# DISCUSS THEORY OF ATOMS AT SESSION

## Summarize Discoveries in Electrons and Nucleus of Elements

### PROF. HARKINS SPEAKER

Speaking at a symposium on the progress of chemistry, Professor W. D. Harkins of the University of Chicago, retiring vice-president of the chemical section of the A. A. A. S., summarized the findings of recent research of one of the most important chemical problems of the day, the structure of the atom.

Professor Harkins stated that the fundamental element is hydrogen, its atom consisting of one positive and one negative electron, that four hydrogen atoms unite to form one helium atom, and that in turn most of the heavier atoms are built up from helium atoms, but a few are built up from helium atoms with one, two, or three hydrogen atoms added on.

**Atom Minute Solar System**

"An atom," said Professor Harkins, "is so small that the most minute particle visible by the best microscope contains as many atoms as there are people on the surface of the earth. It takes 100 million atoms to make a line an inch long. Even in a gas, where the atoms are relatively far apart, the number of atoms is enormous. Thus if an ordinary electric light bulb containing a vacuum were to be pierced by a hole sufficiently large to admit a number of atoms per second equal to the population of the United States, it would take 100 million years for the bulb to fill with air. It is their extremely small size which gives atoms their marvellous properties.

"The atom is much like a minute solar system, in which the central sun is charged with positive electricity and is called the nucleus. This nucleus, which possesses nearly all of the weight of the atom, is surrounded by a set of planets, called negative elections, which have almost no weight.

"Some idea of the size of the parts of an atom may be obtained by supposing a lead shot, ½ inch in diameter, to be suspended in the center of the world's largest auditorium. Let this represent the nucleus. Suppose that the theatre contains from 1 to 92 bees, each of which represents an electron. Let the shot in the center be coated with honey, and suppose that all of the bees present circle around the shot, but in doing so move through all the volume of the auditorium. (Just as the auditorimu would be very sparsely populated with bees, so the atom is very sparsely populated with electrons.)

**Chlorine Twins Act Alike**

"Whether an element is oxygen, copper, gold, lead, or some other element depends only on how many electrons are present in the atom outside the nucleus (the number of bees in the above illustration.) Thus in oxygen there are 6 such electrons; in gold there are 87. Anyone who could make atom nuclei such that 87 electrons would surround each nucleus, could make gold. To do this it is only necessary to make atom nuclei which carry on through 87 positive charges of electricity.

"One of the most interesting discoveries of the present century is that, contrary to the ideas of the nineteenth century, there may be several kinds of atoms which have the same number of negative electrons outside their nucleus, but whose weights are different, thus the element chlorine, the first poison gas used in the late war and a constituent of common salt, may be said to consist of twins.

"These chlorine twins act so much alike that no chemist or physicist can tell them apart without weighing them, and it is difficult to weigh them because it is almost impossible to get them apart. The twins are called isotopes, meaning acting alike, their only difference being that while one of them weighs 35 the other weighs 37. The first splitting up of a single element into two more elementary substances was accomplished in the University of Chicago three years ago, when chlorine was separated into isotopes. While the number of elements which constitute the earth and the stars is only 92, the number of kinds of atoms (isotopes) is several hundred.

"One of the most interesting features of the building of atoms, as was pointed out by the writer several years ago, is that atoms of helium seem each to be built from 4 atoms of hydrogen. In this process there is the remarkable feature that the atom of helium weighs less than te 4 atoms of hydrogen, so that, contrary to the older views, mass is lost in the process.

**Hydrogen Fundamental Element**

"The most striking feature is, however, that this mass is not actually lost, but appears as energy. If one pound of hydrogen, which could be purchased for one cent, could be turned into helium, it would give enough energy to heat a house of 7 room for one thousand years, or it would be sufficient to drive a battleship around the earth more than once.

"One of the interesting features about atoms is that the are built up from positive and negative electrons, and that in nearly all atoms the number of both the negative and the positive electrons is an even unmber.

"The fundamental element is hydrogen, and its atom consists of one positive and one negative electron. Four hydrogen atoms unite to form one helium atom. In turn most of the heavier atoms are built up from helium atoms, but a few are built up from helium atoms with 1, 2, or 3 hydrogen atoms added on.

"That this is the true method by which atoms have been built has been demonstrated by the studies of the writer on the composition of the material of the meteorites and the earth, and has been verified by the fact that Rutherford has been able to disintegrate only those atoms which, according to the writer's theory, contain hydrogen which is not combined in the form of helium."

# RUST DESTROYS GREAT QUANTITIES OF WHEAT

## Discovery and Development of Resistant Varieties Necessary

Investigations of the nature of leaf-rust of wheat, a disease which, during the past two years, is estimated to have caused a loss totaling thirty million bushels, have shown the existence of twelve strains of the rust, Dr. E. B. Mains of the Purdue Agricultural Experiment Station, Lafayette, Indiana, told the American Phytopathological Association in his lecture here yesterday morning. Work of developing a hybrid variety of wheat which will resist all these strains of the disease is under way at the Purdue Station, where the investigations were made, Dr. Mains announced.

The past two seasons, bringing great losses, have emphasized the importance of the leaf-rust of wheat in the soft winter wheat area from Kansas eastward. This disease is never absent throughout the eastern United States. In fact, said Dr. Mains, its general prevalence year after year has resulted in taking the disease as a matter of course, severe epidemics like those of the past two seasons being necessary to attract attention.

**Difference in Rusts Possible**

The only feasible method of reducing the ravages of this disease to the wheat crop, indicated Dr. Mains, is through the discovery or development of resistant varieties of wheat. In 1918 the Department of Botany, Purdue Agricultural Experiment Station, and the Office of Cereal Investigations, U. S. Department of Agriculture, started a co-operative investigation with this in view. Over two hundred varieties of wheat have been grown in fifteen localities throughout the eastern United States for the past four years. In these, while it has been found that a number of varieties are highly resistant, it was also found that a variety might be resistant at one place and very susceptible at another.

