SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES

PUBLISHED BY

N. D. C. HODGES,

47 LAFAYETTE PLACE, NEW YORK.

SUBSCRIPTIONS.—United States and Canada................$3.50 a year.

Great Britain and Europe................. 4.50 a year.

Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and one hundred copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

ELECTRO-HORTICULTURE.

IN the winter of 1889–90 experiments were undertaken at the Cornell University Experiment Station, by Professor L. H. Bailey, to determine what influence the ordinary street electric light exerts upon plants in greenhouses. Much has been said among gardeners concerning supposed retarding or accelerating influences of street lamps upon plants. Many have supposed that the electric light can be introduced profitably into greenhouses for the purpose of hastening growth. Still others have supposed the electric lights at exhibition halls to be injurious to plants, and have said that flowers fade quickly when placed near them. The whole subject of the relation of electric light to vegetation should be understood, and wholly aside from any thought of introducing the light into greenhouses, its influence upon plants, both under glass roofs and in the open, is a question which demands careful investigation.

In recapitulating the results of the experiments made, Professor Bailey says, in Bulletin 30 of the station, that it is impossible to draw many definite conclusions from the researches made. The many conflicting and indefinite results indicate that the problems vary widely under different conditions and with different plants. Yet there are a few points which are clear: the electric light promotes assimilation, it often hastens growth and maturity, it is capable of producing natural flavors and colors in fruits, it often intensifies colors of flowers and sometimes increases the production of flowers. The experiments show that periods of darkness are not necessary to the growth and development of plants. There is every reason, therefore, to suppose that the electric light can be profitably used in the growing of plants. It is only necessary to overcome the difficulties, the chief of which are the injurious influences upon plants near the light, the too rapid hastening of maturity in some species, and, in short, the whole series of practical adjustments of conditions to individual circumstances. Thus far, to be sure, more of the injurious effects than of the beneficial ones have been learned, but this only means that definite facts concerning the whole influence of electric light upon vegetation are being acquired; and in some cases the light has already been found to be a useful adjunct to forcing establishments.

The experiments suggest many physiological speculations, three of which may be mentioned. It is a common notion that plants need rest at night, but this is not true, in the sense in which animals need rest. Plants have simply adapted themselves to the conditions of alternating daylight and darkness, and during the day they assimilate or make their food, and during the night, when, perforce, assimilation must cease, they use the food in growth. They simply practice an individual division of labor. There is no inherent reason why plants cannot grow in full light, and, in fact, it is well known that they do grow then, although the greater part of growth is usually performed at night. If light is continuous, they simply grow more or less continuously, as conditions require, as they do in the long days of the arctic regions, or as the plants experimented with did under continuous light. There is no such thing as a plant becoming worn out or tired out because of the stimulating influence of continuous light.

It would seem, therefore, that if the electric light enables plants to assimilate during the night, and does not interfere with growth, it must produce plants of great size and marked precocity. But there are other conditions, not yet understood, which must be studied. The radish plants, and many others, were earlier but smaller under the influence of the light. Observation and chemical examination showed that a greater degree of maturity had been attained. Perhaps they assimilated too rapidly; perhaps the functions of the plant had been completed before it had had time to make its accustomed growth. Perhaps the highly refrangible and invisible rays from the electric lamp have something to do with it. In fact, this latter presumption probably accounts for much, if not all, of the injury resulting from the use of the naked light, for the effect of the interposition of a clear pane of glass is probably to absorb or obstruct these rays of high refrangibility. Good results which follow the use of a globe or a pane of glass show, on the other hand, that the injury to plants cannot result from any gases arising from the lamp itself, as has been supposed by some observers. In the experiments there was no perceptible odor from the gases of combustion; and it may also be said that commercial forcing-houses are not tight enough to hold sufficient quantities of these gases to injure plants.

