

by Charles Schuchert, in which he describes the fauna of Saint Helena as from the Helderburg and the middle Devonian ages.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 340th meeting was held on Saturday evening, May 4th.

T. H. Kearney presented a paper on 'Loeb's Investigations into the Action of Ions upon Animal Structures, as supplemented by Studies with Seedling Plants,' quoting from Loeb's published papers at some length, special stress being laid upon their value as illustrating the theory of the rôle of ion-proteid compounds in vital phenomena. In experiments with animals it was the action of mixed solutions of two or more salts, as compared with that of each salt in a pure solution, which led to the development of this theory. The result of numerous experiments with seedling plants, as to the limit of concentration of solution which permitted the maintenance of vitality, agreed in many important points with the results obtained by Loeb in experiments with animals. In both cases salt solution was found to be highly toxic, while the addition of a second salt in many cases largely neutralized this poisonous effect and notably increased the degree of concentration of the more toxic salt in which root tips could survive during a twenty-four hours' culture.

Experiments were made with salts of magnesium (sulphate, chloride), of sodium (carbonate, sulphate, chloride and bicarbonate) and calcium chloride, all of which are important components of 'alkali' soils in the western United States. In pure solution they proved toxic in the order named, the limit of endurance for magnesium sulphate being approximately a $\frac{1}{800}$ normal solution, that of calcium chloride a $\frac{1}{4}$ normal. Mixtures were made of equal volumes of definite concentration of each two of these readily soluble salts, and of each of them with the comparatively insoluble magnesium carbonate, calcium carbonate and calcium sulphate, which are likewise abundant in the alkali soils.

In several cases addition of a sodium to a

magnesium salt considerably raised the limit of concentration of the latter endurable by the roots of the white lupine (*Lupinus albus*), but the most striking results were obtained by the addition of calcium, either as chloride or sulphate, to magnesium and sodium salt solutions. Calcium sulphate, added in simple excess of the powdered salt, proved extraordinarily efficacious in neutralizing the toxic effects of other bases, increasing the maximum endurable concentration for sodium sulphate from $\frac{3}{400}$ to $\frac{1}{2}$ normal, and for magnesium sulphate from $\frac{1}{800}$ to $\frac{3}{8}$ normal.

In a $\frac{2}{5}$ or $\frac{3}{8}$ pure solution of magnesium sulphate the root cells were strongly plasmolyzed, while in a corresponding solution plus an excess of calcium sulphate no trace of the plasmolyzing action could be detected. The effect of calcium sulphate upon the corresponding chlorides was much less marked. Hence, while in some cases the effects of mixtures could be ascribed to the cations (basic radicle) alone, in others it seems clear that the anions are also able to make their influence felt. Hydroxyl ions, dissociated in very dilute solutions of sodium carbonate (Na_2CO_3), and sodium bicarbonate (NaHCO_3), markedly stimulated the growth of the roots, just as Loeb found them to stimulate the gastrocnemius of frogs, to absorption of water from, and rhythmical contraction in, a sodium-chloride solution.

The results of this investigation, which was undertaken at the request of the Chief of the Bureau of Soils of the Department of Agriculture, are to be described in a forthcoming bulletin of the Division of Vegetable Pathology of that Department. They are believed to have considerable economic significance, apart from their bearing upon the question of the influence of ions upon organisms.

Under the title 'A Kinetic Theory of Evolution,' Mr. O. F. Cook suggested, on the basis of studies in the Diplopoda and other groups, that evolution be interpreted as a kinetic phenomenon or process of gradual and spontaneous accumulation of variation instead of a reaction to external conditions. It was also held that the differentiation of species is a process quite distinct from evolutionary progress, and that selection and isolation may conduce to the

former while retarding the latter. In this view evolution would be favored by interbreeding rather than by segregation, and natural selection would be an incident rather than a cause of evolution. Diversity was shown not to be conditioned upon segregation, but to be distinctly favored in the economy of species. Under a kinetic theory the origination and inheritance of characters represent but different statements of the same facts, and the predication of a 'hereditary mechanism' is unnecessary. Evolution is not confined or directly connected with any one type of cells or method of reproduction, but is a general property of protoplasm; it is not only a cellular or cytological, but a supracellular or organic, process; evolutionary theories must accommodate both unicellular and compound individuals, and even treat as evolutionary units the colonies of the social insects.

F. A. LUCAS.

CHEMICAL SOCIETY OF WASHINGTON.

