual for its special life conditions. That was a very significant discovery, which first makes the special life of plants comprehensible to us. They possess the capacity in the most wonderful fashion always to make the most of the given circumstances and adapt themselves to them so as to reach the normal life conditions. The best witness thereto is their habitat.

As this capacity was investigated, the most incredible proofs were reached with what exquisite adaptation to plan the forces of Nature act. For example, the leaves of plants stand in a fixed order, so that all may share the sunlight. This is the case even with the thickest-foliaged treetop. All the branches, twigs, and petioles grow in such fashion that this aim is reached; in subservience to it, too, leaves place themselves according to need diagonally, horizontally, or at the top vertically, to avoid unnecessary shadow. It had often been asked why the leaves of different plants are cut up, lobed, and sinuate in so wonderfully manifold a manner. The answer was received when it was noticed that, beheld from above (and so from the standpoint of the sunlight), each sinuation makes room for the projection of a leaf, from below or above. . . . There had, all at once, been found the explanation of the inconceivable variety of the leaf forms. If nothing else will do, the topmost leaves perforate themselves merely that some sunlight may be made possible through the rifts. This will be found the case with the favorite foliage plants, the philodendrons, which, just by reason of these elegantly perforated leaves, acquire an appearance so odd and hence so useful for gardening purposes.

This mutual struggle for light that is peaceably adjusted by mutual accommodation (what an admirable natural prototype of the social struggle!) is, however, renewed in a tree each year, since the old relation of equilibrium is disturbed by the new twigs. But that it is nevertheless always brought about again proves that the plant possesses, not an inherited, general, but an individually variable capacity therefor—which is not thinkable, without a feeling for the existent bodily form. This necessarily caused the plant physiologists to claim that the form perception (previously studied by Roll in the roots) it is that prescribes for the branches and leaves, too, their always orderly mutual position. And it was an admirable confirmation of this view that the characteristic habit of plants always seeks of itself to establish itself again, when it was disturbed by any kind of elemental injuries, as storms, floods, and the like. This form-feeling explains also the strange and otherwise wholly enigmatical plan-following of the tendency of growth in twigs and branches, which prevents the boughs of trees from mutually hindering each other and in growing injuring each other.

To how high a degree this strange perception advances the most serviceable processes of plant life, a new proof at once appeared from a different quarter. Prof. Neger, of Eisenach, called attention to the fact in how remarkable a manner many plants are seen that are compelled to gain a bare living on steep precipices. In the German secondary chain of mountains, are usually found in such places small specimens of the universally-known chickweed or of herb-robert (*Geranium Robertianum*), which, rooted merely in a crack, would at once lose their hold and indolently hang down, if they could not help themselves in this serious predicament in a very peculiar way. To wit, they bend downward the stems of some of the bottommost leaves and lay the leaf surfaces closely upon the rock or the mosses flourishing thereon. The stems of these leaves at once become stronger and form themselves into organs of support, by means of which the plant stands even upon the almost perpendicular wall as if upon firm feet. Of course the leaves used for such purposes soon die off; the petioles, however, remain vigorous and sound, and finally often the whole plant stands upon a scaffold on stilts composed of such petioles, which possesses the still further advantage that dust, earth, and the like collect upon it—sufficient material to improve the scanty soil for the unassuming plant. The building of these remarkable stilt apparatus is no work of accident, but lies (if one dare so express himself) in the *intention* of the plant. For, when Prof. Neger cut off some of the supports, some of the bottommost leaves at once sank down and formed a new support. In the highest degree worthy of note was it, that for this were used only the leaves to be turned down from the rocky wall *outward*—thus only those that were alone available for effective support. All these facts doubtless rest upon the form-feeling, upon a stimulation from the abnormal position of the individual that had as a result the movements of the leaves remedying the evil.

An explanation of form-feeling we cannot at present, it must be admitted, give. We can only help ourselves by saying that this capacity is one of the universal properties of animate matter. One, however, feels in so doing that this kind of explanation is really merely a paraphrase of the facts, and does better, indeed, quietly to confess that we here stand again before a riddle of life. Only of this there can be no doubt: we must ascribe to the plants a richly-developed sense-life. They possess all the beginnings of perception, and perhaps even of finding their bearings in the universe. The same life throbs in them, though less developed than in ourselves; and it is, indeed, more than a mere poetic simile, when our greatest poet speaks of our brothers in forest and plain and field.