**Local Conditions Not a Factor**

If it proved to be due to local conditions, the problem would be solved, since some variety showed resistance in each planting, and this variety could therefore be locally used. If, however, the difference was due to differences in the rust itself, the problem was much more difficult of solution.

Thus if variety A, resistant at X, was widely grown at that place, it would eliminate the strain of rust found there, it is true, but if variety A was susceptible to the strain of rust found at Z, there is nothing to prevent the disease from gradually working into the locality X from Z, and the variety A would then be attacked, and the work of introducing and establishing the variety would be lost, and confidence in the control of the disease by resistant varieties would be destroyed.

**Hybridizing May Be Tried**

To settle this question, 140 collections of leaf rust were tested in the greenhouse of the Purdue Agricultural Experiment Station, by so doing bringing them under the same conditions of soil, temperature, etc. In this way it has been found, said Mr. Mains, that the difference shown in the susceptibility of varieties at different places is due not to local conditions, but to the presence of different strains of the rust at these places. Twelve such strains have been found and studied as to their susceptibility to 35 selected varieties.

While most of these varieties are susceptible to one or more of the twelve strains, yet no strain has been found to which one or more of the varieties are not highly resistant. Failing in finding a variety resistant to all strains, it should be possible to produce such by hybridizing variety A, resistant to the rust at X, and variety B, resistant to the rust at Z, and obtain a variety resistant to the strains at both X and Z. Such work, said Dr. Mains, is well under way.

# DR. KRAUS ADVOCATES NEW CLASSIFICATION

## Former Chemical Distinctions Lose Force

Something of a revolution in chemical thinking was advocated by Professor C. A. Kraus of Clark University in an address delivered at a chemical symposium under the auspices of the American Association for the Advancement of Science.

For more than a century chemists have made a sharp distinction in their thinking between metals, electrolytes, and non-electrolytes. This classification is based upon the different ways in which substances conduct the electric current, but also corresponds to marked differences in chemical character, as is easily seen if one thinks of iron, salt, and gasoline as typical examples.

For a number of years, Professor Kraus and other workers have been making an exhaustive study of the behavior of all classes of substances when dissolved in other solvents than water. Such solvents are liquid ammonia, liquid sulphur dioxide, and many others which are difficult to handle and require work at very low temperatures. As a result of these researches it appears that many substances may, under different circumstances, behave like members of two or more of the foregoing three classes.

In addition, Professor Kraus showed that the progression from purely electrolytic compounds to compounds which are not electrolytic at all is a more or less continuous one, depending upon the relative tendencies of the elements in the compound to be electropositive or electronegative.

Professor Kraus therefore proposed a new classification of substances in four groups, as follows:

(1) Electrolytes, which conduct even in the pure state.

(2) Non-electrolytes, which conduct neither when pure nor when in solution.

(3) Meso-electrolytes, which show a slight conducting power both in solution and when pure.

(4) Pseudo-electrolytes (like the acids), which are non-conductors when pure, but ionize in solution because they combine with the solvent.

In conclusion, Professor Kraus made it clear that the various types of substances with which we are familiar in chemistry differ from one another in degree rather than in kind, while the electromotive force series gives us the key to an understanding both of their differences and similarities.

# BIRTH-RATE STATISTICS DISCUSSED BY PROF. HUNT

Studies of the birth-rate among the graduates of Alleghany College show that probably this collegiate group has not more than replaced itself, Professor H. R. Hunt of the University of Mississippi stated in a paper read before the genetics section of the American Society of Zoologists at the Institute yesterday.

Mental capacity is probably to a certain extent inheritable, said Dr. Hunt. It is therefore important to determine whether the birth rate is tending toward a relative decrease in the number of intellectually superior persons. College graduates as a whole, continued Dr. Hunt, are probably inherently superior mentally to the population at large, yet recent investigations show that they produce relatively few children.

Dr. Hunt gave statistics collected by questionnaires from the men and women who graduated from Allleghany College from 1870-1899. Of the surviving graduates, 316, or 57%, filled out the questionnaires. The married men graduates, plus their wives, the married women graduates, plus their husbands, and the unmarried graduates total 632. This group produced 732 children. Life insurance statistics, said Dr. Hunt, show that only about 588 of these children will probably reach maturity. Thus, 632 graduates produce only 588 children who reach maturity.

When families with wives less than 45 years old are excluded, and the number of unmarried persons is r duced in proportion, the 632 is dimi ished to 425. Of the 531 children this group, 415 will probably survi to maturity. Thus 425 graduates this group produce only 415 childr who reach maturity. It is therefo probable, indicated Dr. Hunt, that t graduates of this college have n more than replaced themselves.

# OFFICIALS ATTACK PARKS SAYS FOREST EXPER

Urging the formation of a powerf organization to correlate public inte ests in our National Parks, Dr. C Adams, director of the Roosevelt Wi Life Forest Experiment Station Syracuse, told the Ecological Socie of America that today prominent o cials and commercial interests open and indirectly attack our Parks. H said that public opinion should strong enough to make such an atta cost the public life of an official. T aim of preserving for future gener tions our supreme scenic wilderne areas with their native plants and a imals, he called a democratic ideal.

To develop a practical park poli and to execute it requires special tec nical ability and a large staff, and a endowment might prove necessar The scientific and educational valu of these wilderness National Pa Preserves, however, cannot be ove estimated, Dr. Adams stated, and remarked that our leading scientif societies might well assume a speci vigilant guardianship of them to s that modern and scientific standard are maintained.