AN adjourned meeting was held in Hopkins Hall, Johns Hopkins University, Baltimore, Md., on April 27th, when the following program was presented: 'The Lowering of the Freezing Point of Aqueous Hydrogen Dioxide,' by H. C. Jones. The author stated that an attempt was made to measure the dissociating power of hydrogen dioxide by means of the conductivity method. This method was abandoned, since all the metals used as electrodes decomposed the dioxides, even at zero degrees. The lowering of the freezing point of aqueous hydrogen dioxide by certain salts was measured and was found to be less than the lowering of the freezing point of water, under the same conditions.

'The Preparation of Semi-Permeable Membranes for the Demonstration of Osmotic Pressure,' by Professor H. N. Morse. The author referred to the difficulties encountered in the preparation of osmotic cells by the method of Pfeffer, and stated the results of some preliminary experiments, undertaken in cooperation with Dr. D. W. Horn, in attempting to overcome these difficulties. Instead of expelling the air from the walls of the cups by immersion in water and exhaustion with an air-pump, as is done in the method of Pfeffer, electrical endos-

mose was employed, the cup being immersed nearly to the top and filled with a dilute solution of potassium sulphate, then surrounded by a cylindrical electrode and another one placed inside. A one-ampere current was passed through the solution for 15 minutes, from the outer to the inner electrode, causing a rapid passage of liquid through the walls of the cup and freeing them from air. The cup was then removed, emptied, rinsed and placed in water until used for the formation of membrane. The method described by the author was as follows: A cup whose walls had been freed from air and filled with water was placed in a solution of a copper salt and filled with a solution of ferrocyanide. A current was passed from the outside inward, the copper and ferrocyanogen ions being driven into the walls from opposite directions; a membrane was built up wherever they met. The results were very satisfactory. The method of construction of the electrodes was described and the resistance of the cups stated. On breaking the cup, the membrane was found as a reddish brown line, usually in the middle of the wall, though deviating more or less to one side or the other.

'Molecular Rearrangement of Sulphamine Acids,' by Dr. Ira Remsen.

'On a Reduction Process for Tin at Comparative Low Temperatures, and Recovery from Waste Products,' by Chas. Glaser. This paper gave a description of a process invented by John C. Toliaferro for the recovery of tin from waste products. The refuse from tin-plate works consists of the remnants of the fatty acids used to protect the black plates from reoxidation after cleaning with acid, and more or less oxidized tin, which often contains some free metal or mixed oxides of tin and lead. The refuse from the oils often contains oxides of the two metals, which are usually recovered by burning off the oil and collecting the residue and metallic fumes. The united dross is reduced to metal in a suitable furnace. Mr. Toliaferro observed that under certain conditions he obtained metallic tin from the refuse fatty acids by heating them to incipient decomposition. Certain experiments were made showing that at a temperature a little above the melting point of tin, stannous soaps are reduced to metallic tin,

gaseous products and some carbon. From these observations the following reduction process was evolved: A large iron pot is heated from below, so that a piece of tin dropped at the bottom will melt. The pot is then filled with refuse fatty acids and the heat increased until they commence to give off vapors. Stannic dross is then introduced with stirring. This may be continued at pleasure or until the fatty acid is almost used up. The reduced tin is removed at convenient intervals.

'On Dr. Theodore Meyer's Tangent System of Sulphuric Acid Chambers,' by Chas. Glaser. The author described a modification of the construction and working of lead chambers used in the manufacture of sulphuric acid. The modification relates to the shape of the chambers and the motion of the gases. Ordinarily the chambers are square and the gases introduced in such a way that they traverse the chambers but once, get only moderate mixing, except where they fall upon the chamber curtains and where they are forced through relatively narrow connecting pipes between chambers. In the modification described, the chambers are round or polygonal, the gases are introduced near the ceiling in the direction of a tangent, and are removed through the center of the bottom by suitably constructed pipes. Experiments show that the gases move first along the sides of the chamber, drifting towards the center in such a way that the whole content gets into rotation. Cooling and draught bring the whirlpool in the center to the exit pipe. When introduced into the second chamber, the gases retain the revolving motion derived from the first, to which is added the motion of the second, so that an epicycloid motion is produced. The gases traverse the chambers a good many times, increasing largely the amount of work performed. It has been demonstrated that by this method the necessary chamber space for one pound of sulphur in twenty-four hours is reduced to below ten cubic feet as against twenty in the old system. The author stated that the cost of producing sulphuric acid, so far as labor and lead chambers are concerned, is reduced to fifty per cent. of what it was by the old method.

