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THE PROGRESS OF CHEMISTRY AND THE RICHMOND MEETING OF THE AMERICAN CHEMICAL SOCIETY

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THE American Chemical Society, holding its seventy-third session at Richmond, Va., from April 11 to 16, listened to over three hundred papers presenting the results of recent research. The program shows what unprecedented progress American chemical industry has made since the war freed the United States from dependence upon Europe. Our dyes and drugs are now mostly made in America, instead of being imported from Germany. A chemical congress has more personal interest for the public than the sessions of other scientific societies, because its proceedings, though expressed in technical terms quite as incomprehensible to the outside world, have more practical application to every-day affairs and business.

The principal event of the opening day was the dedication of the chemical building of the University of Richmond, which takes the place of the laboratory burned down last year. The new laboratory is absolutely fireproof and remarkably commodious and convenient for its cost, $150,000. It corresponds in style with the architectural plan of the Collegiate Gothic adopted when the college was moved in 1914 from its city site to the wooded campus in the suburbs.

Dr. E. Emmett Reid, of Johns Hopkins, a graduate of Richmond College, gave the dedicatory address, in which he said, "Laboratory methods are being adapted to many lines outside of the natural sciences, to psychology, to teaching, to social service, to advertising and to literature. As this progresses the differentiation of methods is increasing. There is an appropriate method for detecting and estimating each chemical element and likewise for each kind of force or radiation. Facts of a certain kind must be proved by appropriate experiments and can not be disproved by some other kind. Each realm has its own technique. We are becoming more and more sane in our search for truth: heated argument is giving way to patient investigation."

Dr. Charles H. Herty, a former president of the American Chemical Society and a graduate of the rival institution, the University of North Carolina, in speaking on the importance of research in industry, deplored the backwardness of the South in this field. He had counted up the contributions of the year to the two official journals of the society and found that out of 427 such research reports the thirteen states south of the Potomac were credited with only four or five per cent. Several of the Southern states had made no contributions to the science of chemistry in the period.

The vision of the chemists was carried to the verge of the invisible and beyond by the demonstration of the ultra-microscope by F. F. Lucas, of the Bell Telephone Laboratories. Pictures of thin sections of alloys thrown upon the screen showed the details of the various constituents and disclosed the causes of the strength or weakness of the metal. An incipient crack started in the edge of a strip of nearly pure iron by thousands of bendings was seen to have followed the line of the scattered inclusions of non-metallic material. By means of this instrument it is possible to make visible a particle of only one five millionth of an inch across, and by the use of the shorter waves of ultra-violet light the magnification and definition can be carried considerably further. Photographed in the dark, the particles so made perceptible are composed of only about five hundred atoms; so the microscopist must have nearly reached the chemist's limit of divisibility.

But the speaker who followed, Professor Victor Henri, of the University of Zurich, went beyond this point, and by the employment of X-rays and analytical mathematics, he demonstrated the arrangement in space of the five atoms forming the fundamental compound of carbon, methane. It has hitherto been surmised that the carbon atom occupied a position in the center, with the four hydrogen atoms around it at equal distances, but according to the new theory the shape of the molecule is a pyramid instead of a tetrahedron. The determination of the structure of the carbon atom is of primary importance, since all living matter, plant and animal, is composed of carbon compounds.

Buttering the plant's bread on both sides is the possibility held out by the experiments reported by Dr. V. N. Morris, of the government's fixed nitrogen research laboratory at Washington. One of the problems of making use of the nitrogen captured out of the free air, where vast quantities of this potential fertilizer are always hanging around unutilized, has been to get it reduced to a stable and solid form that can be tied up in bags and scattered with a shovel. Dr. Morris has tried passing various oxides of nitrogen through a milky suspension of finely ground phosphate rock, itself a fertilizer material, in water or weak acid. The reaction yields calcium nitrate and a soluble form of phosphorus. Since plants need nitrogen, calcium and phosphorus, this promises to be the basis of a triple high-grade fertilizer.

The query, "Have you had your iron to-day?" may soon have to be extended to, "Have you had your copper, manganese, nickel, cobalt and zinc?" For all these metals, as well as a few others, have been found in living plant and animal tissues by Dr. J. S. McHargue, of the Kentucky Agricultural Experiment Station, and seem to be necessary for normal health. Deprived of the last traces of copper and manganese, for instance, plants get most woefully yellow and sickly-looking. Dr. McHargue claimed for the metallic traces in Kentucky's limestone soil some of the credit for the fine pasturage of the bluegrass region and for the magnificent animals that graze thereon.

