SCIENCE NEWS

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MEASUREMENTS OF NUMBER OF MOLECULES IN MATTER

NEW measurements of the number of molecules in a mass of matter equal to its molecular weight, known as Avogadro's number (thus for monatomic hydrogen a mass of about one gram), confirm the accuracy of recent previous measurements, and their departure from an older, long-accepted value still carried in many text-books. The measurements were made by Dr. R. T. Birge, professor of physics at the University of California, and were reported at the Berkeley meeting of the American Physical Society.

The latest Avogadro number, average of several determinations, is 6.02331 multiplied by 10 to the 23d power, which is 1 with 23 zeros written after it. Or we may say the number is 602,331 billion billion. This is the number of molecules contained in something less than an ounce of aluminum or in about a half a pound of iron. If all the inhabitants of the globe, about 2 billion, were to forget the war and start counting the molecules in an ounce of aluminum, and each counted at the rate of one a second and worked 8 hours a day, we should be blessed with universal peace for the next thirty million years.

The previously accepted value of Avogadro's number was 6.0230 times 10^{23}, also obtained by Dr. Birge in 1936 as the most likely value based on all previous measurements. The figure still appearing in many text-books is 6.064 times 10^{23}, which was also obtained by Dr. Birge in 1929 as a correction to the earlier value (1913 and 1917) of 6.062 computed by Dr. R. A. Millikan, of the California Institute of Technology. These figures were based on the famous oil drop experiment by which Dr. Millikan determined the existence of the electron and the value of its charge. Previous to 1913, investigators had only a very vague idea as to the magnitude of Avogadro's number. They knew definitely only that it was the same for all substances, a universal constant, of which there are only about a dozen.

Various methods other than that of the oil drop have been tried, but the most modern and most accurate is an x-ray analysis of crystals, using x-rays of known wavelength. This is the method used by Dr. Birge. He complains, however, that nearly all of the previous measurements of this sort were made on the crystal calcite, because this was the only one the properties of which, particularly the density, were known with sufficient accuracy. Recent accurate determination of the densities of lithium fluoride, rocksalt and the diamond made it possible for Dr. Birge to use these substances. Only the most perfect crystals were selected, and the results they gave agreed very closely. The unweighted average 6.02331 differed by less than 1 part in 10,000 from the value he obtained from calcite, 6.02276. These numbers, it is understood, are all to be multiplied by 10^{23}, or 100,000 billion billion.

SYNTHETIC RUBBER AND 100-OCTANE GASOLINE

THE use of hydrogen fluoride as a catalyst in place of aluminum chloride would not only speed up but would also improve and cheapen the production of synthetic rubber and of 100-octane gasoline, and save quantities of aluminum, chlorine and other critical war materials, according to an announcement made by Dr. Joseph H. Simons, professor of physical chemistry at Pennsylvania State College.

Three oil refineries now under construction will use hydrogen fluoride in a new process which will produce 100-octane gasoline without tetraethyl lead, and will use substances not previously available for motor fuels. Aluminum and chlorine are not only critical materials, but in their making consume vast quantities of electricity, a shortage of which is threatened as the war program expands.

A catalyst is a substance that promotes a chemical reaction but does not appear as an ingredient of the final product. Usually it merely speeds the reaction, but sometimes it will start one which would not have started without it. The catalyst can often be recovered, reconditioned, and used again. This is the case with hydrogen fluoride, but not so with aluminum chloride and similar agents heretofore used.

Hydrogen fluoride, or anhydrous hydrofluoric acid, is made from fluorspar, a mineral found in practically every country. It is the glass-eating acid, one of the most powerful acids known. Both the gas, fluorine and the acid are extremely poisonous. Early experimenting was much discouraged by a number of fatalities and injuries caused by breathing the fumes. But Dr. Simons has been experimenting with these substances for the past twenty years. He pronounces them quite safe if proper precautions are taken.

Through his researches, hydrogen fluoride was already used as a catalyst in 1939 in the production of benzene (a raw material of synthetic rubber), toluene (basis of TNT), aromatic compounds, dyes, drugs and other chemicals.

In the production of styrene, ingredient of Buna-S rubber which is slated to compose 70 per cent. of all our synthetic rubber, so much aluminum chloride would be required that its use should not be considered at all. Hydrogen fluoride will do a better job and save a totally unnecessary consumption of these critical materials.

SPECIAL MEASURES TO FIGHT EPIDEMICS

SPECIAL measures to fight epidemics and keep the nation's fast-growing capital healthy during war have been instituted by Dr. George C. Ruhland, Health Officer of the District of Columbia.

A door-to-door health census of all new arrivals will

be made as soon as the necessary staff can be recruited. The object of this health census, which Dr. Ruhland calls an "immunological inventory," is to determine whether the new arrivals have been vaccinated against smallpox and given inoculations against typhoid fever and whether their children have had toxoid to protect them against diphtheria. Those who have not had these health-protective measures will be urged to get them at once.