'The Solubility of Gypsum in Aqueous Solu-

tion of certain Electrolytes,' by Frank K. Cameron and Atherton Seidell.

This paper gave a description of the complete solubility curves for gypsum in aqueous solutions of sodium chloride, magnesium chloride, calcium chloride, sodium sulphate and a mixture of sodium chloride and calcium hydrogen carbonate at 25° C. With sodium chloride and magnesium chloride the curves show maximum points. The formation of complex ions the authors believe to be possible and probable, but the deviations from the *mass law* are more likely to be due to a condensation of the solvent itself.

With sodium sulphate it was shown that the solubility of the gypsum first decreased and then increased, with increasing concentration of the more soluble salt, until it became greater than in pure water. It is believed that a double salt was formed in the solutions, possibly identical with the mineral glauberite. It did not separate from the solutions on evaporation, however, at ordinary temperatures. Here again the authors think the condensation of the solvent probably plays an important rôle and, under such circumstances, it is probable that the sodium sulphate dissociates to a large extent or completely as a di-ionic electrolyte. The composition of the solid phase, containing both calcium sulphate and sodium sulphate, did not apparently affect the composition of the solution in contact with it. This is regarded as of sufficient interest to merit further investigation. In solutions of calcium chloride the solubility of the gypsum decreases quite rapidly at first, and then very slowly but steadily as the concentration of the more soluble salt increases.

When calcium carbonate in the solid phase was also in contact with solutions of sodium chloride, and was brought to equilibrium with ordinary air, it was found that up to concentrations of about 80 grams per liter of sodium chloride, the gypsum dissolved in very nearly the same quantities as though the calcium carbonate were not present. From this point on, however, the curve makes a sudden drop and then the solubility of the gypsum slowly decreases.

Applications of the results to geological and technical studies were indicated, and a theoretic-

cal discussion accompanied the description of the experiments.

'The Solubility of Calcium Carbonate in Aqueous Solutions of certain Electrolytes and in Equilibrium with Air,' by Frank K. Cameron and Atherton Seidell:

Since the solubility of the calcium carbonate is dependent upon the amount of carbon dioxide in the gas phase in contact with the solution, the solutions were brought to equilibrium with air, previously washed in dilute sulphuric acid, and bubbled through the solutions by means of an aspirator. It was found that the curve for sodium chloride presented a well-marked maximum point. No normal carbonates were in the solution, the calcium dissolving entirely as the hydrogen carbon.

In sodium sulphate solutions, the major part of the calcium dissolved as the hydrogen carbonate, though at the higher concentrations normal carbonates were also found. The curve for this pair of electrolytes showed no maximum point. Curiously, it was found that calcium carbonate was much more soluble in solutions of sodium sulphate than in solutions of sodium chloride, at all concentrations.

The presence of solid gypsum was found to produce an effect on the solubility of calcium carbonate in sodium chloride solutions, greater in amount but similar in nature to that produced by calcium carbonate on the solubility of the gypsum in sodium chloride solutions, and described in the preceding paper. Practical applications of the work were pointed out and a theoretical discussion of the results obtained was given.

L. S. MUNSON,
Secretary.

TORREY BOTANICAL CLUB.

At the meeting of the Club on March 27, 1901, the first paper of the evening was by Dr. John K. Small on 'The North American Genera of Mimosaceæ.' Dr. Small exhibited a uniform series of diagrammatic drawings, illustrating the flowers and fruit of each of these genera, and explained his proposed classification, replacing the previous artificial grouping. The variability of the fruit in valves, margins and cross-partitions was commented on. Dis-

cussion of the common sensitive plant followed, in which it was remarked that the sensitiveness to shock is so delicate as to be stimulated by holding a burning-glass near, or by drops of rain-water on first falling, or by holding a sponge of ammonia or of chloroform near. The utility seems unknown, except as the hot sun setting the leaves on edge prevents injury from intense sunlight. Sachs's suggestion was that the depression of the leaves served as a protection from hail; but it now appears that the native center of the plant is chiefly in the Orinoco regions where hailstorms are unknown. Much energy is exhausted by folding, and it is well known that the greenhouse sensitive-plants are frequently worked to death by repeated irritation.

The second paper, by Dr. Rydberg, soon to be printed, was on 'The Oaks of the Rocky Mountains,' in which region eleven species were described in Sargent's 'Silva,' a number now increased by Dr. Rydberg to twenty-eight.