The chemist is always striding ahead of the inventor and the manufacturer, challenging them with promising and provocative things for which uses must be found. His latest challenge is pure metallic vanadium. Beads of this bright, steely stuff were shown by J. W. Marden and M. N. Rich, research scientists of the Westinghouse Lamp Company. The element has been known in its compounds for many years, but these two men are the first who have been able to get it pure. They mixed the vanadic oxide ore with metallic calcium and calcium chloride and heated the mixture at about 1,500 degrees Fahrenheit in an electric furnace. Vanadium is a soft, malleable metal, easily drawn into wire and workable into other shapes. There is at present no known use for it; therein lies its interest. Tungsten, that now lights our houses, runs our radio sets and hardens our high-speed steels, was not long ago another such useless curiosity, dumped out of the crucible of the chemist at the feet of the world, with the question, "What are you going to do with it?"

The automobile is responsible for the rapidly expanding demand for rubber, which has multiplied its price and made it an international problem. At this meeting of American chemists attention was concentrated upon methods of reducing the rate of abrasion of tires and of preventing their deterioration through aging by oxidation. A new application of rubber has now approached the point of practicality; a method which has been developed simultaneously in Hungary and the United States for depositing rubber on metal by a process of electroplating from the latex. The little globules of caoutchouc suspended in the milk of the rubber tree are charged with negative electricity and when an electric current is passed through the liquid they are carried to the anode and there left as a thin adherent film, which may, by means of a recent invention, be built up into a thick layer.

A possible explanation of why medicine bottles are labeled "keep in a dark place" hinges on researches on the effects of polarized light reported by Professor David I. Macht, of the Johns Hopkins University. Polarized light is ordinary light that has been passed through a sort of crystal filter, or else reflected from a mirror surface at a particular angle, so that its waves no longer vibrate in all directions, but dart through the ether with all their fronts parallel. Polarized light occurs frequently as moonlight and as part of daylight, especially in early morning and late afternoon. Following the pioneer work of Miss Elizabeth Semmens, an English scientist, who produced evidence that polarized light starts the breaking down of starch grains, Professor Macht tried the effects of these rays on several important drugs, such as digitalis, cocain, quinin and atropin. In most cases the effect was to reduce the activity or even produce a deterioration of the drug. This weakening amounted in some instances to as much as twenty per cent. These findings, in Professor Macht's opinion, are of great importance both to chemists and pharmacologists.

A chemical theory of the origin of species was presented in a paper prepared by Dr. Victor C. Vaughan, formerly head of the Medical School of the University of Michigan, and a foremost authority on epidemics. He goes far back beyond Darwin to a period long before the appearance of the earliest and simplest single-celled plant or animal, which is the point where the biologist begins. For he believes that life is molecular and not cellular. The microscope shows us that cells constitute the structural units of all plants and animals, but Dr. Vaughan thinks that the size and shape of these little bags of protoplasm are less important than the composition of their contents. The essential and probably the primary compound of all living matter is protein, which consists of very complex molecules, containing various ammonia, acid and sugar groups.

Dr. Vaughan admits that "up to the present time no chemist has awakened dead matter into life. It may be that this will never be done," but that should not discourage future experimentation in this line. Every element that is found in living matter exists in the mineral kingdom, and the chemist has learned that he can now make out of the inorganic material of earth and air many organic compounds formerly found only in plants and animals. As this gap between the inorganic and organic is being gradually filled in by modern research, so also is the gap between chemical molecules and living creatures. As he says, "Nearly twenty years ago I first stated my belief that life is fundamentally chemical and may, indeed probably does, exist in simpler and less tangible forms than any living cell, or even living bacterium." This opinion has since been confirmed by the discovery of minuter forms that prey upon the bacteria as the bacteria prey upon us, and by the study of the viruses of plant diseases, which are composed of particles so small as to pass through a porcelain filter, yet grow and multiply like living creatures.

The proteins are very changeable compounds and can be easily altered by disease or chemical action. For instance, an attack of measles in childhood may make a man immune to the infection for life. A minute amount of foreign protein, even from a wholesome food like eggs or milk, when injected into the blood renders this article of diet permanently poisonous to that particular person.

The importance of this paper extends beyond the sphere of chemistry into the domain of sociology and ethics. For if Dr. Vaughan's views are confirmed they must radically change current teaching as to the relative importance of heredity and environment.

"I hold that the lowest forms of life have come into existence through chemical agencies," Dr. Vaughan concluded, "And that environment has been a stronger factor in the evolution of life and in the development of the varieties and species than is believed by the biologist of to-day. All life is protein and the development of new species is due to molecular rearrangement in the structure of the protein molecule. Where a protein has at last been evolved which best fits the functional needs and where its environment remains little changed, its chemical constitution will remain remarkably constant."

How to extend the duration of the period of the prime of life is the question which Professor H. C. Sherman, of Columbia University, is endeavoring to answer by the feeding of thousands of white rats. That the secret of longevity is largely dependent upon an abundant supply of an unidentified chemical ingredient of certain foods he demonstrated by the photographs he exhibited before the food division of the American Chemical Society. This is being provisionally called "vitamin A," until it can be isolated and analyzed and given a chemical name indicative of its composition.

