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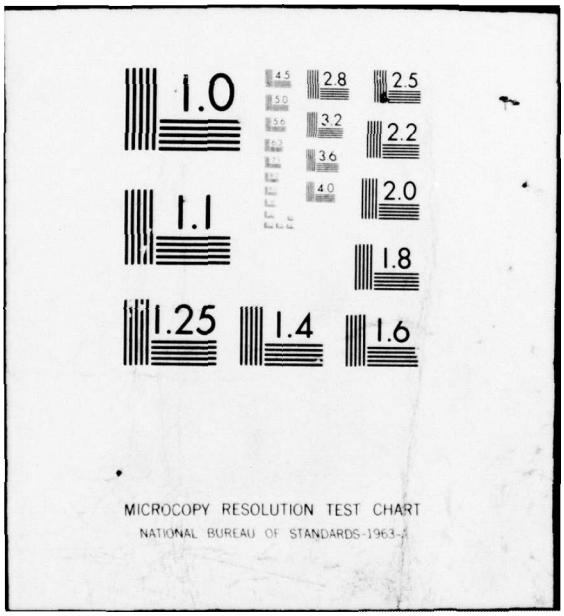
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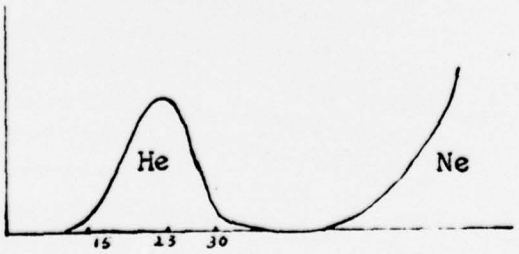
IMPROVED APPARATUS FOR ANALYSIS OF THE ATMOSPHERE

Professor F. A. Paneth and collaborators at the Londonderry Laboratory of Radiochemistry, University of Durham, have recently improved their apparatus (K. F. Chackett, F. A. Paneth and E. J. Wilson, Nature 164, 128 (1949); J. of Atmosph. and Terr. Phys. 1, 49 (1950)) for measuring very small amounts of inert gases. The new apparatus is capable of greater sensitivity and better separation of constituents, particularly helium and neon. It will measure accurately samples containing only about 10^{-9} cc of helium.

Use is made of the differential adsorption of neon and helium on charcoal. The fractionating system is of 15 stages, each consisting of a mercury displacement pump and a charcoal-filled column cooled in liquid nitrogen. The gas mixture is passed from one unit to the next by the mercury pumps, the advancing gas becoming progressively richer in helium. At the end of 15 fractionation operations, pure helium begins to emerge from the system into a collecting vessel. Fractionation of the gas in the adsorbing columns is continued by manipulation of the pumps and the emission of pure helium continues for a time and then falls to essentially zero. After a much longer period of operation, pure neon emerges and is collected, as shown in the figure below:



At the present time, samples from the lower atmosphere are being analyzed in the new apparatus, but it is planned also to analyze air samples collected in V-2 rockets by the Aeronautical Engineering Department of the University of Michigan. The results so far have shown that the composition of the atmosphere does not change appreciably, and that mixing of the constituents due to turbulence and winds predominates over diffusive separation, at least up to 70 km. It is hoped to confirm these findings and to analyze air samples from even greater altitudes.

ABSOLUTE CALIBRATION OF NEUTRON STANDARD

With the aid of the analytical method described in the preceding item, Professor F. A. Paneth plans to make an absolute determination of the neutron flux from a radium-beryllium neutron source. The principle of the method, which was originally proposed by W. J. Arrol (National Research Council Canada, MC 127) is to measure the amount of helium produced in the reaction

$$_{4}Be^{9} + \gamma \longrightarrow {}_{0}n^{1} + 2{}_{2}He^{4}$$

A standard 400 millicurie radium source is enclosed in a small beryllium capsule. The reaction is allowed to go on for about three months, $\sim 10^{-7}$ cc of helium being generated and occluded in the beryllium during that period.