E. S. BURGESS,
Secretary.

THE ONONDAGA ACADEMY OF SCIENCE.

THE 47th regular meeting was held in the Historical rooms, Friday P. M., May 17, 1901.

The first paper was by Dr. John Van Duyn, entitled, 'The Terrestrial Life of Porto Rico.' Dr. Van Duyn spoke entertainingly concerning many facts and observations made during his recent visit, as the deep blue of the ocean, the appearance of different constellations, the character of the rocks and their probable formation, the differences in wind and climate of the northern and southern shores of the island, the animal and plant forms, and the inhabitants. The latter are a mixture of Spaniard, negro and native Indian. Although it has been maintained by high authority that the Indian types have been entirely lost, Dr. Van Duyn was positive that this was not so. He believes that the race possesses vast capabilities for development.

A second paper, entitled 'The Marine Life of Porto Rico,' was given by Dr. C. W. Hargitt, of Syracuse University. He briefly narrated the early work in the natural history of Porto Rico and then told of the recent expedition of the *Fish Hawk* to those waters, and of the

material thus collected. The fishes have already been described in the Report of the U. S. Fish Commission just published; and of the other forms which were sent to the various universities for examination and study, Dr. Hargitt reported on the material received here. The collection comprises the 'Alcyonaria,' and among the forms were several genera new to American waters, and six species new to science. The descriptions of all these will be published in the Reports of the Fish Commission during the present summer.

PHILIP F. SCHNEIDER.

DISCUSSION AND CORRESPONDENCE.

THE LARYNX AS AN INSTRUMENT OF MUSIC.

IN the *American Journal of Science* for April, 1901, Vol. XI., p. 302, an account was given of some speech curves that confirm the view that vowels are usually produced by intermittent puffs of air and not by vibrations of the form generally supposed. The following conclusions were reached: (1) The movement of the air in the mouth cavity is a free vibration and not a forced one; (2) the impulses from the larynx in making vowels are of the nature of explosive openings or sharp puffs of air. It was shown that the characteristic mouth tones in vowels are generally inharmonic to the larynx tone. The elaborate vowel tracings of Professor Hermann (Königsberg) and the late ones of Dr. Pipping (Helsingfors) had already proved that in song the mouth does not reinforce an overtone of the cord; my curves showed the same condition for ordinary speech. Similar results have been obtained by Boeke (Alkmaar), Bevier (New Brunswick), Donders (Utrecht), Merritt (Cornell), Samojloff (Moscow), and others, and can be seen in plates published by Nichols and Merritt (Cornell). The proof is on all sides complete and incontestible that Willis's theory ('Camb. Philos. Trans.,' 1830) of vowel formation is the correct one and that the theory of Wheatstone ('Lond. and Westm. Rev.,' 1837) is erroneous. Although the adoption of the Wheatstone theory led to numerous investigations and secondary hypotheses by Grassmann, Helmholtz and others, its phonetic difficulties were never overcome.

It was also pointed out that the structure of the larynx practically forbids any consideration of the vocal bands as membranous reeds. The accompanying figure is an outline section of the



vocal muscles (*aa*) whose vibrations produce the tone in song and speech. They bear no resemblance in structure or action to membranous reeds. When they are brought together by the action of the arytenoid cartilages, they close the passage of the larynx until forced apart by the air pressure. When this occurs a puff of air is emitted and they close again. The sharpness or smoothness of the puff is regulated by the contraction of the various portions of the thyro-arytenoid muscles which compose the vocal bands. The puffs in their physical forms resemble those that can be produced by a siren disk with differently shaped openings (Seebeck).

Structures of the nature of the vocal bands yield to the air pressure and vibrate wholly or mainly by a side movement, and not by the flap or lateral movement of membranous reeds. Professor Ewald (Strassburg) has illustrated their action by constructing cushion pipes. That the vibratory movement affects the bands through most of their depth is shown by the nodal lines seen with the laryngo-stroboscope of Oertel (Munich). Helmholtz's statement: "Im Kehlkopf spielen die elastischen Stimmbänder die Rolle membranöser Zungen. Sie sind von vorn nach hinten gespannt, ähnlich den Kautschukbändern * * *," was based on the anatomical and physiological knowledge of the time at which he wrote the first edition of the 'Tonempfindungen.'

Professor Le Conte (California) in *SCIENCE* for May 17, N. S., Vol. XIII., p. 790, points out that he had already said that the larynx 'cannot be likened to a stringed instrument nor