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PAPERS READ BEFORE THE DETROIT MEETING OF THE AMERICAN CHEMICAL SOCIETY

NEW methods of analysis and new means of studying the function in the human body of sulfur, as essential for life as iron, phosphorus or iodine, will be possible with heavy sulfur, according to chemists attending the one hundredth meeting of the American Chemical Society at Detroit. The production of heavy sulfur was described for the first time by Drs. David W. Stewart and Karl Cohen, of Columbia University. The researches were conducted under the direction of Dr. Harold C. Urey, head of the department of chemistry, who discovered heavy hydrogen in 1934, for which he received the Nobel prize. Later he prepared heavy forms of oxygen and other elements. Most elements consist of a mixture of several isotopes. These are made of atoms of different weights, though having similar chemical properties. Ordinary sulfur contains four: 95 per cent. being of weight 32; 4 per cent. of weight 34, which is the isotope now isolated; 1 per cent. of weight 33 and one part in 6,000 of weight 36. Separation of the isotope, at a cost of $1,500 per ounce as compared with a cent an ounce for common sulfur, was achieved with Dr. Urey's "counter-current scrubbing method," previously used to separate isotopes of carbon and nitrogen. A gas, sulfur dioxide, was passed upwards and a liquid, sodium hydrogen sulfite, was allowed to flow downwards through 150 feet of bent glass tubing. Sulfur 34 is more soluble in the liquid than the other varieties. Therefore, at the end of the process the liquid in the bottom contained about a quarter of the heavy isotope. Researches are now being made by Dr. Vincent du Vigneaud, professor of biochemistry in the Cornell University School of Medicine, using heavy sulfur to determine the role of the element in bodily chemistry. Using the isotope, sulfur atoms can be tagged at the start of an experiment and identified at intermediate stages, and at the end of the reaction. This method promises also to be of use in tracing sulfur in complicated organic reactions which are not concerned with living organisms.

CHEMICAL changes that take place in the blood of animals suffering from pneumonia was the subject of a report by Dr. M. L. Crossley, of the American Cyanamid Company. He and his associates, Bruno Vassel, L. G. Christopher, R. H. Kienle and G. L. Christopher, discovered changes suggesting a breakdown of the protein of blood serum during the course of the disease. When the animals got well, the blood serum became normal again. The investigations of blood chemistry during pneumonia were undertaken in the hope of providing clues for better chemical treatment of this and other infectious or germ diseases. "How infecting agents cause disease," Dr. Crossley explained, "what changes occur, where these changes are initiated, the nature of the resulting products and their effect on the animal are questions which must be answered before chemotherapy can be highly effective in relieving man of the many ills that now reduce his efficiency, limit his usefulness and endanger his life. These are difficult problems to answer. Even if microörganisms worked as termites, boring into the tissues and reducing their strength, it would still be a difficult task to examine the nature of the damage done and relate it to the cause, and man can not be sawed up like a log nor subjected to physical and chemical tests in ordinary laboratory equipment. It is imperative to know the nature of the chemical reactions involved in infectious diseases, this knowledge is essential to the future development of chemotherapy."

DR. PER K. FROLICH, director of the chemical division of the Esso Laboratories, Elizabeth, N. J., gave the first technical report of the new "butyl rubber," developed after ten years of research by Standard Oil chemists. It is colorless, odorless, tasteless and more stretchable than rubber from trees. In his address, prepared in collaboration with R. M. Thomas, I. E. Lightbown, W. J. Sparks and E. V. Murphree, he said that Nature's rubber molecule and all its synthetic semblances are either wholly or predominantly polymers, or multiples, of much smaller molecules which belong to a class of highly unsaturated compounds called diolefins. It is to this diolefinic origin that the natural and synthetic rubbers owe their extreme degree of unsaturation and resultant chemical reactivity. Chemists working on rubber have been inclined to associate the elasticity and other important physical properties of rubber with its chemical unsaturation. Chemists in the Esso Laboratories, however, in their studies of chain-like polymers with no residual unsaturation, recognized a majority of these important rubber-like properties. Polymers with no residual unsaturation may be made by uniting the simple olefins, or compounds, which are readily available as constituents of petroleum refinery gases. But these olefins because of their saturated character resist all efforts to vulcanize them with sulfur. Through long years of research by a large group of men, the Esso Laboratories have now developed a method of co-polymerizing olefins with small amounts of diolefins to give just the proper degree of unsaturation for vulcanization—but no more. Out of these efforts has come butyl rubber which after vulcanization is a product with substantially no residual chemical unsaturation. As a result, butyl rubber is characterized by a remarkable stability and durability which for many purposes make it superior to natural rubber and to other synthetics. By variations in the composition of the raw materials employed, it is possible to obtain products that differ considerably in their detailed properties, but the basic characteristic remains the same insofar as the limited unsaturation is concerned. His researches have made it possible to pick out definite qualities in which the butyl rubber should excel. These can be achieved, thus adapting it to specific purposes, such as tires, electrical insulation, hose, etc., which may make different demands. Future manufactur-

ing plans are dependent on the progress of tests now being made and will also be governed by the defense needs of the U. S. Government.