The city has remained healthy and free from epidemics so far. Air raid destruction of water supply and sewage disposal systems, however, is seen as a possible source of great, if temporary, danger. Because of this possibility, the District of Columbia Medical Society, acting on Dr. Ruhland's instigation, has warned every one in the National Capital to be immunized against typhoid fever. The entire staff of several departments of the District of Columbia Government and key persons in national Government departments have already been immunized against typhoid fever.

The Health Department of the District of Columbia, with the U. S. Public Health Service, is conducting a survey of mosquitoes in Washington and the vicinity. One variety of mosquito that can carry malaria has been found in near-by Oxon Run, Md. With the increase in air travel between Washington and the South has come increased danger that malaria-infected passengers or mosquitoes might introduce the disease to this city. The first step in fighting this possible danger is the survey to determine the number and location of any mosquitoes capable of carrying the malaria parasites, following which breeding places will be treated with oil or cleared.

The new budget for the local health department has allowed Dr. Ruhland to increase greatly his staff of sanitary inspectors. The new positions are largely being filled with women who, Dr. Ruhland thinks, are better fitted for the job of inspecting boarding and rooming houses to see that they meet health department sanitary requirements.—JANE STAFFORD.

THE PRODUCTION OF SPONGE IRON

DR. R. R. SAYERS, Director of the Bureau of Mines, has announced that two pilot plants of 30 to 50 tons daily capacity are planned by the bureau to test on a semi-commercial scale the production of sponge iron. The operation of these plants as well as direction of the research work will be under the supervision of Dr. R. S. Dean, assistant director of the bureau.

Past experiments of the Bureau of Mines dating back to 1927 and of others have shown the feasibility of producing sponge iron directly from the ore by the use of natural gas or of non-coking coal, cheapest of fuels. Smaller and less expensive furnaces can be used because the ore is not melted as it is in the blast furnace which produces pig iron. They could utilize small deposits of ore, deposits too small to supply a modern blast furnace. Such plants would not displace existing industry, Dr. Sayers stated, but would supplement it by providing low-carbon iron in place of vanished scrap to make steel for guns, tanks, ships and other war material. Ordinarily, pig iron and scrap are mixed to make steel.

Sponge iron can be produced from the ore by hot reducing gases obtained from natural gas or from coal by a "reforming" process. These gases contain carbon monoxide, deadly gas of the automobile exhaust, or hydrogen. The carbon monoxide combines with the oxygen in the ore, leaving metallic iron which collects as a spongy mass at the bottom of the furnace. These two processes, the one using natural gas, the other coal, will be the first to be tried out on a semi-commercial scale in the pilot plants of the bureau. But other processes will be investigated also.

A side-line use for the reducing gases would be the making of high-purity soft iron free from carbon by the reduction of highly pure iron oxide. There is a high demand for this material by electrical manufacturers, particularly for magnet cores and armatures. Much of it was formerly imported from Sweden.

Dr. Sayers stated that when the processes are proven, and the equipment has developed to a commercial scale, the scrap situation in this country will be alleviated a few months thereafter.

POISONING BY PUSS CATERPILLAR

WARNING against the danger of poisoning by the puss caterpillar appears in a report by Dr. Thomas L. Lucas, of the Walter Reed General Hospital, in the *Journal* of the American Medical Association.

Poisoning, serious but not fatal, of a man who had a caterpillar drop on his neck while walking through a southern Maryland cornfield first brought the danger to Dr. Lucas's attention. Severe itching with "wheals" ranging in size from a dime to a silver dollar was followed within ten minutes by burning pain, severe muscle cramps on the side of the neck and shoulder near the poisoned spot, and severe headache. An opiate (codeine) was required for relief of the pain. The skin blistered and peeled and healed "much as a first degree burn would be expected to heal," taking about ten days to heal completely.

Similar symptoms including nervousness, restlessness and rapid pulse rate occurred in several other cases which Dr. Lucas found had been reported in medical literature. Local treatment of the caterpillar "bite" is ineffectual, and the patient must be given an opiate or other drug with systemic effect. He believes that cases occur frequently but are not reported either because the patient does not see a physician or because the caterpillar is not recognized as the cause of the poisoning symptoms.

The puss caterpillar, known technically as Megalopyge opercularis, is a short, bushy variety which seems to rear upon its hind legs and "make a face" at any one coming near it. It has straight, sharply pointed, hollow spines which can prick the skin of any one touching it, thus letting the poison into the body. The exact toxic principle involved needs to be determined.

Puss caterpillars are widely distributed in the Southeastern states and may be spreading to neighboring areas. They may be found on oak, elm, plum and sycamore trees, in flower and truck gardens, in orchards and on corn.

