bined with such figures, as on the Northwest coast, although the general style of art of the object is not like Haida or Kwakiutl work, but more like the carvings of Puget Sound and the lower Columbia River. The fact that the carving of this face is more in relief helps to explain the intent of the author of the Tampico specimen.

The other specimen is a quill-flattener, made of antler (Fig. 6). It was obtained by Dr. Clark Wissler from the Dakota at Pine Ridge, South Dakota, who also made reference to other objects of the same sort among the tribe. Porcupine quills were flattened on it with the thumb-nail. The object in general resembles in shape and size the specimen from Tampico. The slight indications of the hair or head-dress, the deeply cut eyes and mouth in the concave side, the holes or ears at the sides of the head, and the method of indicating the arms by slits, setting them off from the body, are all details which emphasize this general resemblance. The technical work is about as good as that of the Tampico specimen, but the art work is inferior. On the surface are twenty-six horizontal incisions, which were interpreted as year counts. The general shape of the body and the rows of dots are similar to those of the figure pecked on the cliff at Sentinel Bluffs. (See Fig. 7.)

The Tampico specimen may have developed from a quill-flattener, which implement was probably of common and characteristic use among Indian mothers, not only of the plains, but also as far west as Tampico. If the result of such a development, it had probably lost its domestic use and become entirely symbolic.

The head-dress seems to be a so-called war bonnet, and would indicate that the figure was that of an important personage; perhaps a suggestion of what had been hoped for the child's position in the tribe or after death. The arms, body, legs, and feet are apparently bare and ornamented with ceremonial paintings, while about the waist is an apron. The whole object seems of a rather high order of art to be a mere child's doll, and it would seem more plausible to consider it as an emblematical figure. The general style of art and costume indicated show little or no resemblance to those of the Northwest coast, but a strong relationship to those of the plains.

ELECTROCULTURE.*

A FACT which is both interesting and encouraging has for some time been remarked in Europe, and that is the change that has occurred, after several years of somnolence, in favor of the application of electricity to agriculture, not only for the actuating of all kinds of farm machines, but also for quickening the vegetation of plants and the germination of seeds. In France, the Minister of Agriculture quite recently sent to the prefects and subprefects a circular giving instructions for in every way facilitating the application of electricity to the rural districts, and setting forth the advantages to be derived therefrom by agriculture and the industries in general. It must be admitted that our contributor, M. Guarini, has greatly aided this movement by his numerous articles and lectures upon the subject. In Belgium, matters are in a still more advanced state, since the interesting question of electricity in agriculture has been introduced into the curriculum of universities.

The Minister of Agriculture has found the subject sufficiently interesting to commission M. Guarini to develop it, at the Agricultural Institute of Gembloux, in a course of lectures embracing the subjects mentioned further along. The first and second lectures have already been delivered. The second of these, in which M. Guarini elucidates the interesting question of electroculture, merits special notice.

We cannot dwell upon a description of the numerous experiments made and the numerous apparatus employed, nor upon the contradictory results obtained by experimenters in different countries. As regards the latter, they may be summed up in the statement that the products obtained by electroculture are more abundant, come in earlier, and are finer than those obtained in the natural way. On the contrary, we shall speak at some length of the new and original ideas put forth by M. Guarini, and also of his theoretical attempt to explain, chemically and mechanically, the valuable results that are obtained by applying electricity to vegetation.

During the last forty years, especially since the time of the German Sachs, our ideas concerning vegetable physiology have become very clear. At present, we very easily explain the function of every plant organ, its *raison d'etre*, and its form. We cannot, remarks M. Guarini, say as much concerning pine needles and especially the awns of the cereals. On the other hand, we know many things concerning the function of chlorophyl and especially of what it consists—and what is required to stimulate it and render it more active. But, on the contrary, we are entirely in the dark as to how carbonic acid is decomposed in the chlorophyl into carbon and oxygen.