NEW SULPHUR PROCESS FOR THE PRESERVATION OF WOOD.

Consul R. M. Bartleman, writing from Seville, says that the faculty of wood to withstand atmospheric pressure is so small, compared with its mechanical resistance, that a close study of new systems aiming at its preservation is of great interest industrially.

All the wood preservative methods now employed are defective in so far as they make use of solutions the evaporative nature of which makes their action upon the wood effectual only for a certain time. The new method in question, which has been patented in Germany, goes further and utilizes a fixed body which becomes solid upon being instilled into the pores of the wood. This substance is sulphur, the physical properties of which offer interesting advantages, being fusible at about 115 degrees, a temperature which the wood can support without any perceptible change. The sulphur is applied in liquid form, and in hardening completely fills up all the interstices of the fibrous tissue.

Although sulphur oxidates easily if subjected to a high temperature, at a medium temperature it remains impassive, resisting not only the influence of water but also that of acids, concentrated or diluted, and alkaline solutions, if cold. The reason why the utility of sulphur in the direction indicated had not been recognized ere now was on account of its small mechanical resistance, pure sulphur being very brittle and pulverous. But as wood possesses the quality of mechanical resistance of which sulphur is devoid, the compound of these two bodies may, under the proper conditions, easily acquire valuable industrial properties, as, for instance, the vulcanized caoutchouc, which the wood, impregnated with sulphur, resembles a good deal.

To protect wood by means of sulphur the following must be observed, viz.: Sulphur is fused in a befitting receptacle, making use of steam to avoid an excess of heat, which deteriorates the sulphur. Into this liquid, and at a temperature of about 140 deg., are steeped the boards which are to receive the treatment, care being taken to immerse them completely. The foam which gathers at first, called forth by the separation from the wood of the air and humidity it contains, disappears at the moment the wood thoroughly assimilates the temperature of the bath, which is then lowered to 110 deg. At this point the sulphur becomes hard and, while the air contracts itself, the sulphur penetrates into the fibrous tissues, propelled by atmospheric pressure. The boards are then slowly withdrawn from the bath, allowing a thin and even coat of sulphur to form and cover the wood, as any superfluous surcharge can be removed only with the greatest difficulties afterward. This coat of sulphur has a vitreous appearance and forms a very tenacious crust, excluding all tendencies to chip or break.

The degree to which the wood is impregnated varies according to the nature of the wood, the temperature, and the duration of the bath. It may be gaged by the increase in weight of the boards, which amounts to from 30 to 35 per cent where the process is conducted in an open receptacle, and to 100 per cent if in a vacuum pan. Theoretically it may be said that a complete fullness of the pores of the wood would increase its weight by 200 per cent.

In numerous experiments poplar was the best wood to take the sulphur treatment. Oak and pine wood do not admit of the process quite so favorably, because their dry distillation begins at 140 deg., which can be proved simply by observing that while the wood is immersed in the bath bubbles are continually rising, marking the escape of volatile substances. Moreover, the resin blackens the sulphur. The process in question has up to date been applied only to thin boards, but in view of the satisfactory results the hope is entertained of its soon becoming popular for timbers.

BOLOMETRIC MEASUREMENTS IN WIRELESS TELEGRAPHY.

The experiments in bolometric measurements carried out some years ago by C. Tissot, which were published in Inst. Elect. Engin. Journ., were in all respects similar to those of Duddell and Taylor with a sensitive thermo-detector placed in the aerial. This was in the form of a Langley bolometer, carefully insulated from heat disturbances by a vacuum jacket or otherwise. The sending and receiving aerials were "simple," i. e., direct connected. It was found that by varying the value of a non-inductive resistance arranged in series with the instrument in the receiving aerial there was a best value for the resistance from the point of view of the energy absorbed. Tests carried out in 1904, with aerials tuned to minimize the harmonics, up to distances of 9 kilometers showed that the received current varied inversely as the distance. These were extended later to 40 kilometers, and agree with the law given by Duddell for greater distances. The results of Duddell and Taylor, which show that the effective value of the current observed is proportional to the square root of the number of wave trains per second, were also confirmed. The following figures show the variation of received current with distance; the sending current being 2.8 effective amperes with 26 sparks per second; at distances 1.15, 8.0, and 40 kilometers the received currents were 8,290, 1,180, and 235 microamperes respectively, the product current × distance being 9,550, 9,450, and 9,400 in the three cases respectively. These values are likewise in agreement with Duddell's results.