The chemical analysis will proceed as follows: The beryllium capsule is dissolved in H_2SO_4, which results in the generation of about 20 liters of hydrogen. The hydrogen forces the liberated helium through a mercury valve into a combustion vessel where the hydrogen is burned completely and the water electrolyzed for a few seconds in order to drive out all helium. An excess of oxygen is added, carrying the helium into contact with heated palladium to eliminate all traces of hydrogen. The sample is then sent through the 15-stage fractionating apparatus described above and the amount of helium and neon measured. The presence of neon is taken as an indication of the amount of air which was introduced in the analysis; the result can then be corrected to give the amount of helium generated in the nuclear reaction.

INFRA-RED GAS ANALYZERS

The Infra-Red Development Co. Ltd., of Welwyn Garden City, Herts., England, has recently put onto the market a new model gas analyzer in which the recorder pen is attached directly to a shutter moving automatically in one beam of the instrument to preserve a balance as the absorption changes in the other beam. Since all readings are taken with a null balance, the calibration is independent of the source intensity, the receiver intensity, and the amplifier gain. This analyzer has practically no warm-up time and is stable and accurate for periods of many weeks. The scale is direct-reading in concentration of the gas being measured.

Since 1946 this company has been making infra-red gas analyzers of the type first described by Luft. These instruments have a gas microphone as the receiving element and use chopped radiation, with each instrument sensitive to only one gas, the one which fiils the receiver. A series of bench model instruments have been built for the measurement of acetylene, gasoline vapor, carbon dioxide, carbon monoxide, ethylene, methane, and other infra-red absorbing gases. Application to mine gases, anaesthetics, solvent recovery, submarine atmospheres, and combustion products are under investigation.

A two unit instrument has been put onto the market for the analysis of CO_2 and CO in the combustion products of domestic heating appliances and stoves. This method has been accepted by the British Standards Association (BS 717 Revised). As ordinarily built, this instrument reads 0.2 percent CO full scale and 10 percent CO_2 full scale with direct reading to an accuracy of about 1 percent of full scale. In these older type instruments, the sensitivity changes slowly with time so a tank of a known mixture is provided for periodic restandardizing. An analysis takes less than a minute.

The various instruments are quoted on three to four months delivery at prices ranging from $600 to $1,000. Further information is contained in a forthcoming technical report which will be available from the Technical Information Division, Code 250, Office of Naval Research, Washington 25, D. C.

THE OXIDATION OF N-DECALDEHYDE

The detailed mechanism of the liquid phase oxidation of n-decaldehyde has recently been elucidated by H. R. Cooper and Professor H. W. Melville (Birmingham University). The original studies of this oxidation reaction by Bäckstrom correctly indicated that the end products are perdecanoic acid together with some decanoic acid, and provided important early evidence on thermal chain reactions.

Cooper and Melville studied this oxidation reaction using n-decane as the inert solvent. The photochemical experiments were performed between 1 and 5°C. The thermal oxidation reaction is not significant at this temperature. The kinetics of the reaction was studied by measuring the absorption of oxygen at constant pressure. The aldehyde solution was present as a thin liquid film on the walls of the reaction vessel.

In the first stage the aldehyde is broken down photochemically into two radicals, the nature of which could not be determined. The following reaction scheme is suggested:

(RCHO	+ $h\nu$	$\longrightarrow$	RCO + H ?)	
RCHO	+ O_2	$\longrightarrow$	RCO + HO_2	initiation
RCO	+ O_2	$\longrightarrow$	RCOOO	
RCOOO	+ RCHO	$\longrightarrow$	RCOOOH + RCO	propagation
RCO	+ O_2	$\longrightarrow$	RCOOO	
(2 RCOOO		$\longrightarrow$	?)	termination

It is noteworthy that the chain propagation goes on for a long time before two peroxy radicals interact and destroy themselves. The lifetime of the chain was estimated at 1.1 seconds. This corresponds to about 4000 repetitions of the propagating step since the lifetime of the peroxy radical was estimated at 2.9×10^{-4} seconds. The radical concentration was found to be 1×10^{-7} moles/liter. The energetics of these various reactions were also determined together with the effect of hydroquinone as a retarder. These

studies lead to the following figures:

	E act. Kcal. $mole^{-1}$	A l. $mole^{-1}$ sec^{-1}
RCHO + O_2	15.6	3×10^5
RCOOO + RCHO	4.2	2×10^6
RCOOO + RCOOO	1	1×10^8
RCOOO + Hydroquinone	0	4×10^5

Comparing these results with those of hydrocarbon oxidation studies, it is found that the rate of propagation is about 1,000 times larger in the aldehydes than in simple aliphatic or aromatic hydrocarbons. This rate is determined primarily by the ease of removal of the first hydrogen atom from the molecule. On the other hand, the fact that the rate coefficients of the termination reactions are about the same for the aldehydes as for the hydrocarbons suggests that this reaction is not very structure dependent. This may be due to the fact that the oxygen atoms of the peroxide radicals undergoing chain termination exert an insulating effect on the rest of the radical.