It is highly probable that there are certain times in the life of the plant when the electric light will prove to be particularly helpful. Many experiments show that injury follows its use at that critical time when the plantlet is losing its support from the seed and is beginning to shift for itself, and other experiments show that good results follow its later use.

HEALTH MATTERS.

Physiology of the Gastric Glands.

ACCORDING to Heidenheim, the delomorphous or parietal cells of the gastric glands — that is, the glands of the fundus — secrete or elaborate the hydrochloric acid of the gastric juice, while the adelomorphous or central cells secrete the pepsin (*British Med. Jour.*). One of the chief arguments advanced in favor of this view rests on the experiments of Swiecicki, who asserted that in the œsophageal glands of the frog pepsin alone is formed, while only hydrochloric acid is formed in the stomach. Fränkel has submitted the statements of Swiecicki to a renewed test. He prepared the mucous membrane of (1) the œsophagus, and (2) the fundus of the stomach of ten frogs, and extracted each separately in two litres of water. To eighteen centimetres of the watery extract of each there were added two centimetres of a one per cent dilution of hydrochloric acid, and a small piece of fibrine. Both mixtures were kept at 37° C. for twenty-four hours; both extracts digested the fibrine. It would seem, therefore, that both the œsophagus and stomach of the frog contain pepsin, or rather, pepsinogen. This would tend to show that in the frog the delomorphous cells secrete both pepsin and acid, for fibrine is digested in the stomach when the secretion from the œsophagus is prevented from entering that organ. Fränkel found that the mucous membrane both of the stomach and œsophagus produced a mineral acid, for both gave the phloro-glucin-vanillin reaction. Contejean finds that section of the vagi does not interfere with gastric digestion in the frog. Electrical stimulation of the peripheral end of the vagus, or of the central ends of the vagus or glosso-pharyngeal, causes a copious secretion of mucus. In the last case there is no secretion of mucus when the vagi are divided. Perhaps the result is due to a reflex secretion, the reflex centre being in the bulb, while the vagus is the efferent channel for the impulses affecting the secretory glands. In birds also it would appear that the vagus influences the secretion of gastric juice. Oxenfeld finds that in birds (pigeons) stimulation of the peripheral end of the vagus is followed by a copious secretion of acid gastric juice. At the same time the stomach is forcibly contracted, and it might be assumed that the increased quantity of gastric juice was simply forced out of the glands by the concentration of the musculature of the stomach. Oxenfeld, however, is of opinion that this is not the true explanation, and he assumes that the vagus contains secretory fibres for the gastric glands.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

How Children Learn to Talk.—A Study in the Development of Language.—Children's Vocabularies.

PHILOLOGISTS and others interested in the origin of language and the development of intellect find very striking analogies between the development of speech and intelligence in the race and in the child, and have obtained some very valuable hints as to the laws determining the growth of language. Scientific psychologists and educators have also gained many important truths from the study of children. A much more extensive and detailed study, however, is now necessary to further progress in either line.

The first thing to be done in every scientific investigation is to collect a large number of reliable facts, from which generalizations may be made and theories found that will guide the investigator in further researches, and lead to the discovery and unification of a general law of nature that can usually be turned to practical account by the inventor, educator, or legislator. Facts of every kind in regard to development of intelligence in children and their progress in language are important, and in the earlier stages of the investigation the common and ordinary facts rather than the unusual and extraordinary are the most valuable. For the purpose of securing such facts and arousing interest in the study of children I wrote an article some months ago entitled "Children as Teachers," and published it in a number of papers. The records sent me in response to the request in that article are very interesting and suggestive. Many interested in the subject, however, doubtless overestimated the difficulty of securing valuable records, and therefore I have not yet received a sufficient number of records to justify me in making a full report, as I had promised, at present. The records so far examined serve to bring out the great individual differences in children rather than to show what is common to all, yet they are common characteristics suggestive of general laws sufficient to confirm me in the belief that a comparison of a number of such records will give very valuable results.