MANY parts of the present-day automobile would be impossible without some substitution for natural rubber, was stated by James C. Zeder, chief engineer of the Chrysler Corporation. He spoke before a symposium on rubber, synthetics and plastics in the automotive industry, held as a part of the one hundredth anniversary meeting of the society. "The most certain way of expanding the production capacities for synthetic rubbers is to develop uses for them in such places where cost penalties will not be a major objection, and where the man-made rubber may stand on its own as an engineering material. In only a few instances has synthetic rubber been substituted for natural rubber. Yet synthetic rubber has taken the place of natural materials that have qualities that are not easily varied to suit the engineer's needs, or qualities that vary so much in nature that it is desirable to use manufactured materials that will maintain a uniformity of characteristics day in and day out." Many improvements in automobiles await the development of a better material. Mr. Zeder pointed out that "The only thing preventing us from decreasing the brake drum from a 12-inch to perhaps an 8-inch diameter is the maximum pressure which the lining will endure. All the other parts of the brake mechanism can be subjected to greater pressures, and if a better synthetic material can be developed for the lining, this reduction will be made, and we shall have a smaller and a better brake. The same thing is true in the clutch. Here, too, a better clutch plate lining must be found, and when this is done, we shall have a smaller, better and less expensive clutch. Synthetic materials may solve the problem of a suitable fabric for automobile use. We now make cars of metal and rubber which will stand up for a number of years, but the fabrics used in the upholstery are perishable and can not be expected to last for the life of the car. The automobile industry needs an attractive looking, non-perishable fabric, possibly of synthetic origin."

WHEN science can produce gasoline entirely free from knock, double the power or mileage of present-day gas will be possible was stated by T. A. Boyd, of the General Motors Research Laboratories. "From an altogether knock-free fuel, it would not be hard to get either double the power or nearly twice the mileage per gallon, but not both at once. Such a fuel should make possible an engine of much smaller displacement. If with 100 octane number gasoline" (present-day fuels have an octane number of about 70), "miles per gallon could be increased only by 50 per cent., the saving to the car user would amount to half the present retail value of fuel. So even if the present cost of manufacture of gasoline, about five cents a gallon, had to be doubled to make the 100-octane fuel, there would still remain a net saving in cost to the car user of 20 per cent." Mr. Boyd stated that the shortage of gasoline which was feared in 1914 as the use of motor vehicles rapidly mounted has been kept off by chemical research. Then there was about an 18 per cent. yield of gasoline from the crude oil; now it is about 45 per cent., while 70 per cent. to 75 per cent. is possible in modern refineries. Because drivers up to now have been demanding better acceleration and hill-climbing ability, producers have been boosting the performance of gasoline, increasing it about 45 per cent. since 1927, but the improved economy, in terms of mileage, has been about 20 per cent. "Only incidental improvement in economy can be obtained when the primary objective is to boost power," he said. "It begins to appear that from now on the car users may prefer to take the benefits of further improvements in fuels and of advances in engineering in terms of more miles per gallon."

AUTOMOBILE owners were advised to place their cars in garages at night to preserve the finish by Ralph J. Wirshing, assistant head of the department of general chemistry of the General Motors Research Laboratories. This prevents dew from forming on the body, and dew seems to be an important factor in causing the failure of finish. It had formerly been supposed that ultraviolet rays in sunlight, the same ones that cause sunburn on human bodies, were mostly responsible for paint deterioration. However, carefully checked tests made over a period of sereral years in Florida, using a sunshine meter to gauge its intensity, showed that failure was greater with exposure from midnight to noon than from noon to midnight. This suggested that dew, followed by sunshine, was the offender, and confirmation was obtained when further tests were made with a "dew box" to produce it artificially. Rainfall was found not to have the same effect as dew.

AUTOMOBILE bodies are each flooded, in modern treating methods, with more than 4,000 gallons of solution before they are painted, according to V. M. Darsey, of the Parker Rust-Proof Company. This process, he said, produces on the metal surface a protective phosphate coating, which prevents corrosion and makes the paint stick better when applied. First introduced in 1936, when 850,000 bodies were treated, over 2,000,000 are undergoing the treatment this year.

OTTO BEECK, J. W. Givens, A. E. Smith and E. C. Williams, of the Shell Development Company, announced the discovery that certain chemical agents added to lubricating oils iron out microscopic rough spots on two contacting metal surfaces, and increase the wear-preventing properties of the oil many times. Even the best polish that can be given to metal parts by mechanical means leaves minute irregularities, and these engage with each other as one piece of metal slides against another. At these points, localized high temperatures are produced. With the new agents added to the lubricant, the metal is changed at these places to a low melting alloy which actually flows as the two tiny hills come together. "In other words," the report stated, "the surface of the metal is polished much like a roughened surface of hard wax might be polished by a hot iron. These chemical polishing agents are so chosen that the whole surface of the metal does not melt, or even grow hot, but only the minute projecting rough-

nesses. In this way the surface of the metal is polished to a high degree while in motion and by virtue of its motion.'' These agents, it was said, can produce an improvement of ten times in the lubricating qualities of oils. By the addition of another group of agents, consisting of long thread-like molecules, which increase the tightness by which a film of oil is held between moving parts, even under high loads, the improvement may be as much as seventeen times.