Here M. Guarini asks whether, in our time, when so many things are explained by electric phenomena, and when earthquakes and auroræ boreales are explained in the same way, and when we know that heat and light are electro-magnetic vibrations of the ether, we are not authorized in believing that the life of the plant also is based upon an electric phenomenon. He thinks that it is, and demonstrates it to be so. In the first place, he remarks that the awns of the flower glumes of cereals and the needles of conifers serve to absorb and disperse electricity. In the second place, he says that, contrary to what is believed and taught, it is not electricity that in certain cases is capable of acting as a substitute for light in the accomplishment of the chlorophyl function, but it is the light of the sun or of arc lamps which is able to do the work of electricity. The best proof of this fact is found in the following experiment: A plant placed in a pot and inclosed in a metallic cage (Faraday's) will die, although exposed to the sun, because, says M. Guarini, it is withdrawn from the *indispensable* influence of atmospheric electricity and especially of the electric radiations of the sun. On the contrary, if a plant is in absolute darkness, it is capable of yielding much finer, earlier, and more abundant products, provided a judicious electric treatment be applied to it. Apropos of the experiment with the Faraday cage, M. Guarini remarks that in order that the plant shall die, it must be in a pot completely surrounded by the metallic cage. When, in fact, it is in the ground, the influence of the solar electric radiations and of the current which passes from the atmosphere to the ground, but not that which passes from the latter to the atmosphere, will have been completely abolished every time that the potential of the earth changes from its habitual negative to positive, as when, for example, it rains, hails, or snows.

When a plant is put in the ground and surrounded with a metallic cage, it does not, in fact, die completely, but, as the experiments of Grandeau and Leclerc have proved, there is a diminution of from 50 to 70 per cent in the leaves and stems and of from 50 to 60 in the seeds and fruit, which does not occur when the cage does not exist.

After this indispensable preamble, M. Guarini explains the influence of electricity upon the principal vital functions of the plant, that is to say, nutrition, respiration, and transpiration.

NUTRITION.

(1.) *Aerial Nutrition.*—The current that passes through the plant from the atmosphere to the ground, or *vice versa*, decomposes the carbonic acid in the chlorophyl into carbon and oxygen. M. Guarini tried the following experiment: He injected carbonic acid into a vessel of water in which were two electrodes connected with a 110-volt current, when there at once formed a deposit of carbon at one of the electrodes. He states that, in conjunction with Dr. Samarani, of the Agricultural Institute of Gembloux, he has obtained formic aldehyde. For this purpose, special conditions of voltage and amperage are requisite. All this, says M. Guarini, is in perfect accordance with the experimental results obtained by Walther in his experiments on the synthesis of sugars by electrolysis, and in which the raw material was decomposed by carbonic acid.

(2.) *Nutrition in the Soil.*—The natural currents that traverse the ground (telluric currents) or artificial ones (from batteries, accumulators, dynamos, etc.) decompose the chemical products that exist therein and that have been added thereto and form others more assimilable by plants.

(3.) *Distribution of Aliments.*—There is something material in the electric current. When a current is interrupted and the tension is sufficient, there occurs a passage of gas from the positive to the negative pole. In arc lamps on the one hand and electrolysis on the other, there is a transfer of matter from the positive to the negative pole. M. Guarini recalls the experiments of Prof. Heamstropf, of the University of Elsingford, who caused water to rise in a capillary tube placed in a bowl in which was also plunged the positive pole of a static machine, the negative pole being connected with the top of the capillary tube. When, therefore, the potential of the earth is positive, or is made so artificially, and the potential of the atmosphere becomes negative over the plants, the current that goes from the ground to the atmosphere carries along with it the water and nutritive substances, that is to say, quickens the circulation of the sap.

RESPIRATION.

This consists in causing oxygen to enter through the pores of the capillary vessels. When a current passes from the atmosphere to the ground, oxygen is carried in the direction of the current, that is to say, from top to bottom of the plant, and is driven with more or less force into the pores, thus accelerating respiration.

TRANSPIRATION.

This consists in driving out of the plant the gases of combustion, carbonic acid, and water vapor. When a current traverses a plant from bottom to top, the opposite of respiration occurs, and the gases of combustion are driven out of the pores. To all these chemical and mechanical effects must be added another and quite important one. Prof. Lemström has proved that when an electric current of high tension is applied to plants, there occurs a production of ozone in large quantity, nitric acid, nitrous acid, and (perhaps) ammonia. Now, we know that the nascent oxygen of ozone is very active, as is proved by the remarkable greenness of plants after a storm. It results from this, says M. Guarini, that, for respiration, it is necessary that the plant shall be traversed by a current going toward the ground, and that for transpiration it shall be traversed by one going toward the atmosphere, while for nutrition the direction of the current is of no importance. Since nutrition and respiration are the two most important functions of plant life (transpiration being the consequence of it), the best result is obtained when the plant is traversed by a current going toward the ground, and this would correspond to the normal electric state of the atmosphere and earth. In order to prove that experiment is in accord with theory, M. Guarini projected upon the screen a slide from a negative obtained by Prof. Lemström in the experiments that he made with a static machine of his invention. In this picture it was possible to see and compare the results obtained with carrots that had been submitted to an atmosphere which had been electrified positively, negatively, and not at all. When the atmosphere was electrified negatively, the carrots were better than when there was no electric treatment. In this case, as we have said, there was a quickening of the nutrition and transpiration. The results are incomparably better when the atmosphere is electrified positively, that is to say, when we have a current that goes toward the earth. In this case not only are the nutrition and respiration quickened, but, what is more important, a larger quantity of carbonic acid is forced into the plant, that is to say, a larger quantity of nutriment. The pictures shown by M. Guarini proved in addition that the results are deplorable when both kinds of currents are applied.

