general theory is the fact that hydrogenation of unsaturated compounds is not exclusive; polymerization takes place simultaneously, because H_2 can not form H_2^- ions by trapping low velocity electrons, therefore, the positive polymeric clusters can be neutralized by free electrons.

The following list (Table II) of reactions will illustrate these and other points. In the group of oxidation reactions, it will be observed that the stoichiometric principle for both positive and negative ions is quite well confirmed by the M/N values found.

In the group of five decompositions, where no gas is present with electron affinity, it will be observed that the positive cluster is limited to the value of *2*, one neutral molecule and one positive ion entering into reaction. Perhaps this rule may be generalized for the clustering of saturated molecules with themselves.

On passing, however, to unsaturated compounds of carbon, the clusters are larger. Ethylene shows a value above 5, and the triple bond compounds cyanogen, acetylene and hydrogen cyanide show values yet higher, from 8 up to about 20.

As already stated, we do not know the actual size of these clusters, nor has the physical evidence from migration of ions proved unambiguous, even in the simplest cases. If the theories here advanced are correct, we may say that the chemical evidence definitely sets lower limits. Perhaps the clusters are in reality larger. If in general they all initially contain about the same large number of molecules, then evidently the clusters of unsaturated compounds have the greater stability after neutralization. This stability of the clusters of triple bond compounds is further illustrated by the fact that when acetylene polymerizes only 2 per cent. of its H_2 is liberated, cyanogen liberates 5 per cent. of its N_2, HCN 2.5 per cent. of its H_2 and 8 per cent. of its N_2, while ethylene splits out 19.5 per cent. of its H_2, giving a mixture of hydrogen and methane containing 91 per cent. H_2 and 9 per cent. CH_4 by volume, while methane splits out 37.5 per cent. of its H_2 in the free state, during complete reaction.

The studies which I have attempted to describe briefly should be regarded as exploratory. While they set up a general preliminary theory and have put the kinetics in quite a satisfactory state, they have hardly more than scratched the surface of the possible ionic gas reactions, which may prove to have significance in the preparation of new and unusual compounds. Since the reactions take place at low temperatures, they will give many addition-products which would be decomposed at higher temperatures. A number of such compounds not described in the literature have already been observed, but have not yet been prepared in sufficient quantity for thorough examination. The preparative phase of this subject is an attractive field for future investigation, where perhaps more abundant sources of ionization may profitably be employed, since quantitative knowledge of the ionization itself would not be necessary for preparation alone.

S. C. LIND

FIXED NITROGEN RESEARCH LAB.,
WASHINGTON, D. C.,
MARCH, 1926

SIGMA XI IN RESEARCH[1]

SIGMA XI has gained the confidence of all who know its ideals. To-night's initiates are to be congratulated, for the Iowa chapter has had an honorable history. Since it was organized twenty-six years ago, the policy of this chapter has always been conservative, and at the end of the tenth year we find only 161 members, of whom fifty-one were active members. For the year 1911 to 1912, I find the president was Raymond; vice-president, Seashore; recording secretary Pearce; corresponding secretary, Hauser; treasurer, Wylie; and counsellor, Macbride. It was about this time that Iowa began to lay the foundation for the present rapid growth in research.

Sigma Xi stands not only for cooperative research, but also promotes scholarship through selecting the unusual men and women who have that promise of power in research which enables them to go beyond the set limits of knowledge. I fear that sometimes we fail to recognize different types of research workers. Some scientists prefer to discover new material; some to work over the material discovered by others with a view to testing, verifying, or elaborating the principles set forth; some to interpret and to coordinate and correlate the data discovered by others; some prefer to criticize and if possible destroy the principles or theories formulated by others; others, like the professor in the small college, to inspire or train younger students who later catch the spirit of research and carry their training into larger institutions with marked success. All these types are needed; all have their places in furthering the bounds of human knowledge, providing they are in their final endeavors creative.