SYNTHETIC LITHIUM MINERALS

In a systematic study of lithium aluminosilicates and of lithium zeolites, Professor R. M. Barrer, University of Aberdeen, has prepared by a hydrothermal synthesis the following new species in good yields:

$Li_2O \cdot Al_2O_3 \cdot 2SiO_2 \cdot 4H_2O$. (A)

$Li_2O \cdot Al_2O_3 \cdot 2SiO_2$ (B)

$Li_2O \cdot Al_2O_3 \cdot 8SiO_2 \cdot 5H_2O$ (C).

The syntheses are carried out from appropriate solutions using steel autoclaves of 22 cc capacity. The experiments are performed at temperatures of 100-450°C and pressures up to 400 atmospheres. Reaction times vary from a few hours to several days and particular attention is paid to keeping the pH of the mother liquor constant.

The new substances were characterised by optical and by X-ray studies. The species A and C above represent synthetic lithium zeolites. Lithium zeolites do not occur in nature. These synthetic zeolites undergo a number of cation exchange reactions and they also exhibit the characteristic sorption properties of zeolites.

IMPROVED DEXTRAN AS A PLASMA SUBSTITUTE

Dextran, a polysaccharide produced by bacterial fermentation of sucrose, has been under consideration as a substitute for blood plasma, since the suggestions in 1939 and 1940 of Professor Sir Norman Haworth and Professor M. Stacey, University of Birmingham. The sterile transfusion fluids usually consist of a 6 percent solution of depolymerized and fractionated dextran in normal saline. In the development and use of dextran for intravenous administration, attempts are made to attain a mean molecular weight of 70,000, to approximate that of the plasma proteins.

After extensive clinical trials between 1944-1947, Swedish workers reported favorably on dextran-saline solutions for intravenous use. In 1949, Bull et al, in Britain, reported on the efficacy of dextran as a plasma substitute as supportive therapy in the case of burns and demonstrated a sustained venous return in patients with surgical shock or hemorrhage. The widespread use and general acceptance of dextran as a plasma substitute has been limited by the lack of knowledge on the eventual fate of all dextran given intravenously, its toxicity, and the problem of producing molecules of a uniform size.

In Great Britain, A. R. Lockwood (Technical Director, Dextran Limited) and his co-workers have been employing, with considerable success, an improvement of the "solvent fractionating technique" and ultrasonic vibration to degrade the macromolecule of the bacterial polysaccharide to produce an increased homogeneity of cleavage fractions. The use of ultrasonics represents an important step in preferentially breaking glucosidic links in the polysaccharide chain. Improved yields of polysaccharide have been obtained by varying the constituent ingredients of the culture media.

Flocculent manganese hydroxide is being used successfully as an adsorbing agent to reduce the pyrogen content of dextran solutions to meet purity specifications for transfusions.

Attempts are underway to produce macromolecules of dextran which can be labeled with radioactive carbon so that the course and fate of this substance can be followed in the body. Forty percent of dextran taken intravenously still cannot be accounted for by methods currently available for chemical detection.

METHOD FOR PREPARING TISSUE SECTIONS FOR THE ELECTRON MICROSCOPE

Numerous approaches have been made to the problem of cutting tissue thin enough to be studied in the electron microscope, but no method so far reported has been entirely satisfactory. Professor Fritiof Sjøstrand, Department of Anatomy, Karolinska Institute, Stockholm, has approached the problem from yet a different angle. In order to study tissue with electrons having an energy in the neighborhood of 50 kv, the sections should have a thickness well under 1000 Å. It has been difficult to produce a microtome that would either cut uniformly the desired thickness, or produce a section which had not been distorted by the cutting process. Professor Sjøstrand has overcome these difficulties by building an instrument which is able to take an ordinary section and plane it down until the desired thickness is reached. By this procedure, the remaining layer of tissue has not been curled or distorted by the cutting edge, and by means of a gauging arrangement, sections of any desired thickness may be prepared.