It is written, man shall not live by bread alone; the reason being that grains do not suffice for the normal nutrition of mammals, whether rats or humans. Their deficiency is supplemented by milk which is rich in vitamin A. But, as Professor Sherman showed, the value of such a diet depends largely upon the proportion of the bread and the milk. Feeding rats on a mixture of one sixth dried whole milk and five sixths ground whole wheat —the rodent equivalent of bread and milk—it was found that they grew normally, lived healthily and reproduced sufficiently generation after generation. But when he raised the ratio of the milk and made the dietary one third milk and two thirds wheat, the rats throve better, reproduced more rapidly and lived twice as long. Increasing the proportion of milk added more lime and vitamin A to the ration. This contradicts the old adage, "enough's a-plenty." More than enough is better, when vitamins are in question. Another noteworthy point is that the rats getting the barely adequate allowance of vitamin A were apt to become infected with a disease of the lungs in early adult life, which is the same period when young men and women are apt to succumb to pulmonary tuberculosis. It is already apparent that chemistry is beginning to invade various fields of sociology and throw light on many of the mysteries of history.

The liver, especially in young animals, is the storage place for most of the body's reserves of growth-promoting vitamin, and also is rich in manganese and some of the other mineral elements which appear to be necessary, though in minute amounts, for the maintenance of good health. Dr. Sherman expressed the wish that a way might be found to raise livers without having to raise all the animals that surround them.

Babies who have to be fed on evaporated milk in out-of-the-way places where fresh milk is a rarity are not so badly off after all, according to Professor Frank E. Rice, of North Carolina State College. Milk is swallowed as a liquid, but, he explained, part of it turns into solid curds on reaching the stomach; and cow's milk forms large lumpy ones that are all right for calves, but very difficult for infants. Mother's milk forms small, grainy curds that are easily digested, and evaporated milk acts very nearly like it. The fat globules in evaporated milk, also, are much smaller and hence more easily digested than are the fat globules of fresh milk. Aside from the obvious advantage of its cheapness, Professor Rice stated, it has the further desirable qualities of being easily diluted with water, and of not curdling when mixed with acid fruit juices.

The best flour for the big bread batches of modern bakeries is made from wheat that has known a little hardship, said Professor C. O. Swanson, of the Kansas State Agricultural College. "Strong wheats are usually grown on heavier soils and in a comparatively dry climate which has fairly hot weather during the later stages of the crop's development," he continued. "A climate which has more rainfall and cooler weather when the wheat matures produces wheat weaker for bread-making on a commercial scale, though it may be well suited for other purposes."

Live wires, attired in ribbons of synthetic silk, were introduced to the chemists by Dr. W. O. Mitscherling, of Bridgeport, Conn. Viscose made from wood pulp is pulled into a ribbon and after purification is wrapped around the wire while still wet. There it sticks tight and shrinks, making a very close fit, and serving as an excellent insulator. The coating can be made quite transparent, and in this form it is of especial value in constructing radio sets, for the whole wiring and soldering job can be inspected for breaks and other troubles without unwrapping or scraping anything.

A metal that takes fire when breathed upon was one of the novelties exhibited recently. It is barium, an element similar to calcium, not uncommon in minerals but now for the first time obtained in pure form and large yields by a process discovered by Professor R. A. Baker and A. J. King, of Syracuse University. They distil off the metal in a vacuum from a mixture of aluminum and barium oxide and get barium 99.95 per cent. pure. It is a soft and shining metal, somewhat resembling sodium. It is an extremely active and avaricious element, attacking with violence almost every substance brought into contact with it. Moist air sets it aflame. It can only be handled in glass tubes filled with argon, a gas so inert that it unites with nothing. On account of the avidity of barium for the gases of the air it may be useful in removing the last traces of air from vacuum tubes made for electric lamps and radio receivers.

Furs do not naturally follow the fashions, consequently the chemist has to be called in to change tint or pattern to correspond with the style of fabric that milady wants to wear. According to William E. Austin, the present rapidly expanding demand for furs is largely due to the fact that chemistry can now make furs to suit. Of the hundred million skins used in the United States annually the majority have been given chemical baths. More than half of them are rabbit skins which can be obtained in unlimited quantity and take varied dyes and designs. The once despised muskrat enters fashionable circles after being given a bath of aniline black and renamed "Hudson seal." It often happens that the imitation fur becomes more popular than the natural model. Even white ermine, fur of kings, and sable, king of furs, are enhanced in value by chemical treatment. By new bleaching processes it is possible to make a black skin white, so it can be given any desired coloration.

We may some day be able to recognize passing smells as we can now recognize passing autos, by reading off their numbers. E. C. Crocker and L. F. Henderson, of Cambridge, Mass., have worked out a system of tagging odors. They recognize four basic types of smell-perception: "sweet," "acid," "burnt" and "caprylic." Almost no scents belong wholly to any one of these classes, and most of them include all four in varying degrees. With a series of numbers from 0 to 9 to represent intensities, every scent can be designated.