EDUCATION OF MEN OF DRAFT AGE

AMERICA'S draft Army is being selected from a population whose educational training is excellent. The number of American men between the ages of 18 and 25 who have completed less than four years' schooling is under 4 per cent., according to recent Census figures. Of the white male population under 25, only about 2 per cent. fall in this lowest educational bracket; in northern and western sections of the country the figure is 1 per cent.

Because the American people have misunderstood certain statistics, they have been led to believe that young men of draft age are "dumber" than they really are. Army deferments because of "literacy" requirements have given many people the false idea that there are millions of illiterate Americans of draft age, that is Americans unable to read and write, is pointed out by statisticians of the Metropolitan Life Insurance Company.

The Army has set its educational standards much higher than in the last war. Use of very complicated machinery and other equipment, on a large scale, has made this more severe standard necessary. So far, 430,000 men have been deferred for Army service because of inability to meet the Army's educational requirements. This basis for deferment has nothing to do with the 1940 Census classification of persons over age 25, with less than five years of schooling. There are 10,000,000 people in this classification. But a vast majority of these are in three special groups: immigrants who came into the United States before 1914, Negroes, and white persons from certain sections of the rural South.

Where complete illiteracy does exist, it is being wiped out rapidly. People over 25 who were frankly illiterate in 1940 comprise 3.7 per cent. of the population. In 1930 they represented 5.6 per cent. Among Negroes the improvement is particularly conspicuous: 10.0 per cent. in 1940 as against 21.3 per cent. in 1930. But even these figures do not represent the level of schooling of children to-day. They reflect, rather, the educational systems of a generation ago.

ITEMS

LOWEST death rate in the history of the United States death registration states was recorded in 1941, according to the U. S. Census Bureau. Provisional mortality statistics for that year, just tabulated, show a crude death rate of 10.5 per 1,000 population. The 1940 rate was 10.8, a slight increase over the previous low level of 10.6 reached in 1938 and 1939. There were 21,362 fewer deaths in 1941 than in 1940. Most of the decrease occurred in the rural areas. The greatest decreases were in the District of Columbia, Idaho and Vermont. The greatest increases in death rates for individual states were in Arizona and Virginia. The total number of deaths for the entire nation for 1941 was 1,395,507.

HELIUM, only non-inflammable gas suitable for balloons, will be produced in greatly increased quantities to keep aloft more blimps for coastal submarine patrol, to inflate barrage balloons, for deep-sea diving and for medical and scientific uses, according to Dr. R. R. Sayers, director of the U. S. Bureau of Mines. Congress has appropriated $4,000,000 for this purpose which will be made available from Navy Department funds. Production will be stepped up to several times last year's figures. Helium, the element first found in the sun, is now obtained from Texas natural gas. For some years past, the Bureau of Mines plant at Amarillo has been the only helium plant in the world and has given the United States a world monopoly of the valuable gas. Now a new plant will be erected at an undisclosed location, and bureau geologists are searching for other helium-producing fields.

ALL the nickel and at least a third of the copper used in printing plates can be replaced by iron, the National Bureau of Standards has found through research conducted in cooperation with the Government Printing Office. About 10,000 pounds of nickel and 350,000 pounds of copper are normally used every month by the printing industry in the manufacture of printing plates. Much of these strategic metals could be saved by the substitution of iron. The iron can be electroplated onto stereotypes and copper electrotypes, or true iron electrotypes can be made on wax and lead molds.

FIVE of the many vital war products now being produced synthetically in this country would require 2,682 good-sized cargo ships to bring a year's supply from overseas. They would form a bridge of ships across the Atlantic spaced a trifle over a mile apart. This is an estimate made by E. I. du Pont de Nemours and Company. The five products are nitrates for explosives and fertilizers, rubber, dyestuffs, textile fibers, and camphor for medicinal use and manufacture of many essential chemicals. Of these, only nitrates would still be obtainable if the ships could be spared. Chile was formerly our chief source. Now we are making nitrates from nitrogen drawn from the air. The other four products came from countries now in enemy hands. Ninety-five per cent. of our rubber came from countries now dominated by Japan. Most of our dyestuffs formerly came from Germany. Silk, now being replaced by synthetic fibers, came from Japan, and most of our camphor came from the Japanese island of Formosa.

ENTOMOLOGISTS of the U. S. Department of Agriculture report that guayule, one of the leading "white hopes" of the rubber situation, has a number of insect enemies. Most destructive among them is a bark beetle that does not attack the living plants, but feeds upon the heaped-up shrubs after harvesting. Thus far it is known only from Mexico, and it may be possible to keep it out of this country by suitable quarantine regulations. In any case, this new menace to our scanty rubber supply makes it desirable to process guayule as promptly as possible after it is gathered. The entomologists are also studying numerous other insect species that attack plants related to guayule, on the chance that they will transfer their unwelcome attentions to that plant after it has been widely established in cultivation. Among these potential enemies are root-eating white grubs (already known in guayule nurseries), wireworms, millipeds, caterpillars, grasshoppers, aphids, leafhoppers, mealybugs, mites and scale insects.