M. Guarini remarks that in order to derive the greatest benefit from the electric treatment, it is necessary (1) to put the plant in a position in which there is much more carbonic acid in the air, which can be done perfectly in completely closed greenhouses, and (2) to habituate the plants, perhaps, after a certain number of generations, to a forced alimentation, respiration, and transpiration, and thereby to a much more rapid life. By these means and by judicious electric treatment, it will be possible to urge the production of extreme limits and obtain several crops a year.

As for the source necessary for the electric treatment, M. Guarini mentions the three following ones: (1) Atmospheric electricity. Any of the arrangements employed completely answers the object aimed at. It is necessary to employ atmospheric currents much more elevated than those that have been used up to the present, for the purpose of having high enough differences of potential between the top of the stems and the ground and of having them sufficient to overcome the resistances of the plants and the stratum of air that separates the lower part of the stems of the plants. This layer of air is where there is a production of effluvia and consequently of ozone. (2) Static machines. These M. Guarini rejects for the moment, because they are costly, easily get out of order, and do not produce the intense effects desired. (3) Continuous current and high-tension dynamos. These are cheap and strong apparatus, and, when employed in place of atmospheric currents, it is possible to regulate the electric treatment at will.

On this subject M. Guarini recalls the fact that the Society of the Electric and Mechanical Industries of Geneva has recently constructed a continuous current dynamo capable of generating one ampere at 23,000 volts, and that, by coupling three of these machines in series, it is possible to obtain a 69,000-volt continuous current, which is more than sufficient for electroculture. Finally, M. Guarini concludes by saying that the life of the plant is an electric phenomenon that can be regulated at will. The agriculturist will no longer be a common laborer, but a skillful electrician, who, like an engineer in his cab, will direct, from his table in the farmhouse, the sprouting and growth of his carrots, potatoes, and cabbages.

* Specially prepared by our Belgian correspondent.

THE RECENT PROGRESS OF TANNING AS A CHEMICAL INDUSTRY.*

By J. T. WOOD.

I NEED scarcely say how much I appreciate the honor you have conferred upon me by electing me chairman of your section. I assure you that it will be my endeavor to merit this honor, and to do all I can to promote the interests of the section. In opening the session I was in some doubt as to what I could say that would be of interest or value. In Plato's "Charmides," Socrates is made to say, "If everybody did what they have the most science of, we should no doubt have everything done most scientifically;" and as I suppose I have more of the science of tanning than anything else, it seems to me better to talk about that, even at the risk of trying your patience, than to venture upon the unknown ground of a general introductory address.

Eight years ago (October 5, 1895) I had the honor to deliver the introductory address to a course of lectures on tanning to the students of the Goldsmiths' Institute, in which I endeavored to set forth some of the advances which this great industry owed to science. The subject of technical education, which I touched upon in my previous address, is too wide to be discussed here to-night. A little knowledge is said to be a dangerous thing, but I would like to say that if a man takes an interest in his work, if he loves it, he must and will want to know all there is to be known about it; whether such knowledge will be of practical use to him depends entirely upon the character of the man, but it is ridiculous to suppose that it can be hurtful to him. I propose to-night briefly to review the progress made during the past eight years, and, perhaps, to indicate the probable course of discovery in the near future. I may say that much of the ground I am about to traverse has been covered by the valuable Cantor Lectures of Prof. H. R. Procter, delivered in April and May, 1899, and by his "Leather Industries Laboratory Book" (1898), and quite recently his "Principles of Leather Manufacture" (1903). Only last year two new tanning schools have been opened, one in Turin, through the exertions of Signor Andreis, very completely equipped with machinery and

* Read before the Society of Chemical Industry.