The apparatus consists of a heavy steel casting upon which are two members that move at right angles to each other; one is to carry the specimen (having a vertical movement), and the other the cutting edge (having a horizontal movement). Each of these moving members is carried in precise runways which are part of the main casting. The specimen carrier is a large steel block whose top surface is so smooth and flat that a microscope slide will

adhere firmly to it if sufficiently clean. Its movement is controlled by means of a micro-screw. Near the specimen carrier is a large steel post about 4" in diameter, which holds a microgauge made by C. E. Johansson and Company, Eskilstuna, Sweden. This gauge is sensitive to movements of only a few hundred Å. The other moving member holds the knife and is driven to and fro by a screw arrangement. For a cutting edge Professor Sjöstrand uses a Schick injector razor blade which he sharpens on a plateglass mirror surface, using "Linde A" powder. The blade is held at about 30° with the horizontal in a slightly curved position (concave upwards). This slight curvature produces a section of varied thickness.

The specimen is mounted on an ordinary glass microscope slide with collodion. The section and blade are viewed under a low power microscope, while the specimen carrier is moved up until the blade just makes contact with the specimen. A gauge reading is then taken and the amount of material to be removed is calculated, the original thickness of the section being known from the setting of the microtome with which it was cut.

A method for preparing sections for the electron microscope has been previously described (ESN 4, 71 (1950)). This method was developed by Professor L. H. Bretschneider of the Zoological Institute, University of Utrecht, and made use of the old Cambridge rocking microtome which was modified to cut sections down to about 2000 Å. Objections have been raised by other investigators, one complaint being that it is very difficult to cut the sections as thin as 2000 Å, and the other is that even those are too thick for good analysis with 50 kv electrons. Professor Bretschneider used a Philips microscope with 90 to 100 kv.

CONFERENCE ON AUTOMATIC CONTROL AND SERVO MECHANISMS

A conference on Automatic Control will be held 16-21 July at the College of Aeronautics, Cranfield, Bedfordshire. The Conference is being held under the auspices of the Department of Scientific and Industrial Research, and the chairman of the organizing committee is Professor

A. Tustin, Department of Electrical Engineering, University of Birmingham. The papers and discussions will be concerned with the theory, design, production and testing of automatic control systems, and their use in industry. The following main topics will be covered: the general theory and problems of synthesis in automatic control systems; non-linearities in servo mechanisms; process control including its inter-relation with servo control; the human operator. Several more specialized topics may be included and apparatus having a special bearing on the subject of the Conference will be displayed.

NEW SCIENTIFIC JOURNAL

A new quarterly journal, published in English, has recently appeared in the Netherlands. The journal, DOCUMENTA NEERLANDICA ET INDONESICA DE MORBIS TROPICIS, has been initiated by a non-profit foundation and contains articles on original research on tropical diseases. It is planned that articles will deal with diseases and vectors of diseases in a geographic area including the Netherlands, Indonesia, the Netherlands Antilles and Surinam. There are approximately 100 pages per issue with illustrations; Dr. N. H. Swellengrebel is chairman of the editorial board. The price is $4.50 per annum. Specimen copies and further particulars may be obtained by writing The Honorable Treasurer, F.K.A.A. Lambrecht, Rivierenlaan 268, Amsterdam Z., The Netherlands.

PERSONAL NEWS ITEMS

Dr. George Batchelor of Cambridge University will spend a month working with Professor C. C. Lin at the Massachusetts Institute of Technology during late March and April. He will give a series of lectures on the applications of similarity theory on turbulence. Dr. Batchelor has just completed the manuscript for a book on the theory of turbulence which will be published by the Cambridge University Press.

Professor M. J. Lighthill of Manchester University will visit the United States on a lecture tour during March and April. He will visit centers of aerodynamics research on both the East and West Coasts and will describe various phases of the applied mathematics work going on at Manchester.

Prepared by the Scientific Staff
Submitted by Dr. C. E. Sunderlin
Scientific Director

PHILIP D. LOHMANN
Captain, U.S.N.
Assistant Naval Attache for Research