uniform sphere of positive electrification within which electrons move about. He worked it out with elaborate mathematical detail. This will always remain a good illustration of the futility of mathematics when it is based on a false hypothesis. He contributed, however, the very important idea that atoms may be held together by static attraction due to the transfer of an electron from one atom to another. This is still a part of every electronic theory.

Abegg, in 1904, proposed a more qualitative theory in connection with his ideas of "principal" and "contra" valences. Abegg's ideas influenced both Kossel and Lewis.

The most important common idea contributed by both Lewis and Kossel was that every atom has a strong tendency to assume the stable form of a noble gas near it in the periodic system, by the gain or loss of one or more electrons. This led Kossel to a formula for the perchlorate ion in which the chlorine atom had assumed the structure of neon by the loss of seven electrons, and each oxygen atom had also assumed the structure of neon by the gain of two electrons.

While Lewis assumed that atomic ions may be formed in the same manner that was assumed by Kossel he added the thought that the noble gas structure may be formed in compounds by sharing pairs of electrons which belong in common to the atoms held together. Later, Langmuir used the term "covalence" to designate the pair of electrons. According to Lewis, the chlorine of the perchlorate ion has the structure of argon and has four covalences, while each oxygen atom has the structure of neon and has one covalence. Lewis called the portion of the atom within the group of valence electrons the "kernel." The kernel of chlorine has a positive charge of seven units and that of oxygen a positive charge of six units.

The electrons of a covalence are not equally shared by the two atoms, when these are different, but Lewis did not point out clearly that, so far as atoms at a distance are concerned, a covalence balances one positive unit charge in each atom. From this point of view, four of the seven positive charges of the chlorine kernel are balanced by the covalences and three are balanced by the negative electrons associated with the oxygen atoms. Since each oxygen atom with a single covalence has a residual negative charge of one unit the four oxygen atoms give a negative charge of one unit to the perchlorate ion. Reasoning of this sort enables us to select atoms in compounds, which have a residual positive or negative charge when we know their electronic structure. Kossel's theory does not have this advantage.

In 1901 Stieglitz, on the basis of the work of Jakowkin, recognized that the reaction between chlorine and water is ionic in character and assumed that the chlorine molecule separates into positive and negative ions. This is easily explained by assuming that when the atoms of a chlorine molecule separate the covalence electrons remain with one of the atoms. This prepares us to understand that two atoms held by a covalence may separate in three ways: (1) The electrons may go with the first atom, making that negative; (2) they may go with the second atom, leaving the first atom positive; (3) one electron may go with each, which will then be neutral.

Some interpretations of the wave quantum mechanics have replaced Lewis's cubical atoms by the tetrahedral arrangement which had been accepted by organic chemists sixty years ago on the basis of the work of Pasteur, Le Bel and van't Hoff. This has also given a picture of the relation of covalence electrons to the atoms held together which recalls the inclusive orbits suggested in a crude way by the author in 1917 and in a much better form by Campbell, Sidgwick and Knorr in 1923.

The facts that the carbon atoms of a doubled covalence are closer together than those of a single union and that the double bond increases the molecular volume of the compound indicate that the four electrons spread out on the two sides because of the tendency toward a tetrahedral structure. This recalls the old explanation for the cis-trans structure, and Baeyer's treatment of the double union as the limiting case for rings.

It will be seen from the above that Lewis's theory furnishes a simple explanation for many facts which are not so easily reconciled with the theory of Kossel.

OBITUARY

LUCIAN W. CHANEY

LUCIAN W. CHANEY was graduated at Carleton College in the class of 1878. He continued his studies for three years and then joined the faculty of his alma mater in 1882. In the following year he was made professor of biology and geology.

These were years of beginnings for Carleton, and the department to which Professor Chaney was appointed needed to be created by him. He was one of a group of Carleton's earliest faculty members who are known as the "Old Guard," who laid the foundation for high scholarship and character in the young college.