My own interest in science was comparatively late in maturing. Having lived on a farm in my childhood and youth, I assembled numerous natural history collections, but it was not until I went to college that I became fascinated, under the direction of Dr. Spencer Trotter, with scientific inquiries. While a

[1] President's address at the annual initiation of the Iowa chapter of the Society of the Sigma Xi, State University of Iowa, Iowa City, Iowa, February 17, 1926.

sophomore at Swarthmore, I had access to the extensive collection, first hand drawings and the original paintings of Joseph Leidy. These opened up an entirely new world to me, for Leidy was no doubt the greatest paleontologist of his century. Moreover, he lived at the most opportune period of the whole range of natural history. The western hemisphere offered new opportunities for him. His work was predominantly original, for practically every specimen he found was a new species, a new genus, a new family or a new order. None was named or described in the predominating French literature. Leidy was the last great scientific naturalist in history. It has been said that he studied protozoa and man with the same avidity and the same thoroughness.

Traditions at Swarthmore placed Leidy as a great, unpretentious, thoughtful man who had to be piloted to his laboratories and museums on the fifth floor of the main college building or he would lose his moorings and go wandering around the halls of the building. Leidy was an ideal research man of the cooperative, observing type. Speaking of him two years ago, Henry Fairfield Osborn, of the American Museum of Natural History, said: "Even to this day we are verifying the observations of Leidy. We find that he never made an incorrect observation, or published an incorrect figure. His accuracy is these records is one of his greatest and most permanent claims to immortality as a paleontologist." It has been said that two of Leidy's contemporaries were so busy quarreling with each other that neither ever mentioned Leidy in their books, although each described and named species previously named and described by Leidy.

As a junior in college, I began to trace Indian trails around Philadelphia, and the subject of the thesis for my degree of bachelor of science was a detailed description of an Indian skeleton excavated from the banks of the Brandywine. This skeleton, found six feet under ground in a stone coffin with pieces of wampum, four hundred beads and some crude jewelry, made my heart beat with enthusiasm. It was the first experience of the real joy of discovery. I had caught some of the spirit of Agassiz when he said to William James and his other assistants, when starting on his famous trip to South America:

> Come wander with me—
> In regions yet untrod,
> And read what is still unread
> In the manuscript of God.

It was not until I was on my way to Harvard that I shifted my interest from paleontology and animal behavior to human behavior. Here I obtained an opportunity to study with James, Royce and Yerkes, but for the first two years I acted as special tutor in G. H. Parker's course in zoology.

If I were to offer suggestions from my own experience to our new members, I would say:

(1) Select a basic problem for your research, one that you can work on for a period of ten years or more. For example, one of my graduate students has just completed special experiments in the learning of preschool children and one in the emotional development of preschool children. These are special fields in which the students can continue their investigations for at least a ten year period.

(2) Become thoroughly acquainted with the history of your problem and especially with contemporary experimental studies in your special field. Become well orientated and familiar with the principal theories and conclusions of others who have approached your problem. Frequently you can find the best cues for your attack in earlier studies. For example, I became thoroughly convinced of the value of the study of consecutive physical growth curves after having found Quetelet's early investigations, of 1836.

(3) Strive for a complete bibliography of your special subject; do not be satisfied with a few general references. References are of little or no value unless they are complete.

(4) Take accurate, detailed notes each day and keep them in an accessible file. This will furnish the material for your final report, for it is very difficult to write a final report with statistical data only. Keep a notebook or pad in which you can jot down your original ideas and theories from time to time. These original ideas are frequently the most important contribution.

(5) Do not spare any effort in securing accurate data. One of the greatest enemies of first class scientists is the use of inaccurate data.

(6) Study carefully your experimental technic and present your data in the best statistical form. Be certain that your tables are self-explanatory and presented in such a way that the number of observations are apparent. See that the charts and curves are also self-explanatory and constructed according to the best modern standards.

(7) Lastly, I would say, look for the relationship of your problem to the larger field of which it is a part. Many scientists are unable to see the woods for the trees. Reorientate the problem. In doing so you will acquire the true research spirit, not the kind that terminates with the degree of doctor of philosophy.

To those who leave the university this year I wish to say:

(1) Act as scientific centers for your respective communities and institutions.

(2) Help to introduce more and better science into our public schools. My personal opinion is that science offers the best moral training that the curriculum has to offer, since its basic principles are accuracy,

honesty, cooperation and respect for the achievements and rights of others.