A convenient method for those who cannot keep a daily record of a child's progress in language was adopted by some reporting to me. During a certain period special attention was paid to the child's language, and all words the child was known to use understandingly were noted down in alphabetical order (the child's pronunciation of the words being indicated as nearly as possible), and this was taken as the child's vocabulary at that age. A few months later the process was repeated, and the progress that had been made could then readily be seen by comparing the two records.

The number of words used by children two years old differs considerably, but is usually larger than parents supposed. The number varies from a very few words for the child who is backward in learning to talk, though perhaps not less intelligent otherwise, up to a thousand words for children more precocious in that particular. Judging from the records in my possession, from two to four hundred words is the more common number.

The rate at which new words are acquired varies greatly for different children and at different ages. After they are once fairly started in learning language, it is usually quite rapid, especially with those who are late in beginning to talk. For children just past two years of age, from sixty to one hundred words per month seems to be a common number. If new words should continue to be acquired at this rate until maturity, as they probably are by those who study and read much, an adult would have a vocabulary of from 15,000 to 25,000 words (see "Size of an Ordinary Vocabulary," *Science*, Aug. 21, 1891). The additional words used by a child do not represent all of his progress in language. He may have learned the meaning of many words he has had no occasion to use; he may have learned something about forming plurals and the different parts of verbs, and considerable about how to put words together in sentences. The progress in the latter respect may be shown by keeping a record of his characteristic attempts at sentence making, being careful to omit sentences that are evidently repeated from memory.

The part of speech most used by children seems to be the noun. About 60 per cent of the words in the English language are nouns, 22 per cent adjectives, 11 per cent verbs, and 5½ per cent adverbs, while conjunctions, prepositions, and pronouns form but an insignificant portion of the whole. In an ordinary vocabulary, taking "Robinson Crusoe" as the standard, the proportion of nouns is smaller, and in a still smaller vocabulary there seems to be occasion for the use of a greater variety of verbs than nouns, and a necessity for the use of a number of prepositions, pronouns, and conjunctions. On a page of "Robinson Crusoe" containing 215 different words, but 24 per cent were nouns. Hence the fact that in a child's vocabulary of a few hundred words from 55 to 85 per cent of them are nouns, while but few of the prepositions, pronouns, and conjunctions that it hears repeated so frequently are used, is quite significant. Nouns, however, are not always learned easier and earlier than other parts of speech, for such a verb as "come," or adjective as "hot," may be among the first words learned. Any word which can be associated with a distinct, sensible experience can readily be learned, but abstract terms are not found in children's vocabularies.

General terms are used by children, at quite an early age, with some degree of correctness, though of course all that is connotated or included under a general term is not understood by any one until its scientific meaning is known. A general term is applied to all individuals having certain characteristics, though they may differ in other respects. The accuracy with which a child uses general terms depends upon the distinctness of his ideas of the special characteristics to which the term is applied, and his power of noting and discriminating those special qualities among a variety of others. His attainments in these two respects are limited by his previous experience. A child who calls a goat a "dog" may lack in clearness of conception of the characteristics of dogs, or in his powers of discrimination, or only in experience. In the latter case he classifies it with the group of animals it resembles more closely than any others with which he is acquainted. A child of twenty-six months who found a small crab in her oyster soup classified it at once with the group of animals it seemed to her to most resemble, and called it a "bug," then performing a considerable act of inference, she gave it the more definite name "oyster-bug." A little girl of less than eighteen months, who learned the word "cut" in connection with the use of a knife, not only called all knives "cutie," but applied the same term to shears when she saw the same operation performed with them, and later to a sickle with which grass was being cut. Nothing is more interesting or important in the study of children than the way in which they generalize, classify, and infer, and instances of such childish judgments and inferences, so odd to us, yet really so natural and logical from their point of view, should be carefully noted and recorded.

Children sometimes form a language of their own entirely different from that of their parents. This is more likely to occur with children of the same age, especially if they are alone together much. Instances are known of children forming apparently quite