THE process by which invisible infra-red ''light'' is used to accelerate the baking of enamel on automobile bodies may be used in many other ways, was reported by J. L. McCloud, of the chemical and metallurgical department of the Ford Motor Company. These heat rays from special carbon filament electric lamps can be used to dry photographic film, to remove water from electrical parts and even to bake bread. As used in automobile manufacture, the car to which the finish has been applied is passed into a tunnel equipped with these lamps and gold-plated reflectors. In just a few minutes the finish is baked on as effectively as in an hour with the old ovens formerly used.

THREE new chemicals, naphthas that have important uses as solvents in lacquers and lacquer thinners used in automobile finishes, are now obtained from petroleum, which is coming to rival coal and coal tar as an important source of raw materials. Dr. W. J. Sweeney, associate director of the research division of the Esso Laboratories, and E. H. McArdle, of the Standard Oil Development Company, reported that until 1937 toluene, xylene and similar substances, derived from coal tar, were the chief materials used in this way. With paraffin as an intermediate product, the three new chemicals, each having qualities that adapt it to particular needs, have been obtained from the crude oil source. Copper napthenate, obtained by combining copper with napthenic acids which are minor constituents of nearly all petroleums, will protect wood, rope and canvas against dry rot, mildew and many marine growths, according to Drs. Edwin R. Littmann and J. M. Klotz, of Stanco Distributors, Inc. ''Solutions of copper naphthenate,'' he said, ''have high penetrating power and are quickly absorbed. When applied to wood, especially that which is in contact with the soil or subject to moisture or high humidity, the life of the wood is greatly prolonged. Fish nets, hand lines, ropes, etc., after treatment with copper naphthenate are highly resistant to rotting.''

GLASS-MAKING is being changed from an art to a science with the discovery announced by Dr. Maurice L. Huggins, of the Eastman Kodak Company Research Laboratories, of a method of predicting in advance the properties of glass of a certain composition. Previous efforts to do this have met only with partial success. The relationships are really quite simple if one consistently calculates both compositions and properties for the part of the glass which contains but a single oxygen atom. Using only a small number of constants, which he has computed for the elements generally found in glass, it is now possible to calculate accurately just what the glass will do to light passing through it. Formerly, it would have been necessary actually to make a sample of the glass to find its properties.

A METHOD of analysis employing fingerprints of molecules, which is so delicate that it can detect an impurity of a thousandth of one per cent. in a few drops of chemical solution, was described by Norman Wright, of the Dow Chemical Company, Midland, Mich. Furthermore, even those few drops can be returned unchanged after the test, for it consists in passing beams of invisible infra-red light through them. The method, known as infra-red spectroscopy, depends on the fact that highly complex molecules of organic chemicals, that is, those containing carbon, produce characteristic ''fingerprints'' or patterns when the infra-red rays are spread out into a spectrum. Glass can not be used to do this, because it is opaque to the rays. A two-pound prism of rock salt, however, separates the radiation into its various wave-lengths. If our eyes could see infra-red rays, we should view a spectrum, crossed by dark lines where certain wave-lengths are absorbed by the molecules. Since the rays are invisible and unable to affect even a photographic plate, they are detected with a thermopile, which measures their heating effect. This can detect a rise in temperature as small as a hundred-millionth of a degree. The analysis method consists in plotting the pattern made by the absorption bands, and comparing this with the pattern for known organic substances. When the two match, just as when two fingerprints match, it is known that the same individual produced them.

IF you cut down on meat this past summer in order to keep cool during the heat waves, you were on the wrong track, according to findings reported by Dr. E. B. Forbes, director of the Institute of Animal Nutrition, Pennsylvania State College. What you should have cut down was the total quantity of food, and particularly the starch, sugar and fat. Eaten all by themselves, protein foods like meat and fish cause a characteristically high by-product of body heat. Knowledge of this fact is what started the idea of eating less protein food in summer in order to keep cooler. When protein foods are eaten in a mixed diet, such as a meal of meat and vegetables, however, the relatively high heat production characteristic of protein eaten by itself is not in evidence in the sense that the heat production from the mixed diet is less than the sum of the separately determined heat increments of its constituent protein, carbohydrate and fat.

A GERM related to the one that turns milk sour has given a simple test for one of the newest of vitamins, pantothenic acid. Details of the test, which can be used for determining the amount of this vitamin in foods or the abundance or lack of it in a patient, were reported by Dr. F. M. Strong, R. E. Feeney and Ann C. Earle, of the College of Agriculture of the University of Wisconsin. New knowledge of human requirements of this vitamin may be obtained more quickly now that this test is available. The new test is said to be extremely sensitive as well as simple, and its speed appears from the report that 10 to 15 samples of food can be tested, or assayed, for pantothenic acid content in a day.—JAMES STOKLEY.