Professor Chaney's task in those early years was a heroic one. There were no microscopes or other equipment for laboratory work in biology, but he organized his courses with thorough laboratory instruction. He himself sought gifts and he and his family denied themselves necessities in order that he might save from a meager salary to buy precious instruments which he needed for his students. Those of us who had our work with him in the nineties look back to our courses with Professor Chaney with thorough satisfaction and the conviction that the courses in botany which we had with him in his little basement laboratory compare very favorably with modern courses with all their elaborate equipment.

Professor Chaney was both an able teacher and a good friend of every student in his courses. He gave free scope to the student's initiative to do things for himself. But he was always ready with sound advice and help when it was needed, and it was given in a spirit of friendly cooperation.

Professor Chaney also was interested in the students' social life. He may be justly considered the father of Carleton's athletics. This was also accomplished by letting the students do for themselves, while he was always behind the scenes ready with friendly advice and counsel. When Carleton had no athletic budget, Professor Chaney canvassed alumni friends with personal letters every year to raise a modest sum to help the boys.

Professor Chaney's work in geology was also of high character. The museum of geology and mineralogy which he organized was an excellent piece of work and was one of the show places on the Carleton campus. His explorations with Dr. Lyman B. Sperry in the Montana Rockies and their discovery of the glaciers in what was made later Glacier National Park were achievements of high merit.

Professor Chaney retired from the Carleton faculty in 1908, after twenty-five years of service, upon a pension from the Carnegie Foundation. But his great qualities as finder of facts, his clear scientific analysis, his deep interest in human welfare, his complete unselfishness and devotion to truth were still to find a new field of service of equal importance and wider scope. For almost another quarter century he labored in the Federal Bureau of Labor Statistics as a pioneer in the realm of fact-finding and analysis to reduce industrial accidents. Dr. Chaney's achievements as a pioneer in two widely different fields speak eloquently concerning his clear-sighted intellectual qualities, his rectitude and his human sympathy and appreciation. He was a fine product of pioneer life of the West. His achievements are his monument.

FRANZ F. EXNER

CARLETON COLLEGE

SAMUEL HENRY ESSARY

PROFESSOR SAMUEL HENRY ESSARY, botanist of the Tennessee State Experiment Station at Knoxville, died suddenly of a heart attack on April 28.

Professor Essary was a descendant of pioneer stock in the western part of Tennessee. He was born at Chesterfield in 1870, the eldest of five children. He never married. After graduating from Union University, Jackson, Tennessee, he entered the University of Tennessee, taking the degree of master of science in 1907. Subsequently he studied for some time at the University of Wisconsin. His teaching experience in his earlier years included instructorships at La Grange College, Missouri, and Brenau College, Georgia. He then became associated with Professor S. M. Bain at the University of Tennessee, as instructor in botany, following him to the newly established State Experiment Station. After Professor Bain's death in 1918, Professor Essary became station botanist and head of the department.

Continuing the work begun by Professor Bain, in the development of anthracnose-resistant red clover, Professor Essary developed what is looked upon as the best red clover south of the Ohio River. His careful selection has given to the South "Tennessee 76" lespedeza, most valuable as a hay and pasture crop. His "Tennessee Red" and "Tennessee Pink" tomatoes, selected for wilt-resistance, have proved a boon to the truck farmers of the state. Forage and legume crops also held his close attention, and the work he did in selection for regional adaptation and economic usefulness along these lines is of undoubted value.

For several years past he had been devoting considerable time to the selection and breeding of cotton. "Trice," one of the best varieties grown along the northern cotton belt, is one of his improvements.

As a scientist his position is well established. But he was also a true naturalist, gifted with keen insight and unusual powers of observation. He knew thoroughly the Great Smoky Mountains and was a pioneer in blazing several of the trails included in the National Park. He was an excellent photographer, and many of his mountain pictures have appeared in newspapers and magazines all over the country. His botanical knowledge of the mountain flora made these of superlative worth. He left a botanical collection extending over forty years.

He was a most lovable man and his friends were deeply attached to him. Unobtrusive and unselfish, he never tried to advance himself, but was always extending a helping hand to others, especially younger men, about him. In his daily association with Professor Essary over a period of thirteen years the present writer grew to regard him as an elder brother in affection and a wise counselor in mutual undertakings.

LUDWIG STOLZ MAYER