(3) Help to disseminate scientific information, for practice has lagged far behind theory in many fields.

(4) Never let a year go by without carrying out a definite piece of research, adapted to your qualifications, your opportunities and your facilities. See that it is worth publishing, but be sure that it is ready to print before you submit it, for you can never do this particular piece of work again.

(5) Keep in close touch with your major professors. You will always be a part of this university. Your field laboratories are but extensions of our own central laboratories. You can help us and the university quite as much as we can help you.

To those who remain with us I wish to say:

We must lead the life of research, not talk about why we are unable to live it. In our field there is no substitute for ardent, sincere daily effort and consecutive application. It is the ability to work a little longer, a little more in detail, a little more accurately than any one else, under the guidance of our own constructive imagination and thought, that will place us as authorities in our own special fields.

Just as the musician finds pleasure in melody and rhythm and the artist satisfaction in symmetry and proportion, we find the most exquisite delight in discovering new data, verifying tentative principles or formulating new hypotheses. There is perfect abandon in the joy of accomplishment, for the discovery of truth is reality. The search for truth, the living of the truth, the dissemination of the truth are our highest motives. Let us zealously guard and protect our opportunities for research.

We are fortunate to have as president of this university a man with a great vision, who, with the dean of the graduate college and the deans of the colleges of liberal arts, law, medicine, dentistry, pharmacy, applied science, education and commerce, has advanced research on all sides in this university. When I came here eight years ago, I was the first appointee with the title of research professor. To-day scores of professors and instructors are spending half or two thirds of their time in research work, and others are devoting their time exclusively to research. In the preparation last year of a bulletin from the Station on what the University of Iowa is doing for children, twenty departments and colleges in the university were found to be carrying on some phases of research dealing with children. This is probably not possible at any other university in this country at the present time. In this university more than half a million dollars is going annually into research and service for children.

We are steadily gaining a position of preeminence as a research university, especially among the state universities. Research is a source from which real service functions; our opportunities are unusually good. From us much will be expected. Our university has broken down many departmental barriers that still exist in some of the older institutions of higher learning. On all sides we see cooperation. Let us be truly "companions in zealous research."

BIRD T. BALDWIN
IOWA CHILD WELFARE RESEARCH STATION,
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EZRA TOWNSEND CRESSON

IN the death of Ezra Townsend Cresson, at Swarthmore, Pennsylvania, on April 19, 1926, there passed away one of the most kindly, helpful and amiable figures in American entomology. In February, 1859, when not yet twenty-one, he, with James Ridings and George Newman, founded the oldest of our existing entomological societies—The Entomological Society of Philadelphia, whose name was changed in 1867 to The American Entomological Society. A group of enthusiastic collectors and students gathered, whose activities are described by Baron Osten Sacken, entomologist and secretary of the Russian legation at Washington:

> Residing, as I did, in Washington (up to 1862), I had the opportunity of witnessing the origin and first beginnings of the Society. To me, a European, these beginnings afforded such a remarkable insight into American energy and enterprise that I am glad to give a short account of them. . . . The most active member of the Society, however, was its Corresponding Secretary, Mr. Ezra T. Cresson, with whom I kept up at that time an active correspondence. I shall content myself with reproducing passages of his letters, which speak for themselves.
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> On September 4, 1861, Mr. Cresson wrote: "We do our own printing, as you already know; I am the compositor and also assist in the press work, and although I have had little or no experience in setting type (I have set the type for *all* the pages of the *Proceedings* thus far), yet be assured that I will do my best to have your paper got up in as neat and scientific a style as possible."[1]

Cresson devoted himself to the Hymenoptera of North America, not neglecting those of Cuba and of Mexico, and produced, between 1861 and 1882, some sixty-five catalogues, synopses and monographs, culminating in a "Synopsis of the Families and Genera of the Hymenoptera of America north of Mexico" (together with a catalogue of the described species,

[1] "Record of My Life Work in Entomology," Cambridge, Mass., 1903, pp. 41–42. Osten Sacken's date, 1861, as that of the foundation of the society is, however, two years too late.